

APPENDIX C: NATIONAL MARINE FISHERIES SERVICE BIOLOGICAL OPINION, MARCH 18, 2022



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

Refer to NMFS No: WCRO-2021-02307

March 18, 2022

Serge Stanich
Director of Environmental Services,
California High Speed Rail Authority,
770 L Street, Suite 620,
Sacramento, California 95814

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens
Fishery Conservation and Management Act Essential Fish Habitat Response for the
California High Speed Rail San Francisco to San Jose Project Section

Dear Mr. Stanich:

Thank you for your letter of September 13, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the California High Speed Rail (HSR) Authority's San Francisco to San Jose Project Section.

The enclosed biological opinion is based on our review of the proposed action as detailed in the provided biological assessment, and its effects on the federally listed threatened Central California Coast steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS) and the southern DPS of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats. Based on the best available scientific and commercial information, NMFS concludes that the project is not likely to jeopardize the continued existence of these federally listed species or destroy or adversely modify their critical habitat. NMFS has included an incidental take statement with reasonable and prudent measures, and terms and conditions that are necessary and appropriate to avoid, minimize, or monitor the incidental take of federally listed fish that will occur with project implementation.

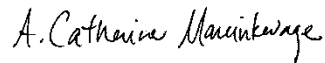
Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. Enclosed we also provide NMFS's review of the potential effects of the proposed action on EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species, as designated under the MSA. The document concludes that the project will adversely affect the EFH of these fisheries in the action area and has included EFH Conservation Recommendations.



As required by section 305(b)(4)(B) of the MSA, the Authority 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 Authority have agreed to use alternative time frames for the Authority's response. The response must include a description of 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 Authority 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 your response to the EFH portion of this consultation, we ask that you clearly identify the number of Conservation Recommendations accepted.

Please contact Katie Schmidt at the California Central Valley Office at (916) 542-3515 or katherine.schmidt@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,



Cathy Marcinkevage
Assistant Regional Administrator for
California Central Valley Office

Enclosure

cc: To the File: ARN 151422-WCR2018-SA00467

Phyllis Potter, Assistant Project Manager, Environmental, CHRSA,
phyllis.potter@hsr.ca.gov

Sue Meyer, Permitting, Compliance, and Mitigation Manager, CHSRA,
sue.meyer@hsr.ca.gov

Ralph Huddleston, Senior Permitting Specialist, Environmental Planning, CHRSA,
ralph.huddleston@hsr.ca.gov

Maggie Sepulveda, Fish and Wildlife Biologist, United States Fish and Wildlife Service,
margaret_sepulveda@fws.gov

Zachary Fancher, Senior Project Manager, United States Army Corps of Engineers,
zachary.j.fancher@usace.army.mil



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

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

California High Speed Rail San Francisco to San Jose Project Section

NMFS Consultation Number: WCRO-2021-02307

Action Agency: California High Speed Rail Authority

Affected Species and NMFS’s 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 (<i>Oncorhynchus mykiss</i>)	Threatened	Yes	No	Yes	No
North American Green Sturgeon (<i>Acipenser medirostris</i>), Southern Distinct Population Segment	Threatened	Yes	No	Yes	No

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

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

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

Date: March 18, 2022



TABLE OF CONTENTS

1. Introduction.....	1
1.1. Background.....	1
1.2. Consultation History.....	1
1.3. Proposed Federal Action	4
1.3.1. Project Section Overview	4
1.3.2. Construction.....	12
1.3.3. Operations.....	17
1.3.4. Maintenance.....	19
1.3.5. Proposed Conservation Measures.....	20
1.3.6. Proposed Compensatory Mitigation	40
2. Endangered Species Act: Biological Opinion And Incidental Take Statement	44
2.1. Analytical Approach.....	44
2.2. Rangewide Status of the Species and Critical Habitat	45
2.2.1. Global Climate Change	51
2.3. Action Area	52
2.4. Environmental Baseline.....	66
2.4.1. Status and occurrence of listed species and critical habitat in the action area.....	66
2.4.2. Factors affecting listed species	71
2.4.3. Conservation and restoration efforts in the action area	72
2.5. Effects of the Action.....	75
2.5.1. Consequences to individuals	76
2.5.2. Consequences to critical habitat	92
2.6. Cumulative Effects	100
2.7. Integration and Synthesis	101
2.7.1. Summary of Effects of the Proposed Action on Listed Species.....	101
2.7.2. Summary of Effects of the Proposed Action on PBFs of Designated Critical Habitat.....	101
2.7.3. Summary of Environmental Baseline.....	102
2.7.4. Summary of Cumulative Effects	103
2.7.5. Effects of the Proposed Action on the Survival and Recovery and on Designated Critical Habitat at the DPS scale	103
2.8. Conclusion.....	105

2.9. Incidental Take Statement	105
2.9.1. Amount or Extent of Take	105
2.9.2. Effect of the Take	113
2.9.3. Reasonable and Prudent Measures	113
2.9.4. Terms and Conditions.....	114
2.10. Conservation Recommendations	123
2.11. Reinitiation of Consultation	124
3. Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response	126
3.1. Essential Fish Habitat Affected by the Project.....	126
3.2. Adverse Effects on Essential Fish Habitat	127
3.3. Essential Fish Habitat Conservation Recommendations	128
3.4. Statutory Response Requirements.....	131
3.5. Supplemental Consultation.....	131
4. Data Quality Act Documentation and Pre-Dissemination Review.....	132
4.1. Utility.....	132
4.2. Integrity	132
4.3. Objectivity	132
5. References.....	133

ABBREVIATIONS AND ACRONYMS

μPa	micropascal
ACID	Anderson Cottonwood Irrigation Dam
AMMs	avoidance and minimization measures
Authority	California High Speed Rail Authority
BA	biological assessment
BART	Bay Area Rapid Transit
BMPs	best management practices
BRMP	biological resources management plan
Caltrans	California Department of Transportation
CCC	Central California Coast
CCMP	Comprehensive Conservation and Management Plan
CCVO	California Central Valley Office
CDFW	California Department of Fish and Wildlife
CMP	compensatory mitigation plan
CMs	conservation measures
CPS	coastal pelagic species
CWA	Clean Water Act
dB	decibel
DPS	distinct population segment
DQA	Data Quality Act
EFH	essential fish habitat
EIR/EIS	Environmental Impact Report/Environmental Impact Statement
EMMA	Environmental Mitigation Management and Assessment system
ESA	Endangered Species Act
FRA	Federal Railroad Administration
HAPCs	Habitat Areas of Particular Concern
HCP	habitat conservation plan
HSR	High Speed Rail
IAMFs	impact avoidance and minimization features
ICF	ICF International, Inc.
ITS	incidental take statement
LID	low impact development
LMF	light maintenance facility
LWM	large woody material
MMPA	Marine Mammal Protection Act
MOU	memorandum of understanding
mph	mile per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
nDPS	Northern distinct population segment
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
OCS	overhead contact system
OHWM	ordinary high water mark

opinion	biological opinion
PAHs	polycyclic aromatic hydrocarbons
PBF	physical or biological feature
PCBs	polychlorinated biphenyls
PCE	primary constituent element
PFMC	Pacific Fishery Management Council
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
RMS	root mean square
ROW	right-of-way
RPMs	reasonable and prudent measures
RRP	restoration and revegetation plan
SCVWD	Santa Clara Valley Water District
sDPS	Southern distinct population segment
SEL	sound exposure level
SFBDE	San Francisco Bay Delta Estuary
SPCCP	spill prevention control and countermeasures plan
SWPPP	stormwater pollution prevention plan
SWRCB	State Water Resources Control Board
TCE	temporary construction easements
TPSS	traction power substation
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WEAP	worker environmental awareness program
WOTUS	waters of the United States

1. INTRODUCTION

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

1.1. Background

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

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 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 National Oceanic and Atmospheric Administration (NOAA) Library Institutional Repository (<https://repository.library.noaa.gov/welcome>). A complete record of this consultation is on file at the NMFS California Central Valley Office (CCVO).

1.2. Consultation History

July 14, 2011: The Federal Railroad Administration (FRA) sent a copy of a memorandum of understanding (MOU) to NMFS and to the United States Fish and Wildlife Service (USFWS) designating the California High Speed Rail Authority (Authority) to act on behalf of the FRA as a non-federal representative and providing that the Authority has assumed FRA's responsibilities under Federal environmental laws for the California High Speed Rail (HSR) project (U.S. Department of Transportation and Federal Railroad Administration 2011).

October 25, 2016: NMFS staff attended a tour of the proposed San Francisco to San Jose alignment route.

July 23, 2019: The State of California signed a MOU with the FRA in which, pursuant to 23 U.S.C. 327(a)(2)(B), the FRA assigned, and the State (acting through its California State Transportation Agency and the Authority) assumed, all of FRA's responsibilities for environmental review, consultation, or other actions required or arising under listed Federal environmental laws, including the ESA, for the assigned railroad projects, including projects necessary for the design, construction, and operation of the HSR system (California State Transportation Agency 2019).

October 1, 2020: The Authority requested a species list from NMFS for the San Francisco to San Jose HSR Project Section, via email.

October 14, 2020: NMFS provided an official species list to the Authority for the San Francisco to San Jose HSR Project Section (Authority 2021a), which identified the following NMFS trust resources:

- Threatened Central California Coast (CCC) steelhead, *Oncorhynchus mykiss*, distinct population segment (DPS; 62 FR 43937, 8/18/1997) and its critical habitat (70 FR 52488, 9/2/2005).
- Threatened Southern distinct population segment (sDPS) of North American green sturgeon, *Acipenser medirostris* (71 FR 17757, 4/7/2006) and its critical habitat (74 FR 52300, 10/9/2009).
- Pacific Coast Salmon - Coho and Chinook EFH.

November 16, 2020: The Authority shared a draft biological assessment (BA) with NMFS and requested that NMFS review and provide comments on the project information completeness before they submitted a formal ESA/MSA consultation request.

December 3, 2020: NMFS returned initial comments and questions on the provided draft material, via email.

January 28, 2021: A coordination meeting was held between NMFS, Authority, and ICF International, Inc. (ICF) consulting staff to go over responses to comments and questions raised by NMFS on the provided draft materials. The sDPS green sturgeon determination was changed to 'likely to adversely affect', NMFS requested a detailed list/table of all waterbodies crossed by the preferred alternative, and NMFS requested more information on impacts and minimization measures for the Visitacion Creek area specifically. NMFS staff also recommended the Authority investigate whether coverage under the Marine Mammal Protection Act (MMPA) may be needed for pinniped interactions, due to construction's proximity to the marine and estuarine waters of San Francisco Bay.

March 23, 2021: Authority staff contacted NMFS Protected Resources Division in Long Beach, California, via email to inquire whether the construction in and adjacent to San Francisco Bay estuarine and marine waters for the San Francisco to San Jose Project Section would require marine mammal harassment incidental take coverage under the MMPA. In this inquiry, the Authority proposed that marine mammal interactions were not likely to occur at the planned construction locations after assessing the potential for marine mammal interactions (including pinniped), and that applying for MMPA take coverage was not necessary to proceed.

March 25, 2021: NMFS staff, Penny Ruvelas, confirmed that, given the project description and estimated potential impacts to marine mammals provided by the Authority, via email, it was unlikely the project section would need to apply for an incidental harassment authorization or letter of authorization under the MMPA for marine mammal interactions during construction. However, she clarified that NMFS does not provide concurrence or informally consult on MMPA determinations when action agencies decide not to apply for coverage.

August 10, 2021: The Authority submitted the revised draft BA to NMFS for additional questions or comments.

August 20, 2021: NMFS returned the revised draft BA with minor suggested edits.

September 13, 2021: The Authority requested formal ESA/MSA consultations for the San Francisco to San Jose HSR Project Section, via email to the CCVO's electronic consultation request system. The submitted consultation packet also included maps of the proposed route and wetland delineations (Authority 2021e, f, g, h), preliminary designs and figures (Authority 2021i, b, d), applicable design standards/criteria (Authority 2012, Authority 2014, 2019c), a specific report on Visitacion Creek (Walter 2018), proposed conservation measures (Authority 2021c), a revised steelhead impacts matrix, and other appendices. The Authority also requested that the MSA consultation also include:

- EFH for Pacific Coast groundfish
- EFH for Pacific Coast coastal pelagic species

September 23, 2021: The Authority submitted the revised impact and mitigation acreages for Table 5-3 (Authority 2021j) to replace Table 5-3 in the BA.

September 30, 2021: The Authority submitted the final inclusive BA (Authority 2021i) for the section to NMFS, via email.

October 14, 2021: NMFS reviewed all provided materials, including the final BA, and considered the informational requirements for formal ESA/EFH consultation for the San Francisco to San Jose HSR Project Section to have been met. NMFS sent a sufficiency notice via email to the Authority and indicated that formal consultation was initiated on September 30, 2021, the date that the final BA was received.

February 1, 2022: NMFS raised concerns that all of the temporary and permanent impacts to green sturgeon habitat were underestimated in the proposed mitigation acreages and NMFS suggested accounting all impacts to tidally influenced waterways as impacts to green sturgeon critical habitat. The Authority agreed to this approach and that an update was required to BA Table 5-3 to reflect this change, via email.

February 8, 2022: NMFS requested a mutually agreed upon extension, via email, for this opinion until March 1, 2022, as the internal review process had been delayed. The Authority agreed to the proposed extension date, via email.

February 28, 2022: NMFS requested another mutually agreed upon extension, via email, for this opinion until March 22, 2022, as the internal review process had been delayed.

March 1, 2022: NMFS sent a list of minor issues requiring clarification in the project description section of the BA, via email.

March 2, 2022: The Authority again agreed to the proposed extension date, via email.

March 8, 2022: Authority staff provided clarification on the list of issues identified by NMFS in the project description section of the BA, via email. NMFS acknowledged the list and changed the corresponding language in this opinion to reflect the clarifications.

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 (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 (50 CFR 600.910). Through a memorandum of understanding signed July 1, 2019, pursuant to 23 U.S.C. 327(a)(2)(B), the State of California (acting through its California State Transportation Agency and the Authority) assumed all of FRA’s responsibilities for environmental review, consultation, or other action required or arising under listed Federal environmental laws, including the ESA, for the HSR system. The FRA funded the environmental review and preliminary engineering for the HSR system, as well as the construction activities of the first section to break ground (the Merced to Fresno Project Section (Authority and FRA 2018, NMFS 2019a)).

1.3.1. Project Section Overview

The Authority proposes to construct, operate, and maintain the HSR San Francisco to San Jose Project Section, which is one of eight independent project sections comprising Phase I of the HSR system in California. The HSR system would be an electronically powered, steel-wheel-on-steel-rail system with state-of-the-art safety, signaling, and automatic train control systems. The trains would be capable of operating at speeds of up to 220 miles per hour (mph) where the alignment has a fully grade-separated, dedicated track, and speeds up to 110 mph on blended system infrastructure. The statewide system’s purpose is to provide a transit connection between the major population centers of the San Francisco Bay Area with the Los Angeles/Southern California metropolitan region and urban centers in the California Central Valley at final build out. When completed, the nearly 800-mile train system would provide new passenger rail service to more than 90 percent of the state’s population (Authority 2019b, a, 2021i). However, each section of the HSR system has been designed to have independent utility regardless of whether other sections are completed, principally through the inclusion of logical termini and local benefits (Authority 2009).

This corridor encompasses three urban counties: San Francisco, San Mateo, and Santa Clara, California. The proposed San Francisco to San Jose Project Section would connect logical termini at planned passenger stations in the cities of San Francisco, Millbrae, and San Jose, California, and therefore achieve transit connection between two major economic, financial, and cultural centers in the Peninsula of the San Francisco to San Jose, hereafter referred to as the San Francisco-San Jose Area. If other project sections of the HSR system are not completed, the infrastructure in this section would be used by regional and intercity services to improve their capacity, reliability, and performance. If no other transportation investments were made in this area, the utility and significance of a convenient, high-speed transit connection that could reduce congestion on regional freeways and serve both the major employment centers and the two international airports along this section become increasingly critical. Implementation of the San Francisco to San Jose Project Section also enables early, incremental improvements to the

existing train services in coordination with Caltrain, which also benefits adjoining communities by reducing local traffic congestion and improving public safety in the existing rail corridor through the proposed grade separation. By using lightweight, electrified trains compatible with HSR lines and equipment, Caltrain can move towards expanded modern electric service and operate with faster services within its San Francisco Peninsula lines (Authority 2021i).

The proposed action consists of the Authority's Preferred Alternative, Alternative A (Figure 1). Alternative A was identified as the most appropriate route to accomplish project goals while minimizing adverse impacts in the San Francisco to San Jose Project Section Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS; (Authority 2019b, a)). Alternative A consists of:

- 42.9 miles of existing Caltrain track currently able to support high speed electrical service
- Modification of approximately 14.5 miles of existing Caltrain track to support HSR trains

The project would operate on a predominantly two-track system primarily within the existing Caltrain right-of-way (ROW), utilizing existing and in-progress infrastructure improvements developed by Caltrain for its Caltrain Modernization Program, including electrification of the Caltrain corridor between San Francisco and San Jose. Required track modifications to enable high speed travel will include curve straightening, track center modifications, and super-elevation¹ of 33 percent of existing tracks. Because the alignment relies heavily on shared track already within the existing Caltrain system, the proposed action mostly entails track modifications on the existing system so it supports higher train speeds. Therefore, these track modifications will expand the existing track footprint minimally, by 1 to 3 feet in width, within the existing Caltrain ROW. The blended system would consist of predominantly ballasted track of varying profiles. Low, near-the-ground tracks would be at grade; higher tracks would be elevated on embankment (earthen fill graded to a slope on either side or supported by retaining walls) and structure (viaduct); and below-grade tracks would extend through four existing short tunnels in San Francisco. Ballast would be composed of granite or similar rock and subballast would be composed of rock similar to roadway construction. This section does not require additional passing tracks beyond those already existing.

Seven existing train stations or platforms throughout the route are proposed to be modified to accommodate HSR service, and new HSR infrastructure will be built at the Millbrae Bay Area Rapid Transit (BART)/Caltrain Station. Station modifications/redesigns will include:

New HSR platforms or station reconfigurations at the existing 4th and King Street (

- Figure 2) and Millbrae (Figure 3) stations
- Bayshore Caltrain Station will be relocated and modified to accommodate the East Brisbane LMF
- Modification to San Bruno and Hayward Park Caltrain stations due to track shifts
- Modifications to Broadway and Atherton Caltrain stations to remove hold-out rule

¹ Super-elevation is the vertical distance between the height of the inner and outer track rails at curves. Super-elevation is used to partially or fully counteract the centrifugal force acting radially outward on a train when it is traveling along the curve.

East Brisbane LMF will include:

- Approximately 100-acre facility, including storage areas for reserve equipment, workshops, and office space
- Speed transition tracks approximately 1,400 feet long
- Maintenance yard with 17-yard tracks and eight shop tracks
- 400-space surface parking lot for automobiles and trucks
- Access road connecting facility to realigned Tunnel Avenue
- Power generator, sewage system, cistern, collection point, and electrical substation

Several safety improvements and additional communication radio towers will be installed in existing passenger train infrastructure to accommodate HSR train service; other alignment and ancillary features include:

- Approximately 38 at-grade road crossings with safety modifications
- Two new structures, two replaced structures, seven modified structures, and three retaining walls
- New perimeter safety fencing along 7.3 miles of ROW
- Installation of 20 communication radio towers for operation (approximately 10 feet by 20 feet fenced areas), mostly co-located at existing facilities such as Caltrain traction power substations (TPSS), switching stations, or paralleling stations

Electrical interconnections required for operation:

- Existing overhead contact system that supports 130 to 140 miles of electrified train tracks, powered by a 25-kilovolt, 60-Hertz, single-phase, alternating current supply system consisting of TPSS
- Relocation of 9.4 miles of overhead contact system poles and wiring
- One switching station and paralleling stations
- Equipment upgrades at traction power facilities (additional transformers)

The majority of the proposed action will be contained primarily within the existing Caltrain ROW. However, in certain locations along the Caltrain corridor (e.g., the Brisbane LMF, communication radio towers, Millbrae Station), the Authority would need to acquire temporary construction easements (TCE) and permanent ROW in addition to the existing Caltrain ROW to build and operate components of the blended system. The East Brisbane LMF would require placing a portion of Visitacion Creek into an underground culvert along its current alignment, such that the maintenance yard, maintenance building, and other associated facilities would be built above the underground culvert. Track modifications associated with the East Brisbane LMF would also require demolishing and relocating the Tunnel Avenue overpass and widening the bridge crossing at Guadalupe Valley Creek.

Operation of the blended system, once modified and upgraded for high speed, electric train travel, would be 1) limited freight service (approximately three round trips per day) between San Francisco and San Jose using the same tracks, 2) Caltrain passenger service, and 3) HSR passenger service. In the blended portions of the system, HSR and Caltrain would operate at speeds of up to 110 mph and would have a coordinated schedule to allow both services to

efficiently serve their respective stations. HSR trains would be able to pass Caltrain trains in existing four-track segments and at the Millbrae Station.

Although the exact vehicle type has not yet been selected, the environmental analyses considered the effects associated with HSR vehicles produced in the world that meet the Authority's safety and operational criteria (Authority 2014). The Authority is considering an electric multiple unit concept, in which several train cars (including both end cars) would contain traction motors, rather than a locomotive hauled train (i.e., one engine in the front and one in the rear). Each train car would have an active suspension, and each powered car would have an independent regenerative braking system, which returns power to the power system. The body would be made of strong but lightweight materials and would have an aerodynamic shape to minimize air resistance, much like a curved airplane body.

The East Brisbane LMF would support San Francisco terminal station operations by dispatching freshly inspected and serviced trains and crews to begin revenue service throughout the day, along with providing daily, monthly, and quarterly maintenance of HSR trainsets. Maintenance activities would include train washing, interior cleaning, wheel truing, testing, and inspections. These activities may occur between runs or as a pre-departure service at the start of the revenue day. Additionally, the light maintenance facility would be used as a service point for any trains in need of emergency services.

For a full description of the auxiliary surface transportation modifications and components of the proposed action (i.e., state highway and local roadway modifications, freight/passenger railroad modifications, bridge reconstructions, TPSS components, and communication system installation), see BA Chapter 2 (Authority 2021i).

The parts of the proposed action that are most likely to affect species and critical habitat under NMFS jurisdiction are the proposed crossings of above-grade or elevated track segments that span over waterways containing estuarine or freshwater habitats (those existing or requiring modification) or the parts of the proposed action that would directly modify such habitats, like the East Brisbane LMF. These locations are identified in greater detail in the Action Area description (Section 2.3).

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not because 1) the project sections do not rely on other sections for operations to commence at a local level, thus the construction and operations of other sections were determined not to be consequences of this proposed action, and 2) all Caltrain electrification upgrades were independently planned and would happen regardless of future HSR service on the system.



Figure 1. Proposed San Francisco to San Jose Project Section HSR route, Alternative A (dark blue solid line) between San Francisco, California, and Scott Boulevard, San Jose, California (Authority 2021i).

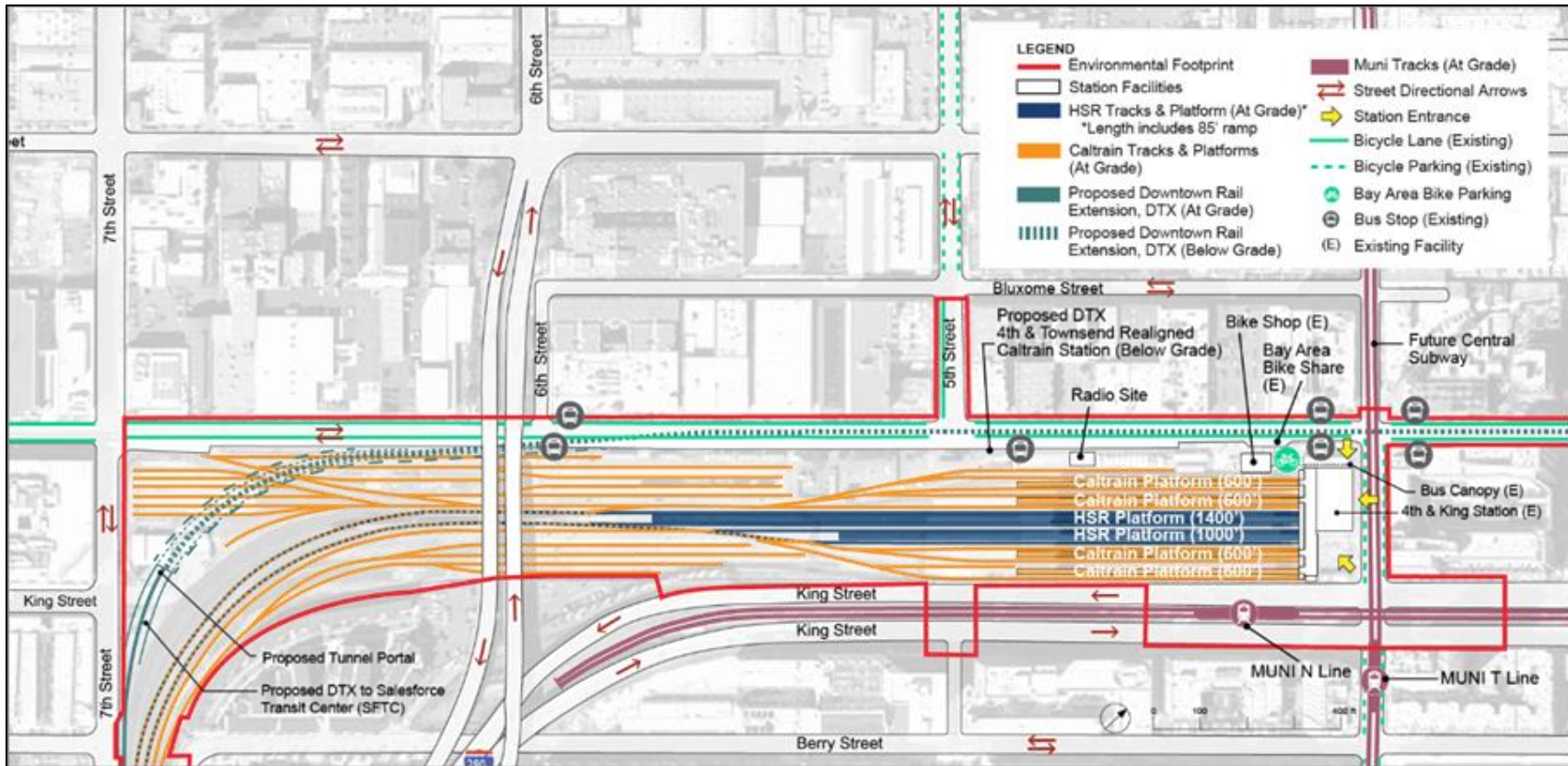


Figure 2. Proposed modifications to 4th and King Street Station, an interim terminal station until access to the Salesforce Transit Center is available (Authority 2021i).

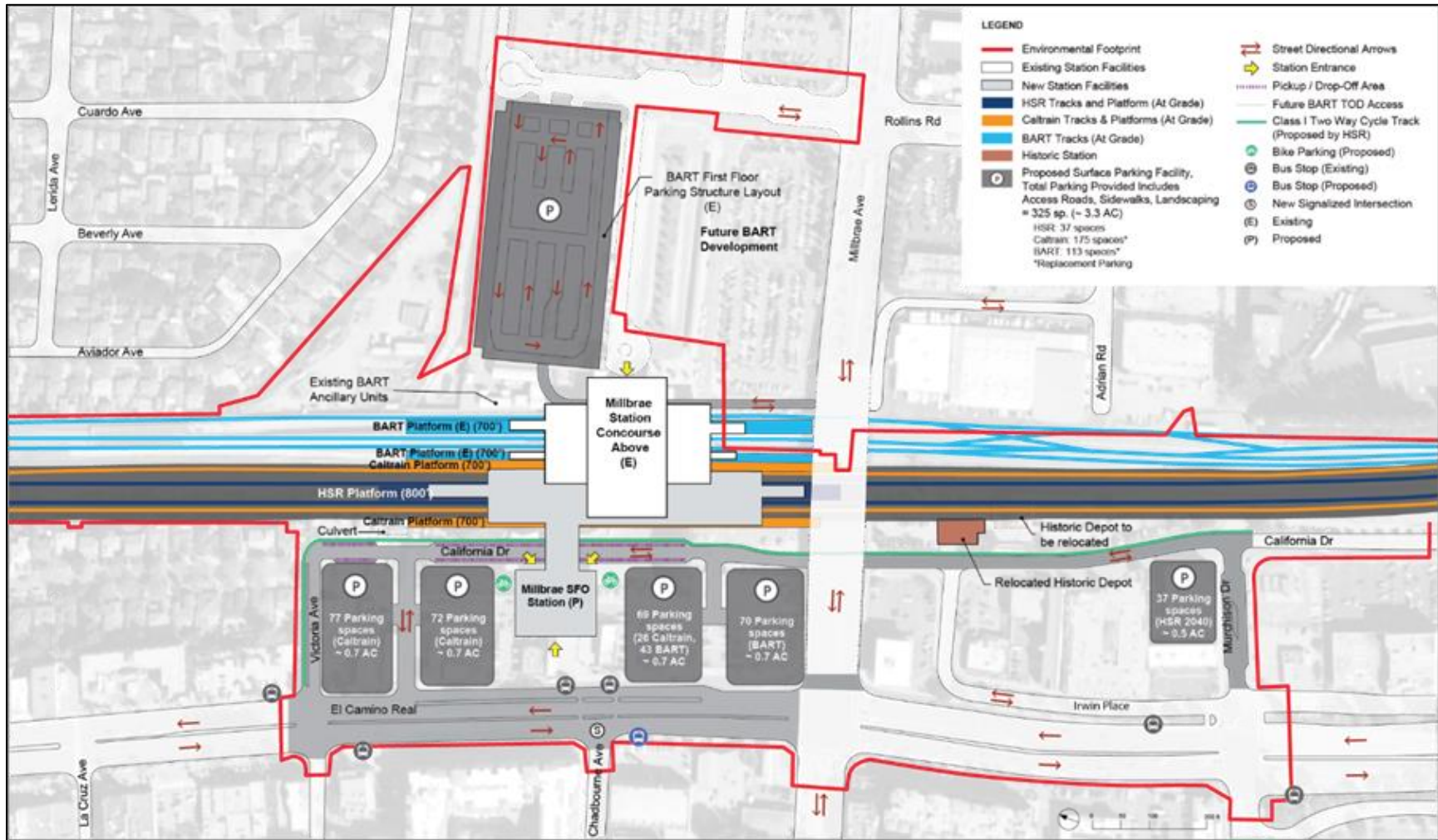


Figure 3. Proposed modifications to BART Millbrae Station Plan (Authority 2021i).

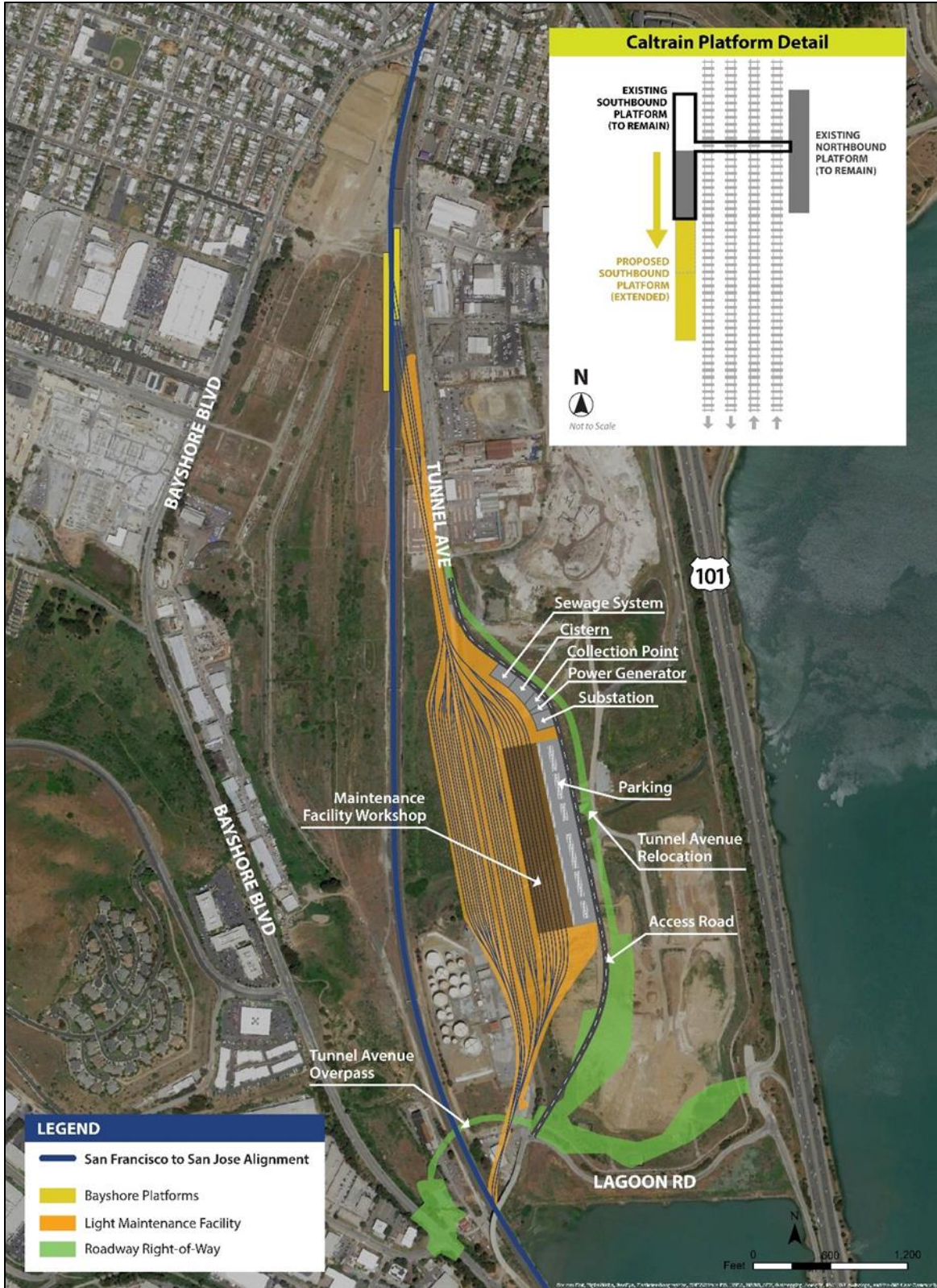


Figure 4. Proposed design of new East Brisbane LMF and Tunnel Avenue reroute and new overpass (Authority 2021i).

1.3.2. Construction

The Authority's general approach to project construction is a phased approach. Construction would likely proceed concurrently along the proposed Project Section and would typically take place 5 days a week with 8-hour days, approximately 250 days per year (except for track realignment within the Caltrain corridor, which would need to occur within established work windows, which include weekdays (outside of AM and PM peak hours), weeknights, and weekends). Given the size and complexity of the project, the design and construction work could be divided into several procurement packages. In general, the procurement would be grouped as follows:

- Civil/structural infrastructure, including design and construction of passenger stations, maintenance facilities, wayside facilities, utility relocations, and roadway modifications
- Trackwork, including design and construction of direct fixation track and subballast, ballast, ties and rail installation, switches, and special trackwork
- Core systems, such as traction power, train controls, communications, the operations center, and the procurement of trainsets

The major track and alignment work in the San Francisco to San Jose Project Section is expected to take three years from mobilization to finishing major activities, and demobilization and restoration of affected areas are expected to take one additional year. Construction of the East Brisbane LMF is projected to occur over a two to three years period and will require substantial amounts of cut and fill to create a level surface. Station and maintenance facility modification and redesigns are expected to take less time and be finished before the track modifications are complete. Rail and safety construction and then testing will occur after these two phases and last approximately four years.

During final design, the Authority and its contractors would conduct several pre-construction activities to optimize construction staging and management. These activities include the following:

- Conducting geotechnical investigations to define precise geologic, groundwater, and seismic conditions along the alignment. The results of this work would guide final design and construction methods for foundations, stations, and aerial structures.
- Identifying construction laydown and staging areas used for mobilizing personnel, stockpiling materials, and storing equipment for building HSR or related improvements. In some cases, these areas would also be used to assemble or prefabricate components of guideway or wayside facilities before transport to installation locations. Field offices and temporary jobsite trailers would also be located at the staging areas. Construction laydown areas are part of the project footprint that is evaluated for potential environmental impacts; however, actual use of the area would be at the discretion of design-build contractor. After completing construction, the staging and laydown areas would be restored to pre-construction condition.

- Initiating site preparation and demolition, such as clearing, grubbing, and grading, followed by the mobilization of equipment and materials. Demolition would require strict controls so that adjacent buildings, infrastructure, and natural and community resources are not damaged or otherwise affected by the demolition efforts.
- Relocating utilities prior to construction. The contractor would work with the utility companies to relocate or protect in place high-risk utilities, such as overhead tension wires, pressurized transmission mains, oil lines, fiber optical conduits or cables, and communications lines or facilities prior to construction.
- Implementing temporary, long-term, and permanent road closures to reroute or detour traffic away from construction activities. Handrails, fences, and walkways would be provided for the safety of pedestrians and bicyclists.
- Conducting other studies and investigations, as needed, such as surveys of local business to identify usage, delivery, shipping patterns, and critical times of the day or year for business activities, as well as necessary cultural resource investigations, and historic property surveys. This information would help develop construction requirements and worksite traffic control plans and identify potential alternative routes and resource avoidance plans.

Temporary staging would occur primarily within the existing Caltrain ROW, except for temporary staging areas and TCEs for the construction of the East Brisbane LMF and Millbrae Station. Track modifications would mostly be performed by track-mounted equipment, and construction materials (e.g., rail, ties, ballast) would be delivered by rail. Modifications to existing Caltrain station platforms would be isolated to each Caltrain station and associated parking lots, which are within the existing Caltrain ROW. At-grade crossing improvements would not require separate construction staging areas.

There are two locations where construction staging areas greater than 5 acres outside the existing Caltrain ROW would be required:

- Brisbane LMF—Construction of the East Brisbane LMF would require TCEs (approximately 74 acres) to establish equipment and materials storage areas close to construction sites for the LMF and the realigned Tunnel Avenue overpass.
- Millbrae BART Station—Construction would require approximately 8 acres of TCE east and west of the Millbrae Station to establish equipment and materials storage areas close to construction sites, build a new HSR station concourse and platforms, build overhead circulation elements between the new station and platforms, and modify roadways.

Land needed for temporary construction activities would be leased from landowners, taken out of its current use, used temporarily for construction, and restored to its pre-construction state after construction is completed. Construction would require the temporary use of 90.7 acres of land outside the Caltrain ROW. TCEs would typically be on roadway rights-of-way, shoulders of the existing railroad tracks, backyards, or vacant areas adjacent to structures that are used for residential, commercial, mixed use, industrial, public facilities, and parks/open-space purposes.

These TCEs would be used for construction equipment and materials staging; no precasting yards or batch plants for concrete manufacturing would be required for project construction.

Major types of construction activities for the project include demolition, grubbing, and earthwork; trackwork; station modifications; construction of the Brisbane LMF; construction of aerial structures; and roadway modifications. The first stage of construction would involve the demolition of building and roadway structures directly affected by the HSR system. Several activities would need to be conducted before demolition work can commence, including:

- Relocation of building occupants and roadways
- Completion of a demolition survey and demolition plan
- Removal and disposal of hazardous materials in a safe and controlled manner, if any hazardous materials such as asbestos are identified
- Obtaining permits from the Bay Area Air Quality Management District

After mobilizing and setting up the construction staging areas, the contractor would commence with clearing and grubbing areas of new ROW in advance of the major structures, roadway and utility relocations. This activity (clearing and grubbing) consists of the removal of topsoil, trees, minor physical objects, and other vegetation from the construction site with use of specialized equipment for raking, cutting, and grubbing.

Construction would also involve earthwork, which includes both excavation and embankment. Excavation is the removal of soils by use of mechanical equipment and embankment is the placing and compacting of soils for the construction process with use of mechanical equipment. The HSR system seeks to balance the volume of soils needed for excavation and embankment and to minimize the input of materials from quarries and disposal of materials outside of the ROW.

Overall, earthwork activities for the Project Section would be minor because construction would occur mostly on the existing at grade Caltrain alignment. The exceptions are earthwork required for construction of the Brisbane LMF. Construction would require the disposal of excavated materials. Construction would reuse 22 percent of excavated materials suitable for embankment construction when permissible (Authority 2019c).

The primary track modifications in the Project Section would be for curve straightening to allow for increased operational speeds on the corridor. Track realignments of less than 1 foot would be performed by track-mounted equipment that would operate along the existing Caltrain tracks as it adjusts track alignment and ballast; these track realignments would not require relocation of overhead contact system (OCS) poles and would be completed within several days at any given location. Track realignments of less than 10 feet would be done at night or on weekends over several work windows to allow continued passenger service; relocation of OCS poles would be required, and speed restrictions would be imposed until the track realignment is completed. For realignments of more than 10 feet, a parallel track and new OCS poles would be built first and then connected to the existing track. The existing track profile would require modification to

allow for increased operational speeds on the corridor, including raising or lowering the profile up to and greater than 6 inches. There are several types of vertical adjustments that could occur:

- Raising or lowering the profile less than 6 inches requires changes to the ballast layer only. OCS poles can remain in place, and only the contact wire would be adjusted.
- Raising or lowering the profile more than 6 inches requires reconstruction of the railbed (ballast and subballast layers). Reconstruction of the railbed for conventional ballast track entails the installation of the roadbed, subballast, ballast, ties, and rail with rail fasteners. OCS poles would need to be reconstructed.
- Ballast will be composed of granite or similar rock. Subballast will be composed of rock similar to roadway construction.

New aerial structures needed for this section would be limited to: (1) the East Brisbane LMF lead-in tracks; (2) the realigned Tunnel Avenue overpass; (3) and either widening existing bridges or building parallel bridges through the four tracking areas of Millbrae Station. A typical aerial structure foundation pile cap is supported by an average of four large-diameter (5 to 9 feet) bored piles. Depth of piles depends on the geotechnical conditions at each pile site. Pile construction can be achieved by using rotary drilling rigs, and either bentonite slurry or temporary casings may be used to stabilize pile shaft excavation. The estimated pile production rate is 4 days per pile installation. Additional pile installation methods available to the contractor include bored piles, rotary drilling cast-in-place piles, driven piles, and a combination of pile jetting and driving.

Following completion of the piles, pile caps can be built using conventional methods supported by structural steel: either precast and pre-stressed piles or cast-in-drilled-hole piles. For pile caps built near existing structures such as railways, bridges, and underground drainage culverts, temporary sheet piling (i.e., temporary walls) can be used to minimize disturbances to adjacent structures. Sheet piling installation and extraction would likely be achieved using hydraulic sheet piling machines.

Typical aerial structures of up to 90 feet would be built using cast-in-place bent caps and columns supported by structural steel and installed upon pile caps. A self-climbing formwork system may be used to build piers and portal beams more than 90 feet high. The self-climbing formwork system is equipped with a winched lifting device, which is raised up along the column by hydraulic means with a structural frame mounted on top of the previous pour. In general, a 3-day cycle for each 12-foot pour height can be achieved. The final size and spacing of the piers depend on the type of superstructure and spans they are supporting.

The selection of superstructure type would consider the loadings, stresses, and deflections encountered during the various intermediate construction stages, including changes in static scheme, sequence of tendon installation, maturity of concrete at loading, and load effects from erection equipment. Accordingly, the final design would depend on the contractor's selected means and methods of construction, such as full-span precast, span-by-span, balanced cantilever segmental precast, and cast-in-place construction on falsework. These superstructure

construction methods are described in full detail in the San Francisco to San Jose Project Section Constructability Assessment Report (Authority 2021b) and are summarized as follows:

- Full-span precast construction—Box girders would be precast and pre-stressed in advance as a full span and stored in a precasting yard. The 110-foot precast segments, weighing around 900 tons, would be transported along the previously built aerial guideway using a special gantry system.
- Span-by-span precast segmental construction—Shorter box girder segments would be precast and pre-stressed and stored in a precasting yard. These segments, limited to 12-foot segments weighing less than 70 tons, would likely be individually transported to the construction site by ground transportation. Once the gantry system is in place, construction would involve hoisting the segments from the ground and installing and tensioning the pre-stressing tendons to create the box girder.
- Balanced cantilever segmental construction—In locations where construction would occur over existing facilities that prevent equipment and temporary supports on the ground, balanced cantilever segmental construction may be used. Under this construction method, box girder segments (12-foot segments weighing less than 70 tons) that are either precast or cast in place would be placed in a symmetrical fashion around a bent column. The segments would be anchored at the ends by cantilever tendons in the deck slab, with midspan tendons balancing the weight between two cantilevers. Precast segments would be precast off-site, transported to the construction site, and installed incrementally onto a portion of the existing cantilever using ground cranes, hoisting devices, or a self-launching gantry. Segments can also be cast in place and installed two at a time, one at each end of the balanced cantilever. Segments generated by casting in place are generally longer than those in precast construction because they do not need to be transported to the construction site.
- Cast in place construction on falsework—The method involves creating a suspended formwork with either a launching girder or gantry system. Once the formwork is in position and reinforcements and pre-stressing are placed, concrete is poured and the pre-stressing is stressed. The formwork is then removed and moved to the next segment.

Construction of road crossings and bridges would be similar to the approach for aerial structures. The superstructure would likely be built using precast, pre-stressed, concrete girders and cast-in-place deck. Approaches to bridges would be earthwork embankments, mechanically stabilized earth wall, or other retaining structures. Crossings of existing railroads, roads, and the HSR would be built on the line of the existing road or offline at some locations. When built online, the existing road would be closed or temporarily diverted. Where HSR would cross over existing railroads, the Authority would coordinate with the rail operators to avoid operational effects during construction. The most common type of roadway modification within the Project Section would be the installation of four-quadrant gates at at-grade crossings, required at 38 at-grade crossings. The installation of four quadrant gates at each at grade crossing would occur within roadway rights of way over a period of 4 to 6 months, with the greatest level of construction activity occurring over a period of 2 to 4 weeks.

Construction of the project would also involve roadway reconstructions at several locations. Portions of Tunnel Avenue and the existing Tunnel Avenue grade separation in Brisbane would require relocation. Construction of the new Tunnel Avenue overpass would occur prior to removing the existing Tunnel Avenue roadway and overpass from operation, which would maintain access to Tunnel Avenue from Bayshore Boulevard throughout the construction process. Roadway work associated with the project would be done using conventional methods in the following sequence as appropriate: demolition, utility relocation, excavation, grading, placing aggregate base, building concrete curb and gutter, and placing concrete or asphalt concrete top surface base and top surfaces. It is anticipated that full and partial street closures would be needed for the reconstruction of roadways. However, it is assumed that major diversions to the existing roadways to be grade separated would be avoided or minimized if they are necessary. Detours and temporary traffic control measures would be required so traffic circulation could be maintained during construction.

1.3.3. Operations

The construction plan is based on the phased implementation strategy for Phase 1 of the HSR system, which assumes that (Authority and FRA 2018, Authority 2019b, a):

- HSR Valley-to-Valley service would be operational in 2029
- Phase 1, which would connect San Francisco with Los Angeles via the Central Valley, would be operational by 2033
- The analysis in this document is based on impact assessment in 2029 (initial operation) and 2040 (operations after initial ridership build up)

Phase 2, which would subsequently extend service to Sacramento and San Diego for full system operation, would occur after the 2040 Phase 1 system operations envisioned in the Draft EIR/EIS.

Consistent with the California High-Speed Rail Authority Sustainability Policy (Authority 2020), the Authority proposes to continue to implement sustainability practices that inform and affect the planning, siting, designing, construction, mitigation, operation, and maintenance of the HSR system. In summary, the Authority's criteria for meeting its sustainability policy for its infrastructure and HSR service are:

- Net-zero greenhouse gas and criteria pollutant emissions in construction
- Operating the system entirely on renewable energy
- Net-zero energy, Leadership in Energy and Environmental Design platinum facilities
- Planning for climate change adaptation and resilience
- Prioritizing life-cycle considerations

- Applicable design standards, including compliance with laws, regulations, and industry standard practices

The following information includes proposed operations throughout the HSR system, which provides context to the proposed operations in the San Francisco to San Jose Project Section. The conceptual HSR service plan for Phase 1 describes service from Anaheim/Los Angeles through the Central Valley from Bakersfield to Merced and northwest into the Bay Area (Authority 2009, Authority 2019a, Authority and FRA 2018). Subsequent stages of the HSR system include a southern extension from Los Angeles to San Diego via the Inland Empire and an extension from Merced north to Sacramento.

Train service would operate in diverse patterns between various terminals. Three basic service types are envisioned:

- Express trains, which would serve major stations only, providing fast travel times between Los Angeles and San Francisco during the morning and afternoon peak
- Limited-stop trains, which would skip selected stops along a route to provide faster service between stations
- All-stop trains, which would focus on regional service

Most trains would provide limited-stop services and offer a relatively fast run time along with connectivity among various intermediate stations. Numerous limited-stop patterns would be provided to achieve a balanced level of service at the intermediate stations. The service plan envisions at least four limited-stop trains per hour in each direction, all day long, on the main route between San Francisco and Los Angeles. Each intermediate station in the Bay Area, Central Valley between Fresno and Bakersfield, Palmdale in the High Desert, and Sylmar and Burbank in the San Fernando Valley would be served by at least two limited-stop trains every hour—offering at least two reasonably fast trains an hour to San Francisco and Los Angeles. Selected limited-stop trains would be extended south of Los Angeles as appropriate to serve projected demand.

Including the limited-stop trains on the routes between Sacramento and Los Angeles, and Los Angeles and San Diego, and the frequent-stop local trains between San Francisco and Los Angeles/Anaheim, and Sacramento and San Diego, every station on the HSR network would be served by at least two trains per hour per direction throughout the day and at least three trains per hour during the morning and afternoon peak periods. Stations with higher ridership demand would generally be served by more trains than those with lower estimated ridership demand.

The service plan provides direct train service between most station pairs at least once per hour. Certain routes may not always be served directly, and some passengers would need to transfer from one train to another at an intermediate station, such as Los Angeles Union Station, to reach their destination. Generally, the Phase 1 conceptual operations and service plans offer a wide spectrum of direct service options and minimize the need for passengers to transfer.

In 2029, the assumed first year of Phase 1 HSR operation, two trains per hour would operate during peak and one train per hour off peak between San Francisco and Bakersfield. When Phase 1 operations occur, the following service is assumed:

- Two peak trains per hour from San Francisco and Los Angeles (one in off peak)
- Two peak trains per hour from San Francisco and Anaheim (one in off peak)
- Two peak trains per hour from San Jose and Los Angeles
- One peak train per hour from Merced and Los Angeles
- One train per hour (peak and off peak) from Merced and Anaheim

1.3.4. Maintenance

The Authority would be a tenant operating within the Caltrain ROW for the blended portions of the Project Section. The Peninsula Corridor Joint Powers Board would continue to perform regular maintenance along the track and railroad ROW as well as on the power systems, train control, signaling, communications, and other vital systems required for the safe operation of the blended system. Maintenance methods would be like those currently used for the existing Caltrain system and would involve:

- Inspection and routine maintenance of the track and ballast, including tamping; OCS; structures; and signaling, train control, and communications components
- Inspections and daily maintenance of the stations and the LMF
- Maintenance of the ROW including culvert and drain cleaning, vegetation control, litter removal, and other inspection that would typically occur monthly to several times a year

The Authority would regularly perform maintenance along the dedicated track and railroad ROW as well as on the power systems, train control, signaling, communications, and other vital systems required for the safe operation of the HSR system. Maintenance methods are expected to be similar to existing European and Asian HSR systems, adapted to the specifics of the California HSR. However, the FRA would specify standards of maintenance, inspection, and other items in a set of regulations (i.e., Rule of Particular Applicability) to be issued in the next several years, and the overseas practices may be amended in ways not currently foreseen. The brief descriptions of maintenance activities provided in the following subsections are thus based on best professional judgment about future practices in California.

The track at any point would be inspected several times each week using measurement and recording equipment aboard special measuring trains. These trains are of similar design to the regular trains but would operate at a lower speed. They would run between midnight and 5 a.m. and would usually pass over any given section of track once in the night.

Most adjustments to the track and routine maintenance would be accomplished in a single night at any specific location with crews and material brought by work trains along the line. When rail

resurfacing (i.e., rail grinding) is needed, several times a year, specialized equipment would pass over the track sections at 5 to 10 mph.

Approximately every 4 to 5 years, ballasted track would require tamping. This more intensive maintenance of the track uses a train with a succession of specialized cars to raise, straighten, and tamp the track, using vibrating “arms” to move and position the ballast under the ties. The train would typically cover a 1-mile-long section of track in the course of one night’s maintenance.

Slab track, the track support type anticipated at elevated sections, would not require this activity. No major track components are expected to require replacement through 2040.

Other maintenance of the ROW, aerial structures, culverts, drains, and bridge sections of the alignment would include culvert and drain cleaning, vegetation control, litter removal, and other inspection that would typically occur monthly to several times a year.

The OCS along the ROW would be inspected nightly, with repairs being made when needed; these would typically be accomplished during a single night maintenance period. Other inspections would be made monthly. Many of the functions and status of substations and smaller facilities outside the trackway would be remotely monitored. However, visits would be made to repair or replace minor items and would also be scheduled several times a month to check the general site. No major component replacement for the OCS or the substations is expected through 2040.

Visual inspections of the structures along the ROW and testing of fire/life safety systems and equipment in or on structures would occur monthly, while inspections of all structures for structural integrity would be conducted at least annually. Steel structures would require painting every several years. Repair and replacement of lighting and communication components of tunnels and buildings would be performed on a routine basis. No major component replacement or reconstruction of any structures is expected through 2040.

Inspection and maintenance of signaling and train control components would be guided by FRA regulations and standards to be adopted by the Authority. Typically, physical in field inspection and testing of the system would be conducted four times a year using hand-operated tools and equipment. Communication components would be routinely inspected and maintained, usually at night, although daytime work may be undertaken if the work area is clear of the trackway. No major component replacement of these systems is expected through 2040.

Fencing and intrusion protection systems would be remotely monitored, as well as periodically inspected. Maintenance would take place as needed; however, fencing and intrusion protection systems are not expected to require replacement before 2040.

1.3.5. Proposed Conservation Measures

The Authority proposes to employ a variety of best management practices (BMPs) and avoidance and mitigation measures (AMMs), also known as conservation measures (CMs), to reduce or avoid adverse impacts to a listed species and the habitats upon which they depend. The proposed CMs that are directly applicable to listed species and habitats under NMFS jurisdiction

(CCC steelhead, sDPS green sturgeon, critical habitat, and EFH) are reproduced below, though other proposed CMs will also be employed that are also expected to protect and conserve NMFS trust resources. A full description of all CMs proposed by the Authority is available in Appendix 2-B: Conservation Measures (Authority 2021c).

The Authority categorized conservation measures into either general minimization measures to be implemented for all activities (e.g., AMM-GEN-1) or resource-specific minimization measures for each affected species or species group (e.g., AMM-FISH-1 for steelhead and sturgeon). General avoidance and minimization measures will be implemented in all relevant aspects of construction and operation of the proposed action while species specific measures will only be implemented in areas supporting the listed or sensitive resource.

AMM-FISH-1: General Fish Protection Measures

The Authority will implement general protection measures to protect and minimize effects on listed fish and their habitat during construction.

- **General design:** The following measures will be implemented during the design phase:
 - Temporary night lighting of overwater structures (if needed) will be designed such that illumination of the surrounding water is avoided.
 - Temporary construction areas (e.g., staging, storage, parking, and stockpiling areas) will be located outside of channels and riparian areas wherever feasible.

The Authority will coordinate with NMFS and request review of design within 2 years of construction. NMFS may comment on and advise the Authority with respect to the impact of design on species listed under the ESA. The Authority has committed as part of the proposed action to using low-impact development methods for stormwater treatment, including locations that could otherwise contribute polluted stormwater to streams that provide habitat for fish listed under the ESA (see: AMM-GEN-18). Such measures may consist of pervious hardscapes (for pollutant-generating areas such as parking lots, maintenance yards, etc.), bioswales, infiltration basins, rain gardens, and any and all other design measures that will capture and treat polluted runoff before it reaches sensitive natural waterways.

- **Bank stabilization and erosion control:** The following measures will be implemented during design and construction phases to minimize habitat disturbance from bank stabilization activities:
 - Temporarily fence areas of natural riparian vegetation that can be avoided with high-visibility ESA fence to enforce avoidance.
 - Use “soft” approaches to bank erosion control to the extent possible (e.g., vegetative plantings, placement of large woody debris). Minimize hard bank protection methods (e.g., revetment/riprap) wherever feasible.

- Avoid the use of wood treated with creosote or copper-based chemicals, or use of materials incorporating “rubber” tire material, in bank stabilization efforts.
- Use quarry stone, cobblestone, or their equivalent for erosion control along rivers and streams, complemented with native riparian plantings or other natural stabilization alternatives that will maintain a natural riparian corridor, where feasible. Cobble size, types and spacing of riparian plantings, and other details on riparian restoration activities will be provided in the restoration and revegetation plan (RRP) described in AMM-GEN-28 (see below).
- Revegetate temporarily disturbed areas with native plants to resemble the existing vegetation.

AMM-FISH-2: Work Windows

Near-water and in-water work will be conducted within specified work windows based on date, channel inundation, and water temperature. Work windows will include the general periods when effects on migrating juvenile and adult CCC steelhead would be minimal. Additionally, in-water work will be allowed when salmonid use is temperature limited (defined as 1 week of average water temperature of 75 degrees Fahrenheit [°F] or more); and work would be allowed in the channel and on the floodplain when channels are dry or ponded. During work windows, work will only be allowed in the channel from 1 hour after sunrise until 1 hour before sunset.

- Near-water or over-water work is defined as construction activities other than impact pile driving occurring within the floodplain, but not in the wetted channel (e.g., located between the wetted channel and the landside toe of the bordering levees or over the wetted channel). In-water work is defined as work within the wetted channel.
- The near-water construction work window for nontidal channels is proposed to be April 30 through December 1. For in-water work in nontidal channels, the construction work window is proposed to be June 15 through October 15. These periods may be extended subject to concurrence from NMFS that reinitiation of consultation would not be required.
- If channels are dry or ponded (i.e., lack continuous flow), or water temperatures average 75°F or more for 7 consecutive days, in-water and near-water work is proposed to proceed outside the work windows stated above. NMFS would be notified if sites with these conditions are present during construction, so that fish presence could be ascertained, and a fish capture and relocation strategy (referred to as ‘fish rescue’ in Authority documents (Authority 2021i, c)) is performed if necessary.

AMM-FISH-3: Underwater Sound Control Plan

The Authority will develop and implement an underwater sound control plan outlining specific measures to avoid and minimize the effects of impact pile driving within 200 feet of habitat for ESA-listed fish. Effects will be minimized by limiting the period during which impact pile driving may occur and by limiting or abating underwater noise generated during impact pile driving.

The underwater sound control plan will be provided to NMFS for review and approval at least 1 month prior to in-water impact pile driving. The plan would evaluate the potential effects of impact pile driving on listed fish in the context of the following interim underwater noise thresholds established for disturbance and injury of fish (Caltrans 2015, 2019).

- Mortality threshold for fish of all sizes includes a peak sound pressure level of 206 decibels (dB) relative to 1 micropascal (μPa)
- Injury threshold for fish less than 2 grams is 183 dB (re: 1 μPa) cumulative sound exposure level, and 187 dB (re: 1 μPa) cumulative sound exposure level for fish greater than 2 grams
- Disturbance threshold for fish of all sizes is 150 dB root mean square (re: 1 μPa)

The underwater sound control plan will restrict in-water work to the in-water work window specified in permits issued by the fish and wildlife agencies, and to daylight hours between 1 hour after sunrise and 1 hour before sunset with a 12-hour break between pile driving sessions.

The underwater noise generated by impact pile driving will be abated using the best available and practicable technologies. Examples of such technologies include, but are not limited to, the use of cast-in-drilled-hole rather than driven piles; the use of vibratory rather than impact pile driving equipment; using an impact pile driver to proof piles initially placed with a vibratory pile driver; and noise attenuation using pile caps (e.g., wood or micarta). Specific techniques selected for employment onsite will be selected based on site-specific conditions.

In addition to primarily using vibratory pile driving methods and establishing protocols for attenuating underwater noise levels produced during in-water construction activities, the Authority will develop and implement operational protocols for when impact pile driving is necessary. These operational protocols will be used to minimize the effects of impact pile driving on listed fish. These protocols may include, but not be limited to, the following:

1. monitoring the in-water work area for fish that may be showing signs of distress or injury as a result of pile-driving activities and stopping work when distressed or injured fish are observed;
2. initiating impact pile driving with a “soft-start,” such that pile strikes are initiated at reduced impact and increase to full impact over several strikes to provide fish an opportunity to move out of the area;
3. restricting impact pile-driving activities to specific times of the day and for a specific duration to be determined through coordination with the fish and wildlife agencies (i.e., NMFS); and
4. if more than one pile-driving rig is employed, initiating pile-driving activities in a way that provides an escape route and avoids “trapping” fish between pile drivers in waters exposed to underwater noise levels that could potentially cause injury.

The Authority incorporated these protocols with the expectation that they will help to avoid and minimize the overall extent, intensity, and duration of potential underwater noise effects associated with impact pile-driving activities to fish.

AMM-FISH-4: Prepare Plan for Dewatering and Water Diversions

Prior to initiating any construction activity that occurs within open or flowing water, or streamside activities, the Authority will prepare a dewatering plan, which would be subject to review and approval by the applicable regulatory agencies (such as NMFS). The plan will incorporate measures to minimize turbidity and siltation. The project biologist would monitor the dewatering or water diversion sites, including collection of water quality data, as applicable. Prior to the dewatering or diverting of water from a site, the project biologist will conduct pre-activity surveys to determine the presence or absence of listed species within the affected waterbody. In the event that listed species are detected during pre-activity surveys, the project biologist will relocate the species, consistent with any regulatory authorizations applicable to the species.

Dewatering will be accomplished through flow diversion, which involves isolating the in-water work area through placement of sandbags or equivalent structures, channeling the stream through an alternate course that may be either a portion of the stream channel, or an artificial structure such as a pipe, or a constructed artificial channel; and then dewatering the work area. To minimize adverse impacts on fish habitat, the first preference is to limit dewatering to a portion of the stream channel (e.g., by first performing work in dewatered habitat on one side of the channel, then restoring flow, and then dewatering the other side of the channel). Any alternate course created in CCC steelhead designated critical habitat must meet NMFS (2011) and CDFG (2009) fish passage requirements. At all dewatering sites, at the conclusion of work for the season, water is allowed to reenter the work area, the isolating structures are removed, and the alternate flow path is dewatered and decommissioned; all alterations to the stream are removed prior to the beginning of the rainy season.

AMM-FISH-5: Fish Capture and Relocation (Rescue and Salvage) Plan

Construction within waterways may entail temporary dewatering to minimize potential impacts on fisheries and minimize potential erosion, sediment loss, scour, or increases in turbidity. Fish relocation operations may occur at any in-water construction site that occurs in modeled steelhead or green sturgeon habitat, or habitat identified by project biologists during pre-construction surveys where dewatering and resulting isolation of fish may occur. Fish capture and relocation plans will be developed by the Authority and would include detailed procedures for fish relocation to minimize the number of individuals of listed fish species subject to stranding during dewatering. The plans will identify the appropriate procedures for removing fish from construction zones and preventing fish from reentering construction zones prior to dewatering and other construction activities. A draft plan will be submitted to the fish and wildlife agencies for review and approval before dewatering begins. A written response from NMFS would be required before in-water construction activities with the potential for stranding fish can proceed.

All fish relocation activities will be conducted under the guidance of a qualified fish biologist and in accordance with required permits. At each crossing of modeled habitat, the fish relocation plan will identify the appropriate procedures for excluding fish from the construction zone and for removing fish from areas subject to dewatering. The primary procedure would be to block off the construction area and use seines (nets) or dip nets to collect and remove fish, although electrofishing techniques may also be authorized under certain conditions. It is critical that fish capture and relocation operations begin as soon as possible and be completed within 48 hours after isolation of a construction area to minimize potential predation and adverse water quality impacts (high water temperature, low dissolved oxygen) associated with confinement. Block nets, sandbags, or other temporary exclusion methods could be used to exclude fish or isolate the construction area prior to the fish removal process. Since work would be performed during the in-water work window (see: AMM-FISH-1) when fish use is expected to be minimal, exclusion barriers would not be expected to have additional adverse consequences to typical fish migration patterns. The exclusionary devices will be removed before the end of the work window. The appropriate fish exclusion or collection method will be determined by a qualified fish biologist, in consultation with a designated fish and wildlife agency biologist, based on site-specific conditions and construction methods. Capture, release, and relocation measures will be consistent with the general guidelines and procedures set forth in Part IX of the most recent edition of the California Salmonid Stream Habitat Restoration Manual (currently, CDFG (2010)) to minimize impacts on listed species of fish and their habitat.

All fish capture and relocation operations will be conducted under the guidance of a fish biologist meeting the qualification requirements (refer to the following subsection, Qualifications of Fish Relocation Personnel). The following discussion addresses proposed fish collection, holding, handling, and release procedures of the plan. Unless otherwise required by project permits, the Authority will provide the following:

- A minimum 48-hour notice to NMFS of dewatering activities that are expected to require fish relocation.
- Unrestricted access for NMFS agency personnel to the construction site for the duration of implementation of the fish relocation plan.
- Temporary cessation of dewatering if fish relocation workers determine that water levels may drop too quickly to allow successful relocation of fish.
- A work site that is accessible and safe for fish relocation workers.

Qualifications of Fish Relocation Personnel

Personnel active in fish relocation efforts would include at least one person with a 4-year college degree in fisheries or biology or a related degree. This person also must have at least 2 years of professional experience performing fisheries field surveys and fish capture and handling procedures affecting juvenile salmonids and sturgeons. The person would have completed an electrofishing training course such as Principles and Techniques of Electrofishing (USFWS, National Conservation Training Center) or similar course, if electrofishing is to be used. To

avoid and minimize the risk of injury to fish, attempts to seine or net fish would always precede the use of electrofishing equipment.

Seining and Dipnetting

Fish capture and relocation operations would begin immediately after isolating the work area. If the enclosed area is wadeable (less than 3 feet deep), fish can be herded out within the work area by dragging a seine (net) through the enclosure prior to final closure of the downstream end of the isolation area. Depending on conditions, this process may need to be conducted several times. The net or screen mesh would be no greater than 0.125 inch, with the bottom edge of the net (lead line) securely weighted down to prevent fish from entering the area by moving under the net.

After isolation of the work area is complete, remaining fish in the enclosed area would be removed using seines, dip nets, electrofishing techniques, or a combination of these depending on site conditions. Dewatering activities would also conform to the guidelines specified in the Dewatering subsection.

Following each sweep of a seine through the enclosure, the fish relocation team will do the following:

- Carefully bring the ends of the net together and pull in the wings, so that the lead line is kept as close to the substrate as possible.
- Slowly turn the seine bag inside out to reveal captured fish, so that fish remain in the water as long as possible before transfer to an aerated container.
- Follow the procedures outlined in Electrofishing and relocate fish to a predetermined release site.

Dipnetting is best suited for small, shallow pools in which fish are concentrated and easily collected. Dip nets will be made of soft (nonabrasive) nylon material and small mesh size (0.125 inch) to collect small fish.

At sites where fish exclusion barriers remain in place for longer than 1 week, the isolated area will be checked for fish presence at weekly intervals.

Electrofishing

After conducting the herding and netting operations, electrofishing may be necessary to remove as many fish as possible from the enclosure. Electrofishing will be conducted in accordance with NMFS electrofishing guidelines (NMFS 2000) and other appropriate fish and wildlife agency guidelines. Electrofishing would be conducted by one or two 3- to 4-person teams, with each team having an electrofishing unit operator and two or three netters. At least three passes would be made through the enclosed cofferdam areas to remove as many fish as possible. Fish initially will be placed in 5-gallon buckets filled with river water. Following completion of each pass, the electrofishing team will do the following:

- Transfer fish into 5-gallon buckets filled with clean river water at ambient temperature.
- Hold fish in 5-gallon buckets equipped with a lid and an aerator, and add fresh river water or small amounts of ice to the fish buckets if the water temperature in the buckets becomes more than 2°F warmer than ambient river waters.
- Maintain a healthy environment for captured fish, including low densities in holding containers to avoid effects of overcrowding.
- Use water-to-water transfers whenever possible.
- Release fish at predetermined locations.
- Segregate larger fish from smaller fish to minimize the risk of predation and physical damage to smaller fish from larger fish.
- Limit holding time to about 10 minutes, if possible.
- Avoid handling fish during processing unless absolutely necessary. Use wet hands or dip nets if handling is needed.
- Handle fish with hands that are free of potentially harmful products, including but not limited to sunscreen, lotion, and insect repellent.
- Avoid anesthetizing or measuring fish.
- Note the date, time, and location of collection; species; number of fish; approximate age (e.g., young-of-the-year, yearling, adult); fish condition (dead, visibly injured, healthy); and water temperature.
- If positive identification of fish cannot be made without handling the fish, note this and release fish without handling. If the fish is a salmonid or sturgeon, photograph it prior to release.
- In notes, indicate the level of accuracy of visual estimates to allow appropriate reporting to the appropriate fish and wildlife agencies (e.g., “Approx. 10–20 young-of-the-year steelhead”).
- Release fish in appropriate habitat either upstream or downstream of the enclosure, noting release date, time, and location.
- Stop efforts and immediately contact the appropriate fish and wildlife agencies if mortality during relocation or the limits on take (harm or harassment) of federally listed species exceeds the Authority’s authorized take limits.
- Place dead fish of listed species in sealed plastic bags with labels indicating species, location, date, and time of collection, and store them on ice.

- Freeze collected dead fish of listed species as soon as possible and provide the frozen specimens to the appropriate fish and wildlife agencies, as specified in the permits.
- Sites selected for release of relocated fish either upstream or downstream of the construction area would be similar in temperature to the area from which fish were relocated, contain ample habitat, and have a low likelihood of fish reentering the construction area or being impinged on exclusion nets/screens.

All equipment used in fish capture and relocation activities must be sterilized prior to use to avoid introductions of aquatic invasive species and limit the spread of disease and parasites. Disinfection protocols are described by California Department of Fish and Wildlife (CDFW; (2016)).

Dewatering

Dewatering will be performed as specified in AMM-FISH-4 in association with fish relocation operations. A dewatering plan will be submitted as part of the stormwater pollution prevention plan (SWPPP)/Water Pollution Control Program detailing the location of dewatering activities, equipment, and discharge point. Dewatering pump intakes will be screened to prevent entrainment of juvenile or parr-sized salmonids in accordance with NMFS screening criteria for salmonid fry (NMFS 1997), including the following:

- Perforated plate: screen openings would not exceed 3/32 inch (2.38 mm), measured in diameter.
- Profile bar: screen openings would not exceed 0.0689 inch (1.75 mm) in width.
- Woven wire: screen openings would not exceed 3/32 inch (2.38 mm), measured diagonally (e.g., 6–14 mesh).
- Screen material shall provide a minimum of 27 percent open area.

During the dewatering process, a qualified biologist or fish relocation team will remain on-site to observe the process and remove additional fish using the previously described relocation procedures.

Contingency Plans

If fish capture and relocation activities cannot be conducted effectively or safely by fish relocation workers and surveys observe five or more juvenile sturgeon or steelhead², dewatering must stop until the fish biologist can contact NMFS to discuss incidental take scenarios and surveys show that fish have left the area. It may be necessary to begin the dewatering process prior to fish relocation. During the dewatering process, a qualified biologist or fish relocation team would be on-site with the aim of minimizing the number of fish that become trapped in

² The presence of at least five steelhead would indicate that the area is exceptionally important to steelhead and that there is high potential for a larger number of fish in the area; thus, the threshold of five is a precautionary value.

isolated areas or impinged on pump screen(s) or isolation nets. In the event that the proposed methods are found to be insufficient to avoid undue losses of fish, the qualified biologist would modify these methods or implement alternative methods to minimize subsequent losses.

In the event that an adult sturgeon or steelhead is found in an area proposed for fish capture/relocation for dewatering, NMFS personnel would immediately be notified and work would stop until the fish biologist and NMFS agree upon a course of action.

Final Inspections and Reporting

Upon dewatering to water depths at which neither electrofishing nor seining can effectively occur (e.g., less than 3 inches/0.1 meter), the fish relocation team will inspect the dewatered areas to locate any remaining fish. Collection by dip net, data recording, and relocation would be performed as necessary according to the procedures outlined previously in Electrofishing. The fish relocation team would notify the Authority when the fish relocation has been completed and construction can recommence. The results of the fish capture and relocation operations (including date, time, location, comments, method of capture, fish species, number of fish, approximate age, condition, release location, and release time) will be reported to the appropriate fish and wildlife agencies as specified in the pertinent permits.

1.3.5.1 Pertinent General CMs

Proposed general CMs are derived largely from impact avoidance and minimization features (IAMFs) incorporated into project design as described in the EIR/EIS prepared for the San Francisco to San Jose Project Section (Authority 2019b, a). The Authority designed these general CMs/AMMs/IAMFs with the intent to benefit federally listed species as well as with the intent to minimize project impacts on other biological and aquatic resources. Again, pertinent general CMs are summarized below, for full details see BA Appendix 2-B (Authority 2021c).

AMM-GEN-1: Designate Project Biologist, Designated Biologists, Species-Specific Biological Monitors and General Biological Monitors

At least 15 days prior to the onset of activities, the Authority will seek the approval of relevant resource agencies to designate project biologists and biological monitors, based on their qualifications and experience. Project biologist(s) will be responsible for ensuring the timely implementation of the biological AMMs as outlined in the biological resources management plan (BRMP), and for guiding and directing the work of the designated biologists and biological monitors. Designated biologists will be responsible for directly overseeing and reporting the implementation of general and species-specific conservation measures. General biological monitors will be responsible for conducting worker environmental awareness program (WEAP) training, implementing general conservation measures, conducting compliance monitoring, and reporting their compliance monitoring activities. No ground-disturbing project activities (e.g., geotechnical investigations, utility realignments, creation of staging areas, initial clearing and grubbing) will begin until the Authority has received written approval from NMFS that the biologists and biological monitors relevant to the regulatory authority and action area of each stated agency are approved to conduct the work.

AMM-GEN-2: Prepare WEAP Training Materials and Conduct Construction Period WEAP Training

A WEAP will be developed and trainings and training updates conducted by designated biologists or general biological monitors. WEAP training materials will, at a minimum, include a discussion of:

- the Federal ESA the California Endangered Species Act, the Bald and Golden Eagle Protection Act, the Migratory Bird Treaty Act, California Fish and Game Code Section 1600, Porter-Cologne Water Quality Control Act (Porter-Cologne Act), and the Clean Water Act (CWA);
- the consequences and penalties for noncompliance with these laws and regulations and project permits; identification and value of special-status plants, special-status wildlife, jurisdictional waters, and special-status plant communities;
- the contact person in the event of the discovery of a dead or injured wildlife species;
- hazardous substance spill prevention and containment measures; and
- conservation measures including the location of planned AMMs.

The WEAP training materials will be created and then submitted to the Authority for review and approval. All construction staff will attend the WEAP training prior to beginning work on-site and would attend the WEAP training on an annual basis thereafter. Fact sheet information will be duplicated in a wallet-sized format and be provided in other languages as necessary to accommodate non-English-speaking workers. Updates and a synopsis of the training will be provided during the daily safety (“tailgate”) meeting. Maintenance crews will be required to attend a contractor education and environmental training class annually. On an annual basis, the Authority would certify that WEAP training had been provided to all construction personnel.

AMM-GEN-3: Prepare and Implement a Biological Resources Management Plan

Prior to construction activities, the designated biologist will prepare the BRMP, which would include a compilation of the biological resources CMs/AMMs applicable to the San Francisco to San Jose Project Section. All project environmental plans, such as the RRP and weed control plan, would be included as appendices to the BRMP. The implementation of these measures will be tracked through final design, construction, and operation phases. The BRMP will be created and submitted to the Authority for review and approval prior to any ground-disturbing activity.

AMM-GEN-4: Delineate Equipment Staging Areas and Traffic Routes

Prior to any ground-disturbing activity, the Authority will establish staging areas for construction equipment in areas that minimize effects on sensitive biological resources, including habitat for listed species, seasonal wetlands, and wildlife movement corridors. Staging areas (including any temporary material storage areas) will be located in areas that will be occupied by permanent facilities, where practicable.

AMM-GEN-5: Establish Environmentally Sensitive Areas and Nondisturbance Zones

Prior to any ground-disturbing activity in a work area, the project biologist will use flagging to mark environmentally sensitive areas that support listed species or aquatic resources and are subject to seasonal restrictions, or establish exclusionary fencing, as needed. The purpose of the flagging and fencing will be explained at WEAP training and during worker tailgate sessions.

AMM-GEN-6: Conduct Monitoring of Construction Activities

From on-site or remotely, a designated biologist will direct the work of general biological monitors who will be present on-site during initial ground-disturbing activities and for all construction activities conducted within or adjacent to identified environmentally sensitive areas and nondisturbance zones. General biological monitors will also conduct daily biological “sweeps” to verify that no listed species are located within the area to be disturbed during that day’s scheduled activities. The general biological monitor(s) will advise the contractor on methods that may minimize or avoid impacts on federally listed species, including all required species-specific measures.

AMM-GEN-7: Establish and Implement a Construction Compliance Reporting Program

The project biologist will prepare monthly and annual reports documenting compliance with all CMs/AMMs/IAMFs, mitigation measures, and requirements set forth in regulatory agency authorizations. The Authority will review and approve all compliance reports prior to submittal to the regulatory agencies. Daily compliance reports will be submitted to the Authority via the Environmental Mitigation Management and Assessment system (EMMA) within 24 hours of each monitoring day. Noncompliance events will be reported to the Authority the day of the occurrence. If agency personnel visit the construction footprint in accordance with AMM-GEN-32, the project biologist will prepare a memorandum within 1 day of the visit that memorializes the issues raised during the field meeting. This memorandum would be submitted to the Authority via EMMA and any issues regarding regulatory compliance raised by agency personnel would be reported to the Authority and the contractor.

AMM-GEN-9: Prepare a Compensatory Mitigation Plan for Species and Species Habitat

The Authority will prepare a compensatory mitigation plan (CMP) that sets out the compensatory mitigation that will be provided to offset permanent and temporary impacts on federal and state-listed species and their habitats from project impacts. The CMP will include the following:

- A description of the species and habitat types for which compensatory mitigation is being provided
- A description of the methods used to identify and evaluate mitigation options. Mitigation options would include one or more of the following:
 - Purchase of mitigation credits from an agency-approved mitigation bank

- Protection of habitat through acquisition of fee-title or conservation easement and funding for long-term management of the habitat. Title to lands acquired in fee would be transferred to CDFW and conservation easements would be held by an entity approved in writing by the applicable regulatory agency. In circumstances where the Authority protects habitat through a conservation easement, the terms of the conservation easement would be subject to approval of the applicable regulatory agencies, and the conservation easement would identify applicable regulatory agencies as third party beneficiaries with a right of access to the easement areas.
 - Payment to an existing in-lieu fee program
- A summary of the estimated permanent and temporary impacts on species and species habitat and description of the process that would be used to confirm impacts. Actual impacts on species and habitat could differ from estimates and, should this occur, adjustments would be made to the compensatory mitigation that would be provided.
 - An overview of the strategy for mitigating impacts on species. The overview will include the ratios to be applied to determine mitigation levels and the resulting mitigation totals.
 - A description of habitat restoration or enhancement projects, if any, that would contribute to compensatory mitigation commitments.
 - A description of the success criteria that will be used to evaluate the performance of habitat restoration or enhancement projects, and a description of the types of monitoring that would be used to verify that such criteria have been met.
 - A description of the management actions that will be used to maintain the habitat on the mitigation sites, and the funding mechanisms for long-term management.
 - A description of adaptive management approaches, if applicable, that will be used in the management of species habitat.
 - A description of financial assurances that will be provided to demonstrate that the funding to implement mitigation is assured.

AMM-GEN-10: Conduct Operations and Maintenance Period WEAP Training

Prior to initiating operations and maintenance activities, personnel will attend a compliance reporting training session arranged by the Authority. At a minimum, operations and maintenance WEAP training materials would include information similar to that provided during the construction WEAP.

AMM-GEN-11: Implement Measures to Minimize Impacts during Off-Site Habitat Restoration, or Enhancement, or Creation on Mitigation Sites

Prior to ground-disturbing activities associated with habitat restoration, enhancement, or creation actions at a mitigation site, the Authority will conduct a site assessment of the work area to identify biological and aquatic resources, including plant communities, land cover types, and the distribution of special-status plants and wildlife. Based on the results of the site assessment, the Authority will obtain any necessary regulatory authorizations prior to conducting habitat restoration, enhancement, or creation activities, including authorization under the Federal ESA or California Endangered Species Act, Cal. Fish and Game Code Section 1600 et seq., the CWA, and the Porter-Cologne Act.

AMM-GEN-12: Undocumented Contamination Plan

Prior to construction, the Authority will prepare a CMP addressing provisions for the disturbance of undocumented contamination. Undocumented contamination could be encountered during construction activities, and the Authority would work closely with local agencies to resolve any such encounters and address necessary clean-up or disposal.

AMM-GEN-13: Dispose of Construction Spoils and Waste

During ground-disturbing activities, the Authority may temporarily store excavated materials produced by construction activities in areas at or near construction sites within the project footprint. Where practicable, the Authority will return excavated soil to its original location to be used as backfill. Any excavated waste materials unsuitable for treatment and reuse will be disposed at an off-site location, in conformance with applicable state and federal laws.

AMM-GEN-14: Restrict Stockpiling and Redistributing Excavated Soil

Excavated materials will be stockpiled and redistributed as follows:

- Contractors will temporarily store excavated materials produced by ground-disturbing activities in designated stockpile areas at or near the excavation site and within the project footprint or another authorized location, or
- The collection, stockpiling, and redistribution of topsoil will be conducted as described in the RRP.

AMM-GEN-15: Transport of Materials

During construction, the contractor will comply with applicable state and federal regulations, such as the Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation, and Liability Act, the Hazardous Materials Release Response Plans and Inventory Law, and the Hazardous Waste Control Act. Prior to construction, the contractor will prepare a hazardous materials and waste plan describing responsible parties and procedures for hazardous waste and hazardous materials transport.

AMM-GEN-16: Permit Conditions

During construction, the contractor will comply with the State Water Resources Control Board (SWRCB) CWA Section 402 General Permit conditions and requirements for transport, labeling,

containment, cover, and other BMPs for storage of hazardous materials during construction. Prior to construction, the contractor will prepare a hazardous materials and waste plan describing responsible parties and procedures for hazardous waste and hazardous materials transport, containment, and storage BMPs that would be implemented during construction.

AMM-GEN-17: Maintain Construction Sites

Prior to any ground-disturbing activity, the Authority will prepare a construction site BMP field manual. The BMP field manual will contain standard construction site housekeeping practices required to be implemented by construction personnel for the following topics: temporary soil stabilization, temporary sediment control, wind erosion control, non-stormwater management, waste management and materials control, rodenticide use, and other general construction site cleanliness measures. All construction personnel will receive training on BMP field manual implementation prior to working within the project footprint.

AMM-GEN-18: Prepare and Implement an Operational Stormwater Management Plan

Prior to construction, the contractor will prepare an operational stormwater management and treatment plan. During the detailed design phase, each receiving stormwater system's capacity to accommodate project runoff will be evaluated. As necessary, on-site stormwater management measures, such as detention or selected upgrades to the receiving system, will be designed to provide adequate capacity and to comply with the design standards in the latest version of Authority Technical Memorandum (Authority 2012). To the extent feasible, stormwater treatment will employ bioretention/biofiltration with a sand/compost mix in filter columns as part of the treatment system for impervious surfaces designated for vehicle use, as described by McIntyre et al. (2015), McIntyre et al. (2016). If this method is not feasible, stormwater treatment will use another method or measure that would have equal or greater effectiveness in removing known toxins to aquatic species, including steelhead.

On-site stormwater management facilities will be designed and built to capture runoff and provide treatment prior to discharge of pollutant-generating surfaces, including station parking areas, access roads, new road over- and underpasses, reconstructed interchanges, and new or relocated roads and highways. Low-impact development techniques will be used to detain runoff on-site and to reduce off-site runoff such as constructed wetland systems, biofiltration and bioretention systems, wet ponds, organic mulch layers, and planting soil beds; vegetated systems (biofilters), such as vegetated swales and grass filter strips, will be used where appropriate.

AMM-GEN-19: Work Barriers

Prior to construction (any ground-disturbing activities), the contractor will verify to the Authority through preparation of a technical memorandum the use of work barriers. Nominal design variances, such as the addition of a plastic barrier beneath the ballast material to limit the potential release of volatile subsurface contaminants, may be implemented in conjunction with site investigation and remediation.

AMM-GEN-20: Spill Prevention Plan

Prior to construction (any ground-disturbing activities), the Authority will prepare a CMP addressing spill prevention. A spill prevention, control, and countermeasure plan (or spill prevention and response plan if the total aboveground oil storage capacity is less than 1,320 gallons in storage containers greater than or equal to 55 gallons) will prescribe BMPs to prevent hazardous material releases and clean-up of any hazardous material releases that may occur.

AMM-GEN-21: Prepare and Implement Hazardous Materials Plans

Prior to operations and maintenance activities, the Authority will prepare hazardous materials monitoring plans. These would use as a basis a source such as a hazardous materials business plan as defined in Title 19 California Code of Regulations and a spill prevention, control, and countermeasure plan.

AMM-GEN-22: Prepare and Implement a Construction Stormwater Pollution Prevention Plan

Prior to construction (any ground-disturbing activities), the contractor will comply with the SWRCB Construction General Permit requiring preparation and implementation of a SWPPP. The construction SWPPP will propose BMPs to minimize potential short-term increases in sediment transport caused by construction, including erosion control requirements, stormwater management, and channel dewatering for affected stream crossings. These BMPs will include measures to incorporate permeable surfaces into facility design plans where feasible and would address how treated stormwater will be retained or detained on-site. Other BMPs will include strategies to manage the amount and quality of overall stormwater runoff. The construction SWPPP will include measures to address, but are not limited to, the following:

- Hydromodification management to verify maintenance of pre-project hydrology by emphasizing on-site retention of stormwater runoff using measures such as flow dispersion, infiltration, and evaporation (supplemented by detention where required). Additional flow control measures will be implemented where local regulations or drainage requirements dictate.
- Implementing practices to minimize the contact of construction materials, equipment, and maintenance supplies with stormwater.
- Limiting fueling and other activities using hazardous materials to areas distant from surface water, providing drip pans under equipment, and daily checks for vehicle condition.
- Implementing practices to reduce erosion of exposed soil, including soil stabilization, regular watering for dust control, perimeter siltation fences, and sediment catchment basins.
- Implementing practices to maintain current water quality, including siltation fencing, wattle barriers, stabilized construction entrances, grass buffer strips, ponding areas, organic mulch layers, inlet protection, storage tanks, and sediment traps to arrest and settle sediment.

- Where feasible, avoiding areas that may have substantial erosion risk, including areas with erosive soils and steep slopes.
- Using diversion ditches to intercept surface runoff from off-site.
- Where feasible, limiting construction to dry periods when flows in waterbodies are low or absent.
- Implementing practices to capture and provide proper off-site disposal of concrete wash water, including isolation of runoff from fresh concrete during curing to prevent it from reaching the local drainage system, and possible treatments (e.g., dry ice).
- Developing and implementing a spill prevention and emergency response plan to handle potential fuel or hazardous material spills.

The SWPPP will be implemented by the construction contractor as directed by the qualified SWPPP practitioner or designee. As part of that responsibility, the effectiveness of construction BMPs would be monitored before, during, and after storm events. Records of these inspections and monitoring results will be submitted to the local regional water quality control board as part of the annual report required by the Statewide Construction General Permit.

AMM-GEN-23: Prepare and Implement an Industrial Stormwater Pollution Prevention Plan

Prior to construction of any facility classified as an industrial facility, the Authority will comply with existing water quality regulations. The stormwater general permit requires preparation of a SWPPP and a monitoring plan for industrial facilities that discharge stormwater from the site, including vehicle maintenance facilities associated with transportation operations. To the extent feasible, stormwater treatment will employ bioretention/biofiltration with a sand/compost mix in filter columns as part of the treatment system for impervious surfaces designated for vehicle use, as described by McIntyre et al. (2015), McIntyre et al. (2016). If this method is not feasible, stormwater treatment will use another method or measure that would have equal or greater effectiveness in removing known toxins to aquatic species, including steelhead. The permit includes performance standards for pollution control.

AMM-GEN-24: Seasonally Restrict Storage of Material and Equipment in Areas Subject to Flooding

Material and equipment storage on the active floodplain of a river will be limited to the restricted period from April 15 to October 31. From November 1 to April 14, equipment may enter into the restricted river channel areas but must be removed daily and stored outside the areas subject to flooding.

AMM-GEN-25: Clean Construction Equipment

Prior to any ground-disturbing activity, the Authority will ensure that all equipment entering the work area is free of mud and plant materials. The Authority will establish vehicle cleaning locations designed to isolate and contain organic materials and minimize opportunities for weeds and invasive species to move in and out of the project footprint. Cleaning may be done by

washing with water, blowing with compressed air, brushing, or other hand cleaning. The cleaning areas will be located to avoid impacts on surface waters, and appropriate SWPPP BMPs will be implemented to further control any potential for the spread of weeds or other invasive species.

AMM-GEN-26: Prepare and Implement a Weed Control Plan

Prior to any ground-disturbing activity during the construction phase, the project biologist will develop a weed control plan, subject to review and approval by the Authority, with the purpose of minimizing and avoiding the spread of invasive weeds during ground-disturbing activities during construction and operations and maintenance. Weed control treatments may include application of permitted herbicides and manual and mechanical removal methods. Use of hand removal or controlled burning will be preferred over mechanical removal; use of mechanical removal will be preferred over herbicide treatment.

AMM-GEN-27: Prepare and Implement an Annual Vegetation Control Plan

Prior to initiating operations and maintenance activities, the Authority will prepare an annual vegetation control plan to address vegetation removal for the purpose of maintaining clear areas around facilities, reducing the risk of fire, and controlling invasive weeds during the operational phase. The Authority will generally follow the procedures established in Chapter C2 of the California Department of Transportation (Caltrans) Maintenance Manual to manage vegetation on Authority property (Caltrans 2014). Vegetation may be controlled by chemical, thermal, biological, cultural, mechanical, structural, and manual methods. Only Caltrans-approved herbicides may be used in the vegetation control plan. Pesticide application will be conducted by certified pesticide applicators in accordance with all requirements of the California Department of Pesticide Regulation and County Agricultural Commissioners. Noxious/invasive weeds will be treated where requested by County Agricultural Commissioners. The vegetation control plan would be updated each winter and completed in time to be implemented no later than April 1 of each year.

AMM-GEN-28: Prepare and Implement a Restoration and Revegetation Plan

A RRP for upland vegetation will be prepared and implemented. The RRP would describe the restoration and revegetation of habitat for federally listed species where vegetation or soil has been temporarily disturbed. Restoration activities include, but are not limited, to grading landform contours to approximate pre-disturbance conditions, returning soil to its original location wherever possible, stockpiling and spreading of topsoil, removal of invasive plant species, stabilizing soil surfaces with mulch or straw certified as weed-free, and revegetating disturbed areas using native plant species to the extent practicable. During construction activities, the Authority will implement the RRP in temporarily disturbed areas. The RRP will be submitted to NMFS for review and approval of the portions relevant to the regulatory authority and action area of each stated agency prior to its implementation.

AMM-GEN-29: Establish Monofilament Restrictions

Prior to any ground-disturbing activity, the project biologist will verify that plastic monofilament netting (erosion control matting) or similar material is not being used as part of erosion control

activities. The project biologist will identify acceptable material for such use, including: geomembranes, coconut coir matting, tackified hydroseeding compounds, and rice straw wattles (e.g., Earthsaver wattles: biodegradable, photodegradable, burlap). Within developed or urban areas, the project biologist may allow exceptions to the restrictions on the type of erosion control material if the project biologist determines that the construction area is of sufficient distance from natural areas to ensure the avoidance of potential impacts on wildlife.

AMM-GEN-31: Work Stoppage

During construction activities, the project biologist will have stop work authority to protect any federally listed wildlife species within the project footprint. This work stoppage will be coordinated with the Authority or its designee, and ground-disturbing activities in the construction area(s) where the potential construction activity could result in take of listed species will be suspended (but work may continue in other areas). The suspension will continue until the individual leaves voluntarily, is relocated to an approved release area using NMFS-approved handling techniques and relocation methods, or as required by NMFS for those resources under each agency's regulatory authority. Any such work stoppages and the measures taken to facilitate the removal of the species, if any, will be documented in a memorandum prepared by the project biologist and submitted to the Authority within 2 business days of the work stoppage.

AMM-GEN-32: Facilitate Agency Access

If requested before, during, or upon completion of construction activities, the Authority or its designee will allow access by the USFWS, NMFS, United States Army Corps of Engineers (USACE), CDFW, and SWRCB or other resource agency staff to project lands (including mitigation lands) where these lands are under permittee control with 24-hour notice. To address any safety issues, all visitors need to check in with the resident engineer prior to accessing the construction site.

AMM-GEN-33: Flood Protection Plan

Prior to construction, the contractor will prepare a flood protection plan. The project section will be designed both to remain operational during flood events and to minimize increases in 100- or 200-year flood elevations, as applicable to locale. Design standards will:

- establish track elevation to prevent saturation and infiltration of stormwater into the subballast, minimize development within the floodplain to such an extent that water surface elevation in the floodplain will not increase by more than 1 foot, or as required by state or local agencies, during the 100- or 200-year flood flow (as applicable to locale),
- avoid placement of facilities in the floodplain or those that raise the ground with fill above the base flood elevation, and
- design floodplain crossings to maintain a 100-year floodwater surface elevation of no greater than 1 foot above current levels, or as required by state or local agencies, and so that project features within the floodway itself would not increase existing 100-year

floodwater surface elevations in Federal Emergency Management Agency–designated floodways (or as otherwise agreed upon with the county floodplains manager).

The impacts of pier placement on floodplains and floodways will be further minimized by:

- Designing site crossings to be as nearly perpendicular to the channel as feasible to minimize bridge length.
- Orienting piers to be parallel to the expected high-water flow direction to minimize flow disturbance.
- Elevating bridge crossings at least 3 feet above the high-water surface elevation to provide adequate clearance for floating debris, or as required by local agencies.
- Conducting engineering analyses of channel scour depths at each crossing to evaluate the depth for burying the bridge piers and abutments. Implement scour-control measures to reduce erosion potential.
- Using quarry stone, cobblestone, or their equivalent for erosion control along rivers and streams, complemented with native riparian plantings or other natural stabilization alternatives to restore and maintain a natural riparian corridor.
- Placing bedding materials under the stone protection at locations where the underlying soils require stabilization as a result of stream-flow velocity.
- Reviewing and coordinating with NMFS where bank stabilization practices will occur in suitable habitat for threatened or endangered species under NMFS jurisdiction.

AMM-GEN-34: Conduct Land Cover and Habitat Verification

Under supervision of the project biologist, designated biologists or general biological monitors will verify the mapped land cover and habitats for federally listed species. Throughout the project footprint, this verification will be conducted prior to ground-disturbing activities.

AMM-GEN-35: Conduct “Take” Notification and Reporting

The USFWS, NMFS, or both will be notified as soon as practicable, but no later than within 24 hours, by telephone and email, after discovery of a project-related accidental death or injury of a federally or state-listed species during project-related activities.

AMM-GEN-36: Restore Temporary Riparian Impacts

Within 90 days of completing construction in a work area, the project biologist will direct the revegetation of any riparian areas temporarily disturbed as a result of the construction activities, using appropriate native plants and seed mixes. Native plants and seed mixes will be obtained from stock originating from local sources to the extent feasible. The project biologist will monitor restoration activities consistent with provisions in the RRP.

AMM-GEN-37: Restore Aquatic Resources Subject to Temporary Impacts

Within 90 days of the completion of construction activities in a work area, the Authority will begin to restore aquatic resources that were temporarily affected by the construction. Aquatic resources are those resources considered waters of the U.S. under the federal CWA or waters of the state under the Porter-Cologne Act. As set out in the RRP (AMM-GEN-28), such areas will be, to the extent feasible, restored to their natural topography. In areas where gravel or geotextile fabrics have been installed to protect substrate and to otherwise minimize impacts, the material will be removed, and the affected features would be restored. The Authority will revegetate affected aquatic resources using appropriate native plants and seed mixes (from local vendors where available) and conduct maintenance monitoring consistent with the provisions of the RRP.

AMM-GEN-40: Develop and Implement an Environmental Management System

To the extent feasible, the Authority is committed as part of the proposed action to identifying, avoiding, and minimizing hazardous substances in the material selection process for construction, operation, and maintenance of the HSR system. The Authority will use an environmental management system to describe the process that would be used to evaluate on an annual basis the full inventory of hazardous materials as defined by federal and state law and would replace hazardous substances with nonhazardous materials.

AMM-GEN-41: Minimize the Impacts of Operational Lighting on Wildlife Species

To address the permanent and intermittent impacts from artificial light at night, the Authority will implement measures to minimize the intensity and duration of operational lighting of permanent facilities (e.g., radio sites, maintenance facilities). Outdoor lighting at the LMF will be consistent with minimum Occupational Safety and Health Administration requirements established by 29 Code of Federal Regulations Section 1926.56 when the LMF is in use and would be limited to within 100 feet of the permanent facility. The Authority will minimize the duration of lighting at other operational facilities such as radio communications towers and traction control structures by using methods other than lighting (e.g., remote monitoring systems) to ensure security of facilities when they are not in use and by using shielding and downward direction.

As determined by the Authority, operational facilities, including trains, will use lighting that avoids shorter wavelengths of light (i.e., blue wavelengths). Lamps will have the lowest color temperature feasible for the desired application; green and red lighting appears to have the least wildlife impact and will be appropriate for some applications, such as security lighting (Kayumov et al. 2005, Longcore and Rich 2016).

1.3.6. Proposed Compensatory Mitigation

The Authority proposes to provide compensation and long-term habitat conservation for the permanent loss of various types of aquatic habitats that support sensitive and listed species from the project as proposed. Suitable habitat expected to be lost would be confirmed during pre-construction field surveys. An explicit goal is that compensatory mitigation ultimately provided will be commensurate with the type (freshwater/estuarine, rearing, migratory, or critical habitat) and amount of habitat lost.

CM-FISH-1: Provide Compensatory Mitigation for Permanent Impacts on CCC Steelhead Habitat, sDPS Green Sturgeon Habitat, and Essential Fish Habitat

The Authority would provide compensatory mitigation for permanent impacts on habitat for CCC steelhead, sDPS green sturgeon and EFH that is commensurate with the type (rearing, migratory, or critical habitat) and amount of habitat lost as follows:

- All rearing and migratory aquatic and riparian habitat within designated critical habitat would be protected and restored or protected and enhanced at a minimum of 2:1 (protected:affected).
- All other rearing and migratory aquatic and riparian habitat would be protected and restored or protected and enhanced at a minimum of 1:1 (protected:affected).

Unless agreed upon in coordination with NMFS, compensation would occur within the same DPS domain as the impact was incurred. Where feasible, on-site, in-kind mitigation would be prioritized, if possible. Off-site mitigation will prioritize actions recommended in local or regional conservation plans where there is coordination and approval by NMFS. Other options include the purchase of riparian and aquatic habitat credits at an NMFS-approved anadromous fish conservation bank, or another NMFS-approved conservation option, for the areal extent of riparian and suitable aquatic habitat affected by the project. In the event the Authority chooses not to utilize existing mitigation banks, it would propose other approaches to the applicable regulatory agencies for consideration. Any such approaches would take into account the following:

- Riparian habitat conditions that are consistent with the existing flow regime and maintain and improve habitat characteristics (e.g., shade, formation and maintenance of refugia)
- Local and regional conservation goals
- Long-term access for monitoring and maintenance
- Upstream and downstream conditions

Conservation options suitable to offset impacts on CCC steelhead and sDPS green sturgeon habitat and EFH would be considered in the development of the CMP (AMM-GEN-9), RRP (AMM-GEN-28) and flood protection plan (AMM-GEN-33).

In addition, the Authority proposes to provide compensatory mitigation for other wetland and aquatic habitat types negatively affected by the proposed action that are otherwise not accounted for in CM-FISH-1 (habitats within direct NMFS jurisdiction), but that may also provide additional benefit to anadromous fishes through improved conditions in upstream or adjacent aquatic habitats under other agencies' jurisdictions.

CM-RIPN-1: Provide Compensatory Mitigation for Permanent Impacts on Riparian Habitat

The Authority proposes to compensate for permanent impacts on riparian habitats at a ratio of 2:1, unless a higher ratio is required by agencies with regulatory jurisdiction over the resource.

Compensatory mitigation may occur through habitat restoration, the acquisition of credits from an approved mitigation bank, or participation in an in-lieu fee program.

CM-AQUA-1: Prepare and Implement a CMP for Impacts on Aquatic Resources

The Authority would prepare and implement a CMP that identifies mitigation to address temporary and permanent loss, including functions and values, of aquatic resources as defined as waters of the U.S. (WOTUS) under the federal CWA and waters of the state under the Porter-Cologne Act. Compensatory mitigation would prevent net loss of functions and values and may involve the restoration, establishment, enhancement, and/or preservation of aquatic resources through one or more of the following methods:

- Purchase of credits from an agency-approved mitigation bank
- Preservation of aquatic resources through acquisition of property
- Establishment, restoration, or enhancement of aquatic resources
- In-lieu fee contribution determined through consultation with the applicable regulatory agencies

The following ratios would be used for compensatory mitigation for aquatic resources unless a higher ratio is required pursuant to regulatory authorizations issued under Sections 404/10 of the CWA/Rivers and Harbors Act or the Porter-Cologne Act:

- Seasonal wetlands: between 1.1:1 and 1.5:1 based on impact type, function and values lost
 - 1:1 off-site for permanent impacts
 - 1:1 on-site and 0.1:1 to 0.5:1 off-site for temporary impacts
- All other wetland types: 1:1
- All non-wetland types: mitigated on-site at 1:1 or off-site 1:1 if on-site mitigation is not practicable.

For mitigation involving establishment, restoration, enhancement, or preservation of aquatic resources by the Authority, the CMP would contain, but would not be limited to, the following primary information:

- Objectives: A description of the resource types and amounts that would be provided, the type of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the proposed compensatory mitigation would address the needs of the watershed or ecoregion.
- Site selection: A description of the factors considered in selecting the location and spatial extent of the mitigation site(s).

- Adaptive management plan: A management strategy to address changes in site conditions or other components of the proposed compensatory mitigation.
- Financial assurances: A description of financial assurances that would be provided for the success of compensatory mitigation.

Additional information required in a CMP as outlined in 33 Code of Federal Regulations Section 332.4(c), as deemed appropriate and necessary by USACE would also be addressed in the CMP. In circumstances where the Authority intends to fulfill compensatory mitigation obligations by securing credits from approved mitigation banks or in-lieu fee programs, the CMP need only include the name of the specific mitigation bank or in-lieu fee program to be used, the number of credits proposed to be purchased, and a rationale for why this number of credits was determined appropriate.

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

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

2.1. Analytical Approach

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

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

The designations of critical habitat for CCC steelhead and sDPS green sturgeon use the terms 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 Part 424) replaced these terms with physical or biological features (which is now physical or biological features essential to the conservation of the species (PBFs); 50 CFR 424.02). The shift in terminology does not change the approach used in conducting a “destruction or adverse modification” analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

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

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

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would 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" as described in 50 CFR 402.02. 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.

More detailed CCC steelhead DPS and critical habitat listing information can be found at [NOAA Fisheries West Coast Region's protected species CCC steelhead page](#), and more detailed information concerning sDPS green sturgeon and their critical habitat listing information can be found at [NOAA Fisheries West Coast Region's protected species sDPS green sturgeon page](#).

Table 1. Description of species, ESA listing classifications, and summary of species status.

Species and Recovery Plan	Listing Classification and Code of Federal Regulations Citation	Status Summary
<p>Central California Coast steelhead (anadromous <i>Oncorhynchus mykiss</i>) DPS</p> <p>Final Coastal Multispecies Recovery Plan (NMFS 2016c); Volume IV: Central California Coast Steelhead (NMFS 2016d)</p>	<p>Threatened, 50 CFR 223.102</p>	<p>The CCC steelhead DPS description includes all naturally spawned anadromous <i>O. mykiss</i> (steelhead) originating below natural and man-made impassable barriers from the Russian River to and including Aptos Creek, and all drainages of San Francisco and San Pablo Bays eastward to Chippis Island at the confluence of the Sacramento and San Joaquin Rivers. Also, steelhead from two artificial propagation programs: The Don Clausen Fish Hatchery Program, and the Kingfisher Flat Hatchery Program (Monterey Bay Salmon and Trout Project) (50 CFR 223.102). As of 2016, the Don Clausen Hatchery was still in operations producing steelhead juveniles while Kingfisher Flat Hatchery operations had not occurred since 2014.</p> <p>Historically, approximately 70 populations supported the CCC steelhead DPS, with a possible abundance of nearly 100,000 spawning adults throughout its range, but since near the end of the 20th century substantial ubiquitous declines have been observed. Currently, the largest population (Russian River) may only see up to 7,000 adult returns while it is more common for most streams to host only 500 fish or less (NMFS 2016d). Their largescale decline has been attributed to a variety of factors but was primarily due to large-scale habitat degradation, historical overfishing, artificial propagation, and periodic climatic events like extended drought and poor ocean conditions. In 2016, a final recovery plan was completed for multiple coastal salmonid species, including CCC steelhead, and a recovery priority number of ‘5’ was assigned to this DPS and indicates a moderate risk of extinction (NMFS 2016d, c, 2017b). Recovery numbers are assigned based on a combination of the species’ demographic risk and their recovery potential, and lower recovery priority numbers indicate higher priority in recovery plan development and implementation.</p> <p>According to the most recent NMFS 5-year species status review (NMFS 2016a), the status of the CCC steelhead DPS has not changed since 2011, as updated information did not indicate a change in the biological risk category in either direction. The scarcity of CCC steelhead population abundance time-series data continues to hinder trend detection attempts. Steelhead still occur in the North Coastal and Interior strata and, based on more recent information, perhaps the population of the Santa Cruz Mountain stratum is larger than previously thought. 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 (NMFS 2016d).</p>
<p>North American green sturgeon</p>	<p>Threatened, 50 CFR 223.102</p>	<p>The sDPS of North American green sturgeon consists of green sturgeon originating from the Sacramento River basin and from coastal watersheds south of the Eel River (exclusive) (50 CFR 223.102), with the</p>

Species and Recovery Plan	Listing Classification and Code of Federal Regulations Citation	Status Summary
<p><i>(Acipenser medirostris)</i> sDPS</p> <p>Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon <i>(Acipenser medirostris)</i> (NMFS 2018)</p>		<p>only known spawning population in the Sacramento River watershed (spawning observed in the mainstem of the Sacramento River and also in its tributaries the Feather River and Yuba River) (NMFS 2015, 2021). After initial ocean entry, subadult and adult green sturgeon spend most of their lives in oceanic environments where they occupy nearshore coastal waters along the entire US West Coast (Colway and Stevenson 2007, Rosales-Casian and Almeda-Jauregui 2009). Within the nearshore marine environment, sDPS green sturgeon prefer marine waters of less than 100 meters depth (Erickson and Hightower 2007), especially coastal bays and estuaries for feeding and thermal refugia (Kelly et al. 2006, Moser and Lindley 2006, Lindley et al. 2008, Kelly and Klimley 2011, Lindley et al. 2011, Schreier et al. 2016). There are no hatchery populations that augment sDPS abundance.</p> <p>A recovery priority number of a ‘5’ was assigned to the sDPS and its population trend was noted as ‘stable’ in the latest NMFS Biennial Report to Congress on the Recovery of Threatened and Endangered Species 2015-2016 (NMFS 2017b). However, this report to Congress also included a proposal to change its recovery priority number to ‘7’. There is not a reliable estimate of the historical population abundance of sDPS green sturgeon (NMFS 2018), but a recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so the species can be evaluated relative to recovery criteria (Mora et al. 2015, Mora et al. 2018). The recovery criteria set for the sDPS is for a minimum adult population census of 3,000 or more individuals for three generations (or at least 500 individuals spawning in any given year), and to have consistent spawning occur in at least one additional location outside of the mainstem of the Sacramento River (NMFS 2018). In 2018, a total of 2,106 adults were estimated for the sDPS (NMFS 2021). Presumed sDPS green sturgeon have been documented in other river systems within the sDPS’s range from self-reported recreational catches in the San Joaquin River and Napa River. It is possible the San Joaquin River also supported spawning historically but no documentation exists to date. San Joaquin River tributaries contain habitat attributes that could also support green sturgeon; in 2017 a single adult individual was recorded in the Stanislaus River (Anderson et al. 2018) and in 2020 an adult green sturgeon was captured in a fyke trap in the San Joaquin River near the Merced River confluence (personal communication, received via email April 11, 2020 (Stuphin 2020)).</p>

Species and Recovery Plan	Listing Classification and Code of Federal Regulations Citation	Status Summary
		<p>According to the most recent NMFS 5-year species status review and the final recovery plan (NMFS 2018, 2021), some threats to the species have been reduced, such as take from commercial fisheries and removal of some passage barriers. Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather River for the first time in 2011. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the majority of spawning continues to occur in the Sacramento River mainstem. Current threats include poaching, continued habitat truncation from persisting passage impediments or dams, poor water quality and prey contamination, habitat degradation, and climate change. Therefore, no change to the status of the sDPS green sturgeon was proposed in the most recent status review; its status as ‘threatened’ remains applicable (NMFS 2021).</p>

Table 2. Description of designated critical habitat, designation date and notice, and status summary.

Critical Habitat	Code of Federal Regulations Citation	Description
CCC steelhead critical habitat	50 CFR 226.211	<p>Designated critical habitat for CCC steelhead includes a total of 1,465 miles of stream habitat and 386 square miles of estuarine habitat in 46 watersheds (70 FR 52488, September 2, 2005). This encompasses most, but not all, occupied habitat but excludes some occupied habitat based on economic considerations within its range: Russian River 5th Field HUC 1114, Bodega 5th Field HUC 1115, Marin Coastal 5th Field HUC 2201, San Mateo 5th Field HUC 2202, Bay Bridges 5th Field HUC 2203, Santa Clara 5th Field HUC 2205, San Pablo 5th Field HUC 2206, and Big Basin 5th Field HUC 3304. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (50 CFR 226.211).</p> <p>PBFs considered essential to the conservation of the species include: freshwater spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine areas.</p> <p>Degraded habitat conditions were one of the primary factors for listing the DPS and all life stages of CCC steelhead are still currently impaired by lack of complexity/shelter (in-stream large woody material (LWM)), high sediment loads, degraded water quality, lack of winter refugia, and reduced access to historic spawning and rearing habitats (NMFS 2016d, b, c). Habitat conditions are the most degraded in the Santa Cruz Mountains and San Francisco Bay strata. Restoration of steelhead habitat, including fish passage improvements, water conservation, and improvement of instream features has occurred periodically and improved critical habitat functionality, but only in those limited areas (NMFS 2016d). Notably, the development of the 2014 Groundwater Sustainability Management Act is expected to help alleviate the over extraction of aquifers upon which cold water fisheries such as CCC steelhead depend, though it may be some time before beneficial effects are seen.</p>

Critical Habitat	Code of Federal Regulations Citation	Description
sDPS green sturgeon critical habitat	50 CFR 226.219	<p>Critical habitat in freshwater riverine areas includes the stream channels and a lateral extent as defined by the ordinary high water line. Critical habitat includes the Sacramento-San Joaquin Delta. Critical habitat also includes the mainstem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Lower Feather River from the confluence with the mainstem Sacramento River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Lower Yuba River from the confluence with the mainstem Feather River upstream to Daguerre Dam. Critical habitat in coastal marine areas includes waters out to a depth of 60 fathoms, from Monterey Bay in California, north and east to include waters in the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are included as critical habitat for sDPS green sturgeon.</p> <p>PBFs in freshwater areas include: food resources, substrate type or size, water flow, water quality, migration corridor; water depth, and sediment quality. PBFs in estuarine habitats include: food resources, water flow, water quality, migratory corridor, water depth, and sediment quality. PBFs in nearshore coastal marine areas include: migratory corridor, water quality, and food resources.</p> <p>Widespread habitat modifications, altered river hydrographs, and loss of spawning habitat in the Sacramento and Feather Rivers were some of the reasons sDPS green sturgeon were listed as threatened (NMFS 2015, 2018, 2021). Habitat quality and accessibility factors in their freshwater range are ranked by the Recovery Team as very high threats currently impeding the recovery of the population. Large dams and flow dependent barriers in the Sacramento, Feather, and Yuba rivers have been identified as limiting the population’s access to spawning and rearing habitat, and therefore limiting reproductive potential. Water flow amount and temperature management in the Sacramento River directly relates to successful egg development and hatching; however, uncertainty and multiple species needs on this system have prevented a flow prescription for sDPS green sturgeon needs. Repeated stranding of adults, requiring their capture and relocation, after high flow events regularly occur in the Yolo and Sutter bypasses due to inadequate passage structures/modifications. In estuarine and nearshore marine environments, alteration of the prey base through the introduction of non-native species, poor water quality and sediment contamination, and shoreline development continue to degrade the habitat available to the DPS. Although the current conditions of PBFs for sDPS green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.</p>

2.2.1. Global Climate Change

Another factor affecting the rangewide status of CCC steelhead and sDPS green sturgeon, and the aquatic habitats upon which they depend, is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Hayhoe et al. 2004, Moser et al. 2012, Bedsworth et al. 2018). While snowmelt from the Sierra Nevada has declined, total annual precipitation amounts have shown no discernable change (Kadir et al. 2013). Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995), and modeling of climate change 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, Bedsworth et al. 2018). Total precipitation in California may decline while critically dry years may increase (Lindley et al. 2007, Moser et al. 2012, McClure et al. 2013, Bedsworth et al. 2018). Wildfires are also expected to increase in frequency and magnitude (Westerling et al. 2006, Westerling and Bryant 2007, Allen et al. 2010, Westerling et al. 2011, Moser et al. 2012, Bedsworth et al. 2018), and are expected to negatively impact forested watersheds that remain mostly undeveloped.

In the San Francisco Bay region³, warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan et al. 2012, Ackerly et al. 2018). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan et al. 2012). CCC steelhead, which utilize coastal streams/hydrologic units for spawning and rearing, are almost completely dependent on annual precipitation amounts, without summer snowpack. As annual precipitation amounts vary, lessen, and/or become truncated to core winter months, the availability and accessibility of freshwater habitat is expected to greatly decrease as favorable water years become infrequent.

The Anderson Cottonwood Irrigation Dam (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River, which does depend on snowmelt during summer months. The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher than ACID during late spring and summer. Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected. Their embryonic and larval life stages are most vulnerable to warmer water temperatures as both stages occur during peak summer temperatures, so this run is particularly at risk from climate warming.

³ The action area is on the interior of the San Francisco Peninsula, from downtown San Francisco to the San Jose-Santa Clara region. Both the San Francisco Bay and San Jose region exhibit similar Mediterranean climate patterns.

Estuaries, including seasonally closed lagoons, may also experience changes detrimental to the survival and success of salmonids and green sturgeon. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002, Ruggiero et al. 2010). Continued sea level rise (0.42 to 1.67 meters by 2100) is expected to cause sandbars to form farther inland which can affect the amount of time lagoons are connected to the ocean (Dalrymple et al. 2012, Rich and Keller 2013). In marine and nearshore environments, ecosystems and habitats important to salmonids and sturgeon success are likely to experience changes in temperatures, pH, circulation, water chemistry, and food supplies (Feely et al. 2004, Osgood 2008, Abdul-Aziz et al. 2011, Doney et al. 2012, Turley 2018). The projections described above are for the mid to late 21st Century; in shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Santer et al. 2011).

In summary, observed and predicted climate change effects are generally detrimental to the anadromous species under examination (McClure 2011, Wade et al. 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. CCC steelhead and sDPS green sturgeon may have already experienced some detrimental impacts from climate change, especially during extended recent droughts. The threat to the existence of these anadromous fishes from global climate change will increase into the future. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure et al. 2013) and should be included in baseline considerations.

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). All GPS locations provided are approximate.

The San Francisco to San Jose HSR project extent begins northwest of the existing San Jose Diridon train station on Scott Boulevard (37.363521°, -121.959536°) in Santa Clara, California, and ends at the 4th and King Station (37.776653°, -122.394829°) in San Francisco, California. The action area includes all areas containing the HSR route alignment, all waterway crossings, track and bridge expansions, and all necessary features (the railway, embankments, aerial viaducts, trenches, or tunnels); new stations or station upgrades; parking lots; the Brisbane LMF (37.695636°, -122.398081°); all ancillary features (TPSS, switching/paralleling stations, and communication/control stations); the necessary electrical interconnections, infrastructure, and upgrades; general network upgrades; wildlife crossings; all necessary modifications to existing highway, roads, and other railways; all HSR permanent and temporary ROW/TCEs; and all temporary and permanent access roads. Because construction and operational impacts have potential to impact aquatic species and habitats outside of the project extent footprint through water quality and underwater sound impacts, an additional 2,000 feet around all project components, and both up and downstream of waterway crossings, is also included as part of the action area to encompass these effects.

There are at least 30 alignment interactions or crossings over waterways or drainages that are expected to have some amount of effect on species or habitats under NMFS jurisdiction. Most of these waterways are currently considered ‘constructed’ or have been reduced to stormwater drainages through prior urban/commercial/railroad development, the effects of which are considered already existing in the environmental baseline. These small waterways will drain to waterways which may contain individual steelhead or green sturgeon, their designated critical habitats, and eventually the San Francisco Bay, and are therefore included in the action area.

The proposed route (EIR/EIS Preferred Alternative A (Authority 2019a), Figure 1) will be examined from south (Scott Boulevard, closest in connection to the San Jose Diridon Station) to north (ending at the 4th and King Station), as if traveling the proposed route from San Jose to San Francisco. There are approximately twelve overcrossings of, or close proximity of HSR buildings or infrastructure to, waterways that may contain steelhead, green sturgeon, or affect their critical habitats. Locations at which interactions with species and habitats under NMFS jurisdiction are:

- 1) a crossing over Stevens Creek (37.391976°, -122.069729°; Figure 5);
- 2) a crossing over San Francisquito Creek (37.447218°, -122.170364°; Figure 6);
- 3) a crossing over San Mateo Creek (37.568884°, -122.324729°; Figure 7);
- 4) a crossing over Easton Creek (37.590098°, -122.368686°; Figure 8);
- 5) a crossing over Mills Creek (37.591883°, -122.372998°; Figure 8);
- 6) Millbrae Station and associated upgrades/modifications (37.600288°, -122.386854°; Figure 3 & Figure 9);
- 7) a crossing over Colma Creek (37.649438°, -122.410131°; Figure 10);
- 8) a crossing near Oyster Point Channel (37.668306°, -122.393015°; Figure 11);
- 9) a crossing over Guadalupe Valley Creek and the Brisbane LMF construction near Brisbane Lagoon (37.686901°, -122.398910°; Figure 4 & Figure 12)
- 10) Brisbane LMF/Visitacion Creek (37.695959°, -122.397060°; Figure 13)
- 11) a crossing near Islais Creek Channel (37.748008°, -122.393074°; Figure 14), and
- 12) a crossing near China Basin Channel/Mission Bay (37.770372°, -122.398396°; Figure 15).

The action area would also include any mitigation banks, conservation banks, or any areas restored through the payment of in-lieu fees or permittee-responsible areas restored, or funded by the Authority, to offset unavoidable adverse effects to special status species or habitats in this section. Since there are no NMFS-approved mitigation banks that offer appropriate species or habitat type credits for the impacted DPSs that also include the action area of the project within their service areas, and there are no in-lieu fee program locations identified that could provide credits suitable to offset expected impacts, the Authority expects to conduct permittee responsible restoration to offset said unavoidable impacts caused by this project section (Authority 2021i, c).

As described in Section 1.3.5 Proposed Conservation Measures of this opinion, since the CMP is being developed, the Authority has not yet selected any site(s) on which they propose to mitigate impacts to steelhead, green sturgeon, or their habitats. Therefore, it is unclear what areas would be affected by the proposed compensatory mitigation component of the Federal action and such areas cannot be included in the action area of the proposed action at this time (though proposed CM-FISH-1 does stipulate that any compensation would occur in the same DPS domain as where

the project impact was incurred). In the future, when a site(s) suitable for compensatory mitigation is confirmed, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, and at that time the action area will be revised to include the identified mitigation site, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center's programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017a) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

HSR project sections outside of the San Francisco to San Jose Project Section will be analyzed in their own biological opinions (Authority 2009, 2021i) as those sections are submitted to NMFS for review separately due to their independent utility and will not be included in the action area here.

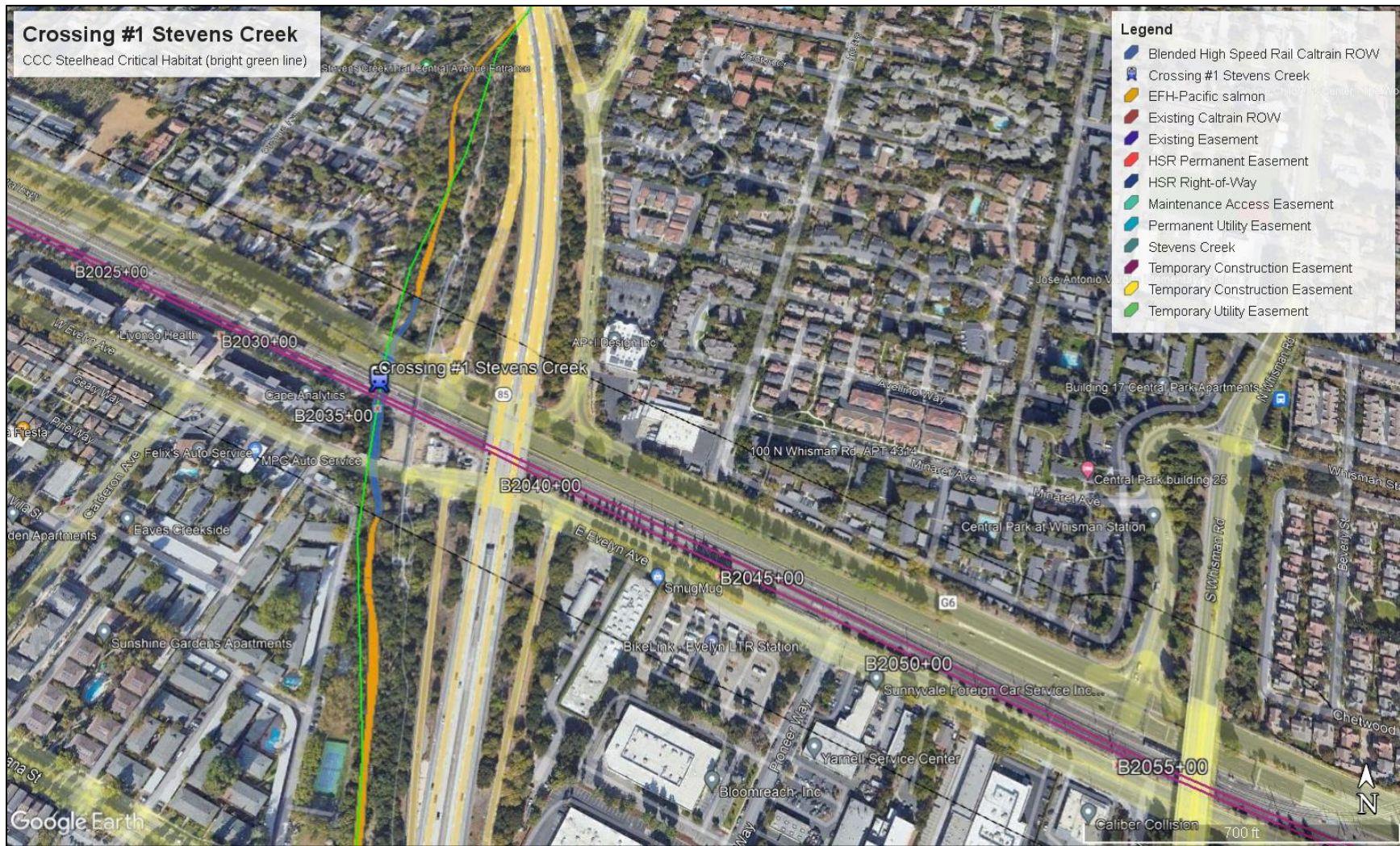


Figure 5. Stevens Creek Crossing #1. HSR to use existing at-grade tracks (maroon lines) that cross HWY 85 and Stevens Creek in Mountain View, California. Stevens Creek is CCC steelhead designated critical habitat (bright green line).

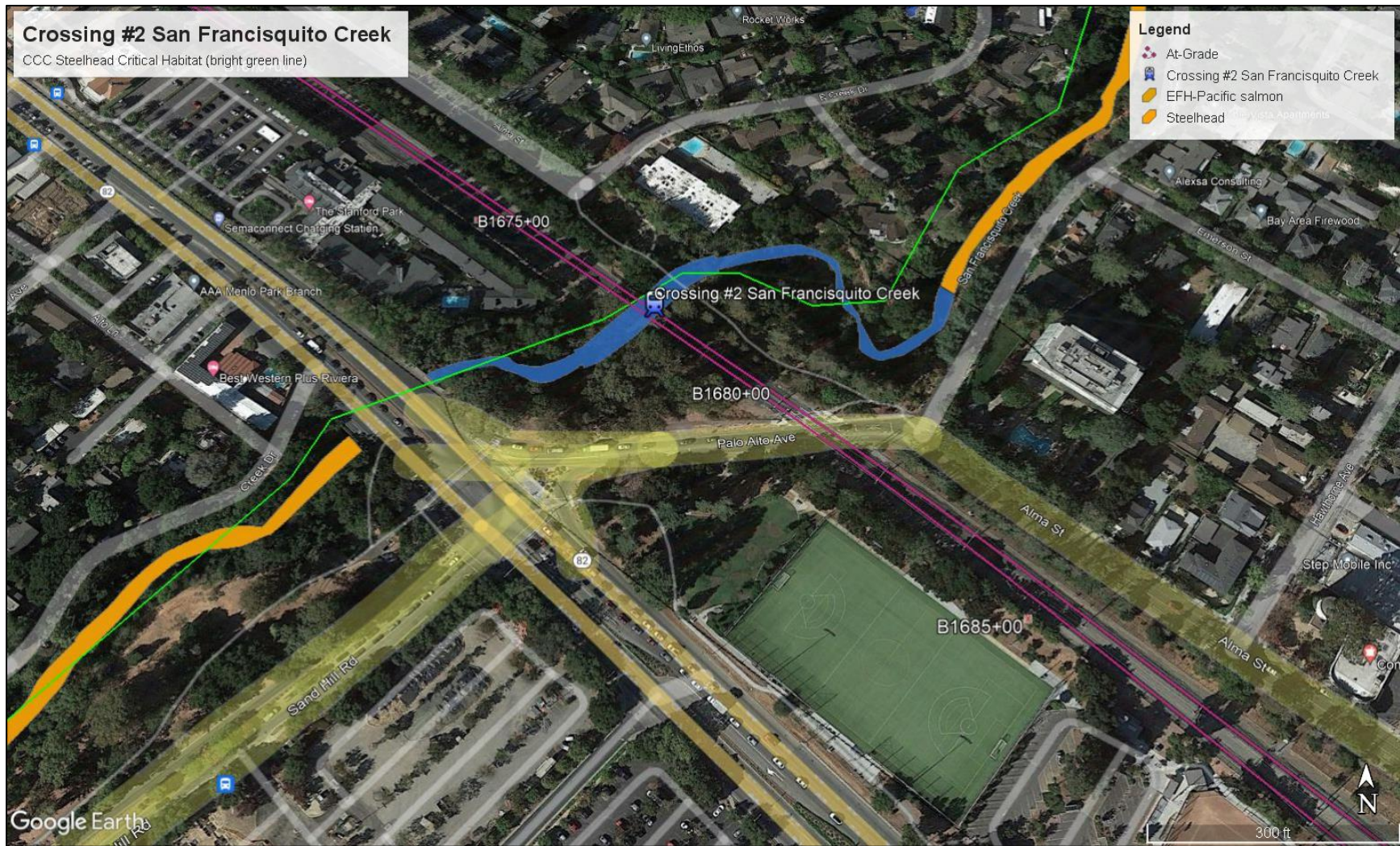


Figure 6. San Francisquito Creek Crossing #2. HSR to use existing at-grade tracks (maroon lines) that cross Palo Alto Avenue and San Francisquito Creek near HWY 82 in Menlo Park/Palo Alto, California. San Francisquito Creek is CCC steelhead designated critical habitat (bright green line).

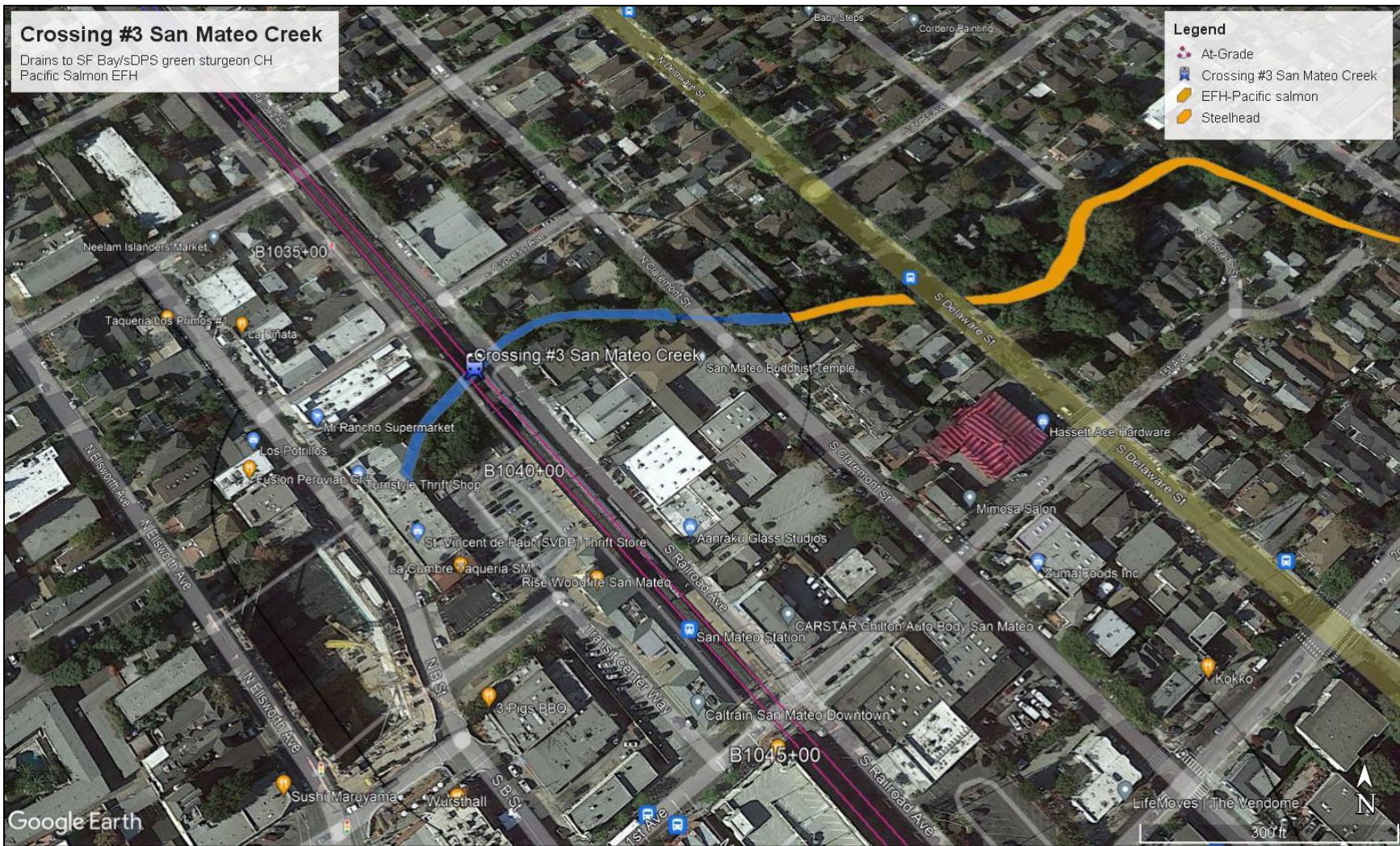


Figure 7. San Mateo Creek Crossing #3. HSR to use existing at-grade tracks (maroon lines) that cross San Mateo Creek near South Railroad Avenue and the San Mateo Station in San Mateo, California. San Mateo Creek drains to the San Francisco Bay estuarine waters (orange layer).

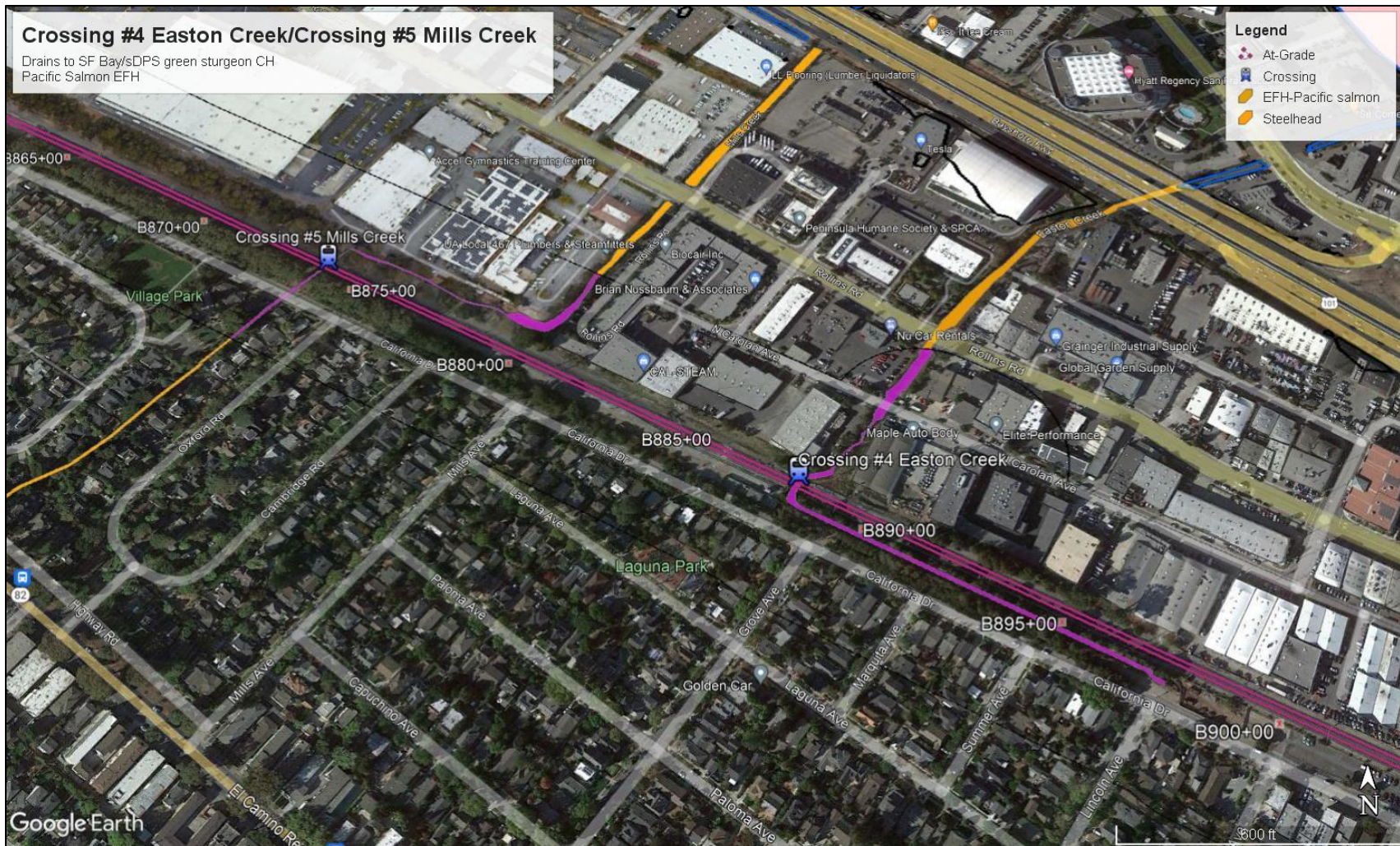


Figure 8. Easton Creek Crossing #4 and Mills Creek Crossing #5. HSR to use existing at-grade tracks (maroon lines) that parallel California Street in Burlingame, California, and cross Easton and Mills creeks. Both Easton Creek and Mills Creek drain to San Francisco Bay estuarine/marine waters and sDPS green sturgeon designated critical habitat (pink layer, upper right-hand corner).



Figure 9. Millbrae Station Location #6. HSR to use existing at-grade tracks (maroon lines) to service existing Millbrae BART Station. Areas to be altered in station redesign represented by multiple opaque layers. Highline Creek (now considered a constructed watercourse, vibrant magenta) drains to San Francisco Bay estuarine/marine waters and sDPS green sturgeon designated critical habitat (downstream of vibrant orange sturgeon layer).

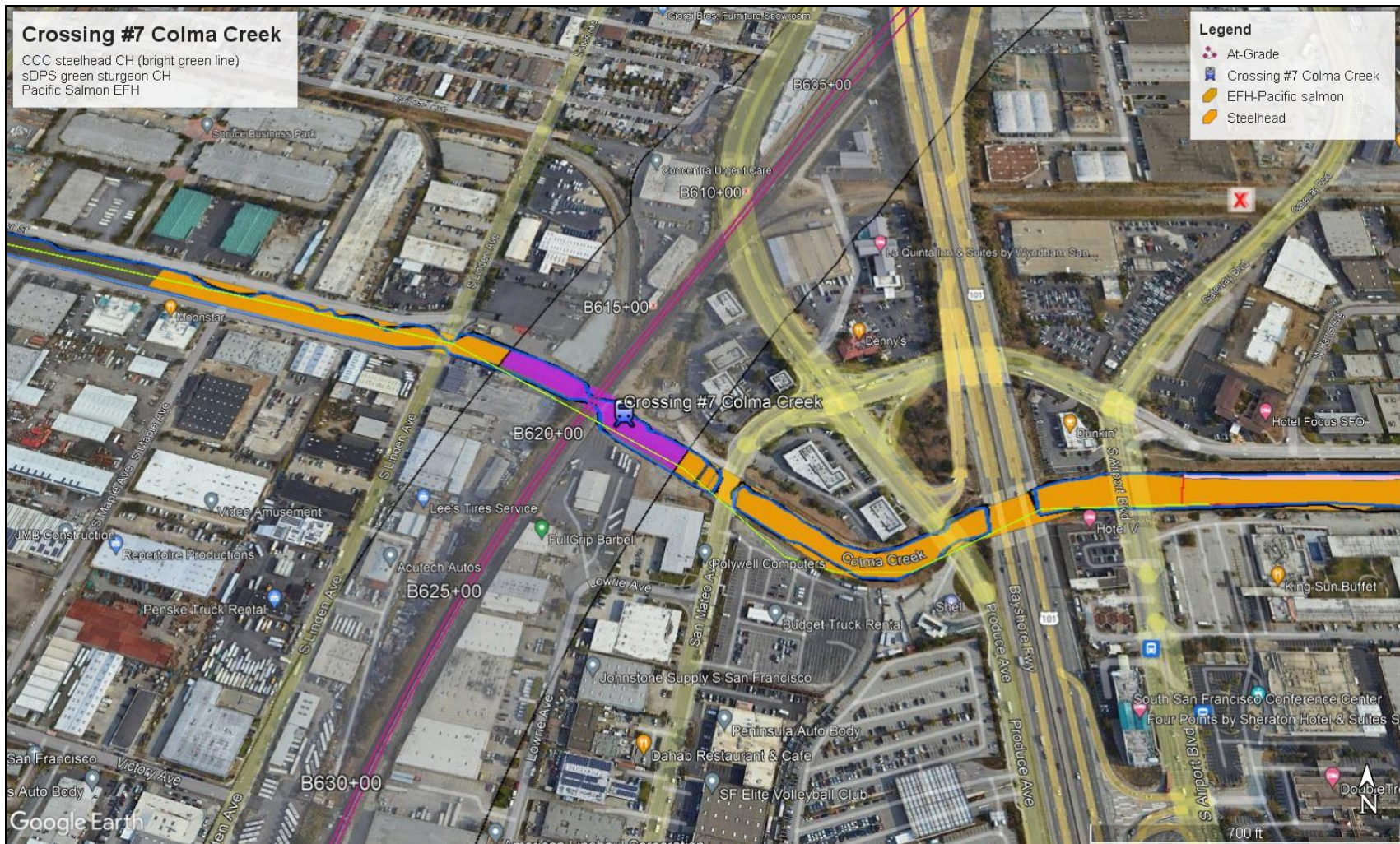


Figure 10. Colma Creek Crossing #7. HSR to use existing at-grade tracks (maroon lines) to cross Colma Creek between Linden Avenue and San Mateo Avenue west of HWY 101 in South San Francisco, California. Colma Creek is sDPS green sturgeon designated critical habitat (bright green line).

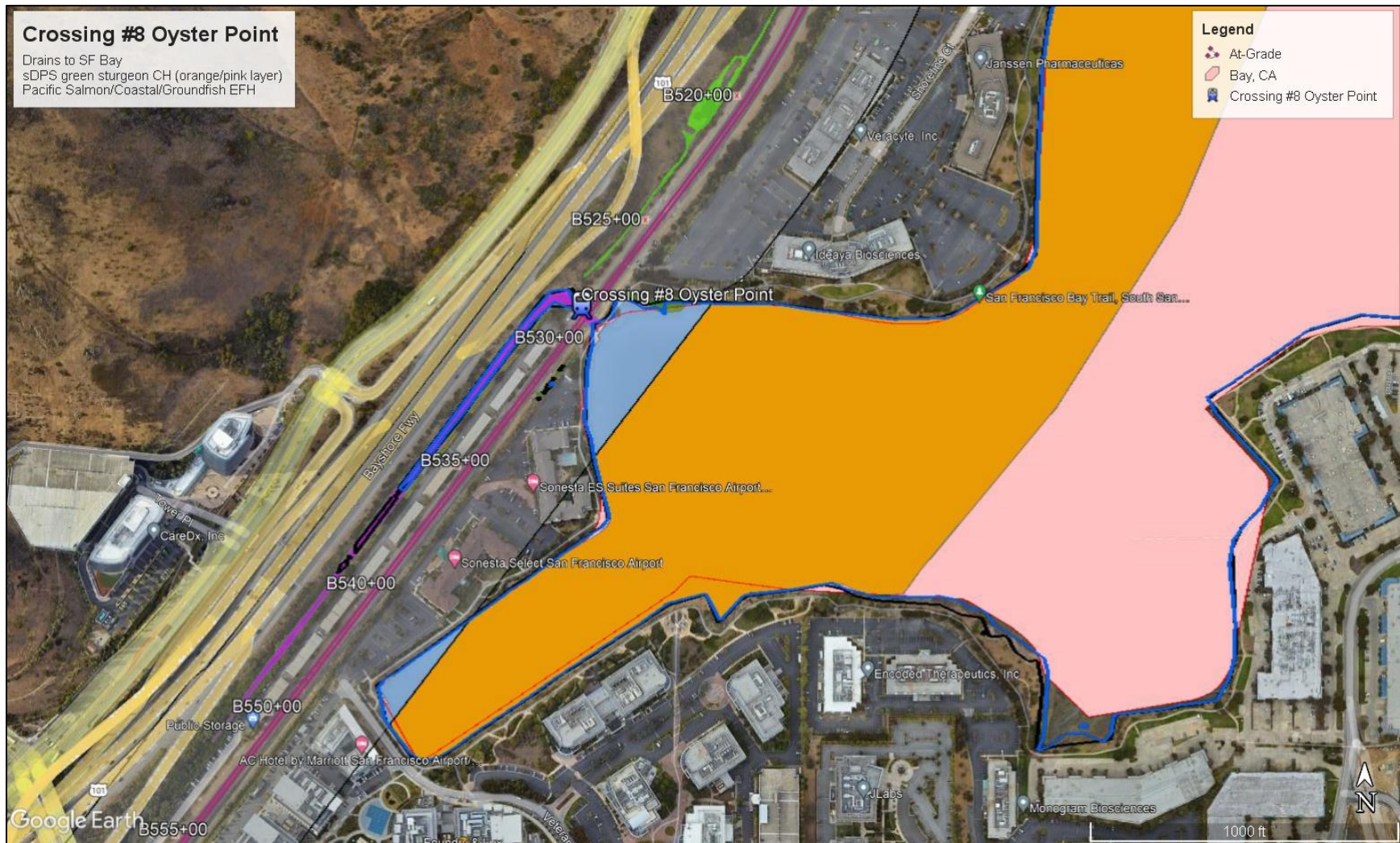


Figure 11. Oyster Point Crossing #8. HSR to use existing at-grade tracks (maroon lines) to cross an Oyster Point tidal drainage east of HWY 101 and south of Brisbane Marina in South San Francisco, California. Oyster Point Channel is considered sDPS green sturgeon designated critical habitat (blue/orange/pink layers).



Figure 12. Guadalupe Valley Creek/Brisbane Lagoon Crossing #9. HSR to use existing at-grade tracks (maroon lines) to cross the Guadalupe Valley Creek discharge outlet into Brisbane Lagoon near Tunnel and Bayshore Boulevard in Brisbane, California, south of the proposed Brisbane LMF location. These waterways are tidally influenced and are considered sDPS green sturgeon designated critical habitat (pink layer: Bay, CA).

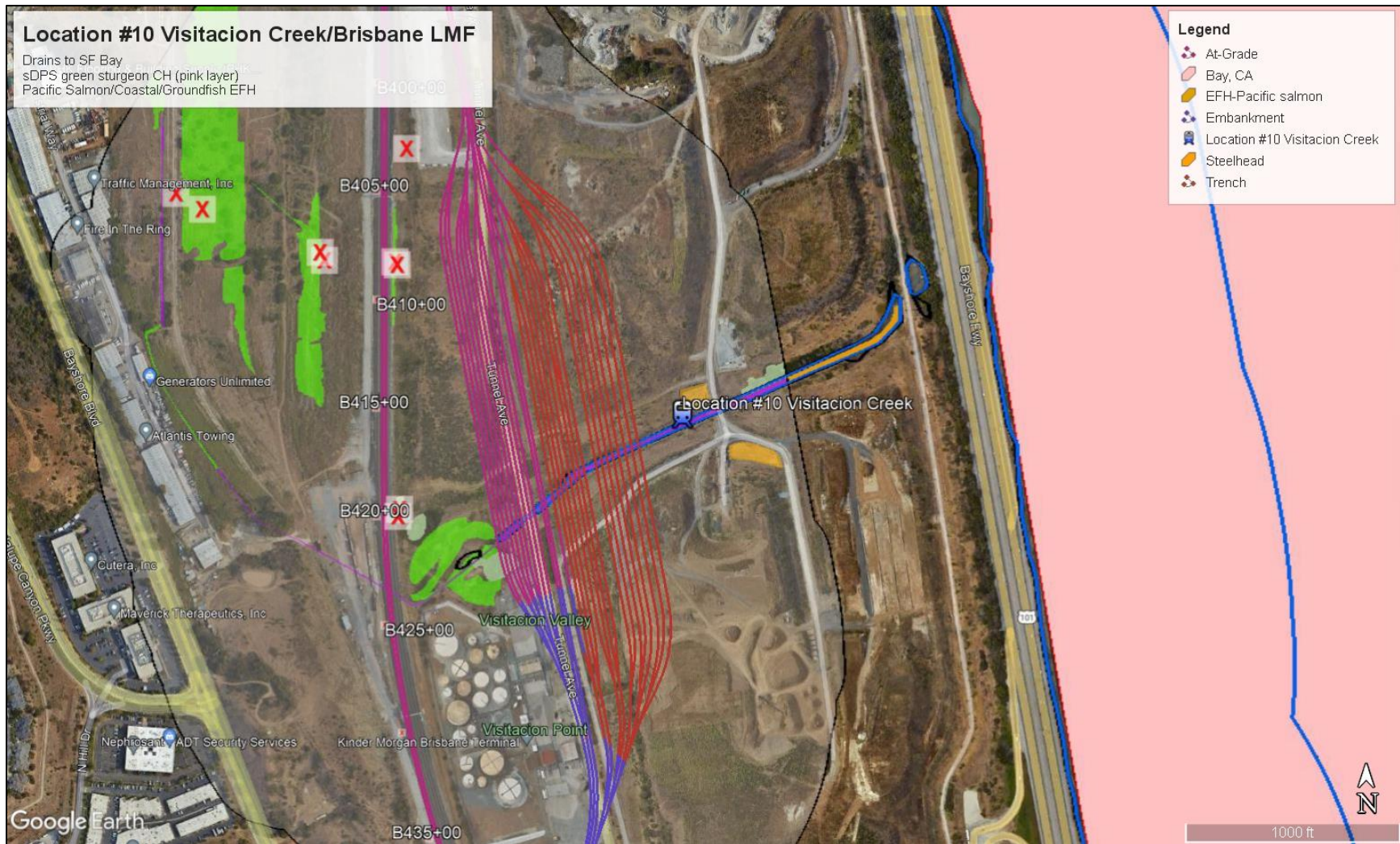


Figure 13. Visitation Creek/Brisbane LMF Location #10. HSR to use existing at-grade tracks (far left-hand side maroon lines: At-Grade) and place new track lines (red: Trench, purple: Embankment) for entrance/exit to proposed Brisbane LMF (transparent white area). Visitation Creek drains into the San Francisco Bay and is considered sDPS green sturgeon designated critical habitat because it is tidally influenced (pink layer: Bay, CA).

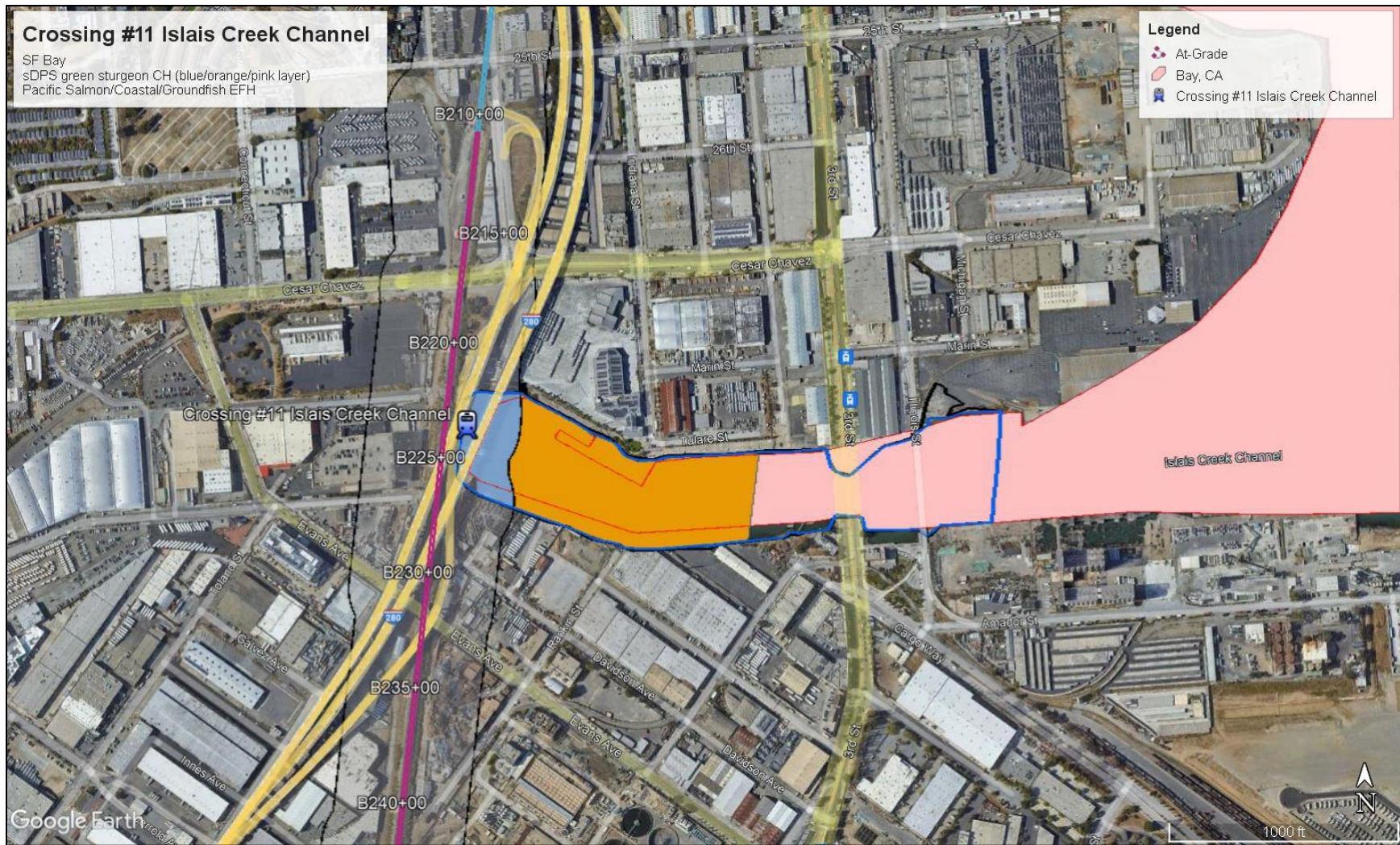


Figure 14. Islais Creek Channel Crossing #11. HSR to use existing at-grade tracks (maroon lines) to directly west of San Francisco Bay waters under HWY 280 in San Francisco, California. Islais Creek Channel is considered sDPS green sturgeon designated critical habitat (blue/orange/pink layers).

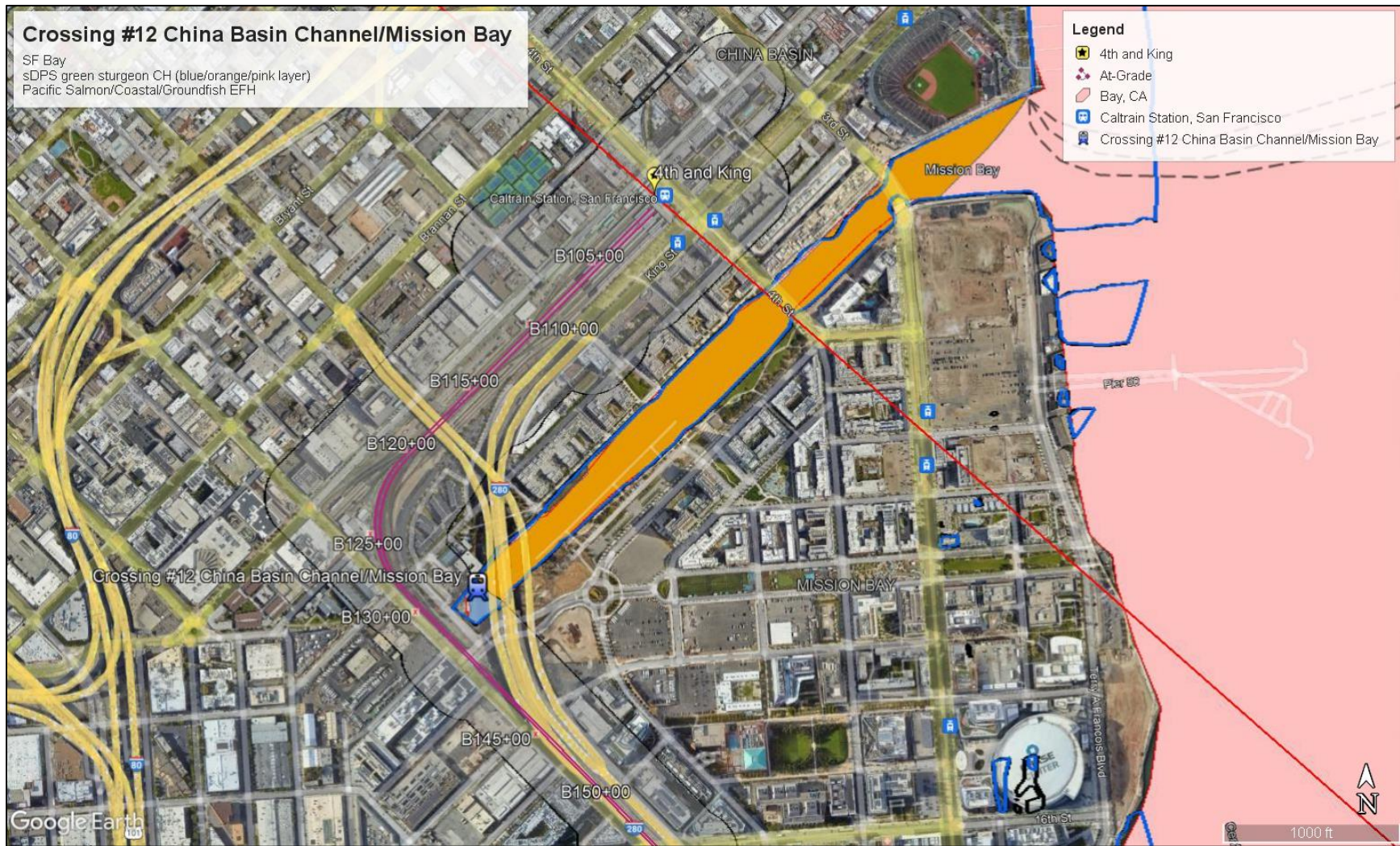


Figure 15. China Basin Channel/Mission Bay Crossing #12. HSR to use existing at-grade tracks (maroon lines) to directly west of San Francisco Bay waters near HWY 280, south of the 4th and King Station terminus, in San Francisco, California. China Basin/Mission Bay Channel is considered sDPS green sturgeon designated critical habitat (blue/orange/pink layers).

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).

2.4.1. Status and occurrence of listed species and critical habitat in the action area

The federally listed anadromous species under NMFS jurisdiction that use and occupy the action area are adult and juvenile CCC steelhead and adult, subadult, and juvenile sDPS green sturgeon (egg and larval stages are not expected within the bounds of the described action area).

2.4.1.1 CCC steelhead

In general, steelhead are described as a highly migratory species that exhibits a great amount of variation in the time and location spent at each life history stage compared to other members of the *Oncorhynchus* genus. Like other Pacific salmonids, they follow an anadromous life history pattern of adults spawning in freshwater streams, juveniles undergoing physiological changes that allow them to migrate, feed, and mature in the ocean, to eventually return to their natal waters to complete the cycle and reproduce. While this basic life history pattern is observed by the species, the life history strategies of steelhead are extremely variable between individuals. In addition, steelhead are iteroparous (i.e., can spawn more than once in their lifetime (Busby et al. 1996)) and therefore may be expected to emigrate back down the system after spawning. As such, the determination of the presence or absence of steelhead in the action area accounts for both upstream and downstream migrating adult steelhead (kelts).

Adult CCC steelhead express a winter-run ecotype and are considered ocean maturing. Ocean maturing adults enter freshwater with well-developed gonads ready for spawning (i.e., winter steelhead). Winter-run CCC steelhead immigrate December through April and spawn shortly thereafter (Sharpovalov and Taft 1954, Moyle et al. 2008). Adult winter steelhead freshwater presence varies but is correlated with higher flow events.

CCC steelhead spawning would be expected to occur from December through April in spawning reaches far upstream of the action area. Again, adults may be capable of iteroparity and kelts can return to the ocean after spawning. Therefore, kelt CCC steelhead may be expected in the action area as they pass through again, leaving the spawning areas for the ocean until May.

Eggs hatch in approximately 25 to 35 days depending on water temperatures, and alevins remain in the gravel redd for two to three weeks after hatching. The fry that emerge from the redd will then rear in edge water habitats and gradually move to deeper faster waters or other areas better

suited for rearing. Juvenile CCC steelhead will rear in freshwater and estuarine habitats for one to two years before completing the transition to a smolt and completing their migration out to the ocean. Many factors influence juvenile residence time; in low productivity systems juveniles may rear for more than two years to reach a minimum body size before leaving (McCarthy et al. 2009, Sogard et al. 2009). When juveniles are able to complete the physiological transition to a smolt, in the San Francisco Bay area they typically emigrate sometime between February and June, with peaks in April and May (Fukushima and Lesh 1998). Due to their extended freshwater residency, juvenile CCC steelhead may be present in the action area in any waterbody connected to San Francisco Bay estuarine waters, but especially in the Stevens Creek, San Francisquito Creek, and San Mateo Creek watersheds and adjacent connected areas.

Since the action area contains both freshwater and estuarine rearing habitat types for CCC juveniles, and migration corridors for adult CCC steelhead, individuals from these two life history classes may be encountered in the action area. Though CCC steelhead are present in the action area, their abundance has declined considerably since peak observations in the past. These populations are considered part of the Coastal San Francisco diversity strata (NMFS 2016d, a, c), which entirely lacks an estimate of adult abundance (Williams et al. 2016). The Stevens Creek population is considered an independent population while the San Francisquito Creek and San Mateo Creek populations are considered potentially independent. A population is considered independent when it has a high likelihood of persisting for 100 or more years and whose extinction risk is not substantially altered by exchanges of individuals with other populations. Both are considered essential to the recovery target set for the Interior Diversity Stratum (NMFS 2016d).

2.4.1.2 CCC steelhead critical habitat

The action area contains designated critical habitat that supports the freshwater and estuarine rearing and migration activities of CCC steelhead. PBFs include:

Freshwater rearing sites with:

Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;

Water quality and forage supporting juvenile development; and

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.

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.

Estuarine areas free of obstruction and excessive predation with:

Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;

Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and

Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The proposed HSR alignment crosses Stevens Creek (Crossing #1) and San Francisquito Creek (Crossing #2) on existing railroad bridges. Both of these creeks are designated critical habitat for CCC steelhead. Stevens Creek within the action area contains freshwater rearing habitat of poor quality and migration habitat of good quality. At times, it is also tidally influenced. San Francisquito Creek within the action area similarly contains freshwater rearing habitat of poor quality and migration habitat of fair quality. It is not considered estuarine habitat. Also, all accessible reaches with estuarine habitats and channels connected to the South San Francisco Bay within the action area are CCC steelhead designated critical habitat (Crossings #6 through #12) and these areas are generally considered estuarine habitat of poor quality but migration habitat of good quality.

The waterways used by the Coastal San Francisco Bay Diversity Stratum in the action area have experienced a vast amount of change that has degraded these habitats' ability to support steelhead needs. Streams that once naturally flooded and meandered around hillsides before reaching San Francisco Bay were hardscaped and straightened into channels. Extant bayside streams currently exist in urbanized settings which required flood control modifications and channelization. Dams blocking anadromy are present on many streams and are used for water supply, aquifer recharge, or recreational activities (The Coastal Conservancy 2004). The Stevens Creek Reservoir, constructed in 1935 and located only 8 miles upstream from the creek outlet, is an impassable barrier. Similarly, the Searsville Dam, constructed in 1890 and located approximately 13 miles from the San Francisquito Creek mouth, is also an impassable barrier. Additionally, numerous partial barriers exist downstream of these impassable dams on both creeks, which affect the movement adult and juvenile steelhead. Past and current urbanization, commercial and residential development, channel modifications, a high degree of road and railway densities, riparian vegetation removal, and a lack of large wood material continue to severely impair these waterway (NMFS 2016d, c).

In the past 150 years, the diking and filling of tidal marshes has decreased the surface area of the greater San Francisco Bay by 37 percent. More than 500,000 acres of the estuary's historic tidal wetlands have been converted for farm, salt pond, and urban uses (San Francisco Estuary Project Management Committee 1994, San Francisco Estuary Partnership 2016, 2022). These changes have diminished tidal marsh habitat, increased pollutant loadings to the estuary, and degraded shoreline habitat due to the installation of docks, shipping wharves, marinas, and miles of rock riprap for erosion protection. Though extensively degraded from their natural states, due to reduced accessibility and availability, any remaining freshwater or estuarine habitat designated as critical habitat has a high intrinsic value for the recovery of the species.

2.4.1.3 sDPS green sturgeon

The sDPS of the anadromous green sturgeon occurs along the western seaboard of the US. Non-spawning adult and subadult and sDPS green sturgeon spend much of their lives existing in marine and estuarine waters, and would be expected to use accessible areas that are tidally influenced in South San Francisco Bay within the action area. Tidal waters inland of the Golden Gate Bridge are considered part of the San Francisco Bay Delta Estuary (SFBDE). Adult and subadult sDPS green sturgeon are expected to occur in relatively large concentrations during the summer and autumn months in these habitat types within the action area, but otherwise have a year-round presence. Interestingly, both sDPS and Northern DPS (nDPS) green sturgeon individuals coexist in the West Coast marine environment, but the two DPSs only enter spawning areas of their respective natal rivers (Lindley et al. 2011). So, nDPS individuals may also be encountered within the action area, but the nDPS is not listed under the ESA.

Green sturgeon are long-lived (54 to 72 years old, maximum age range (Nakamoto et al. 1995)) and relatively late-maturing (approximately 15 years of age (Van Eenennaam et al. 2006)). Adult sDPS green sturgeon enter San Francisco Bay in late winter through early spring and spawn in the Sacramento River primarily from April through early July, with peaks of activity likely influenced by factors including water flow and temperature (Heublein et al. 2008, Poytress et al. 2011, Poytress et al. 2015). Post-spawn fish may hold for several months in the Sacramento River and out-migrate in the fall or winter, or move out of the river quickly during the spring and summer months, with the holding behavior most commonly observed (Heublein et al. 2008, Mora et al. 2015, Mora et al. 2018). Post-spawn outmigration through the SFBDE is also variable, with individuals migrating to the Pacific Ocean rather quickly (2-10 days) and others remaining in the estuary for a number of months after leaving upstream holding habitats (Heublein et al. 2008).

The juvenile life stage is from completed metamorphosis to first ocean entry. It is unknown how long juveniles remain in upriver rearing habitats after metamorphosis, but they likely spend the first year in freshwater environments. The ability to transition to seawater occurs at 1.5 years of age (Allen and Cech 2007). The subadult life stage begins at the first entry to the Pacific Ocean and extends until maturity is reached. In coastal bays and estuary habitat like those in the action area, adult and subadult green sturgeon feed on shrimp, clams, crabs, and benthic fish (Moyle et al. 1995, Dumbauld et al. 2008).

The status of the sDPS green sturgeon population in the action area is reflective of the overall status of the sDPS because the DPS is typified by its single reproductive population in the Sacramento River Basin, unlike steelhead populations which may be based on their origin/natal streams. See Table 1 for more detail.

2.4.1.4 sDPS green sturgeon critical habitat

The action area contains designated critical habitat of sDPS green sturgeon where it contains parts of the SFBDE and is tidally influenced. The PBFs within the action area include:

Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages.

Water flow. Within bays and estuaries adjacent to the Sacramento River (*i.e.*, the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.

Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.

Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats.

Depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages.

Sediment quality. Sediment quality (*i.e.*, chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

The proposed HSR alignment either crosses over SFBDE waters on existing tracks and bridges (Crossing #7 Colma Creek, Figure 10 and Crossing #8 Oyster Point, Figure 11) or runs nearby and drains to such habitat, locations #6 (Millbrae Station, Figure 9) through #12 (China Basin/Mission Bay Channel, Figure 15), in the action area. In addition, new overwater structures/bridges are being placed over tidally-influenced waterways for the Tunnel Avenue reroute (Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon) or such waterways are proposed for culverting and removal (Crossing #10 Visitacion Creek). Therefore, most of the alignment has potential to interact with sDPS green sturgeon SFBDE critical habitat because either: (1) the existing train tracks are so close to tidally-influenced water channels even when not directly crossing them, in many cases less than 1 mile upstream with culverts that drain to SFBDE waters; or (2) new habitat alterations will directly affect tidally-influenced waterways.

Currently, many of the PBFs of sDPS green sturgeon in the action area are degraded (NMFS 2018). In the SFBDE, habitat destruction, modifications, or curtailment are recognized as specific threats that have occurred on a wide spread scale, as referenced in the CCC steelhead critical habitat section above, through the implementation of channel control structures and impoundments, ubiquitously throughout the action area. Structures built to divert water and by upstream impoundments have changed flow patterns, channel morphology, and water depth/presence and salinity in certain areas. Localized flow patterns can impact habitat quality for the sDPS green sturgeon and flow may impact migration and movement. Non-native species introductions, global climate change, and contamination have altered the available prey base. Non-point source contamination from legacy contamination and continued inputs is a persistent threat to the functionality of the remaining critical habitat (NMFS 2015, 2018, 2021). For example, research conducted on white and green sturgeon has shown that many of the non-native food resources including the non-native overbite clam, *Corbula amurensis*, are either non-digestible (as separate issue, (Kogut 2008)) or, if digested, may expose green sturgeon to selenium at elevated concentrations compared to native clams (Linville et al. 2002, Lee et al. 2006, Linville 2006, Presser and Luoma 2010a, b, Linares-Casenave et al. 2015).

In summary, although the current conditions of listed salmonid and green sturgeon critical habitat are significantly degraded, the remaining migratory corridors and rearing and foraging habitat that remain in both the San Francisco Bay Interior watersheds and SFBDE areas are considered to have high intrinsic value for the conservation of these species.

2.4.2. Factors affecting listed species

A vast amount of urbanization has occurred throughout the action area, including a high percentage of streamside road densities. Both freight and passenger transit railroad lines are concentrated in the narrow strip of flat land between the Santa Cruz Mountains and the South San Francisco Bay (approximately 6 miles in width), along with several highways and expressways on top of urban and suburban surface streets. For example, at least 21 overwater structures ranging in size from that of a small foot bridge to the size of multiple-lane freeway overpasses and exchanges cross Stevens Creek, which is only about 12 stream miles in length in total from the base of Stevens Creek Reservoir to its exit into SFBDE waters. At least two of the overwater crossing structures support existing railroad lines. Nearly the creek's entire length is bordered by houses and subdivisions, or by roads and shopping centers, changing to freeways and other industry by the time it meets estuarine waters. Where larger riparian vegetation still remains, on average, only one mature tree makes up the riparian corridor between the freshwater channel and concrete. Some road and rail lines also encroach over or into tidal marshes via embankments or elevated trestles, in association with dikes and levees, to create artificial dry land. Ubiquitous use of these practices throughout the action area have effectively isolated the remaining marshlands and facilitated additional nearshore development.

Utilization of the water resources in the action area for human needs has also directly impacted the anadromous species that are dependent on these watersheds. In the San Jose-San Francisco Bay Area, water agencies rely on a diverse portfolio of both local and imported water sources (Ackerly et al. 2018). For example, approximately two-thirds of the action area's community water systems are small, self-sufficient and locally-sourced, and serve less than 10,000 people each (Ackerly et al. 2018), while the remaining deficit is sourced from the Sierra Nevada (Regional Water Management Group 2019) or is made available by groundwater desalination and non-potable water reuse. Local surface water flows in the action area are directly coupled to winter precipitation, which is highly variable year to year, and increasingly, climate change is affecting SWE availability from the Sierra Nevada. In an effort to address this tenuous system and increase the Bay Area's climate change resiliency, efforts are being undertaken to expand water storage and conveyance infrastructure locally while also increasing water recycling, desalination, groundwater augmentation and banking, water transfer, and stormwater harvesting abilities (Ackerly et al. 2018).

As such, there are several dams that form reservoirs to store and supply surface water for human needs as noted in the Sections 2.4.1.1 and 2.4.1.2. The existing water infrastructure and management has altered and currently controls the hydrographs experienced by steelhead in their accessible habitats, often to the detriment of oversummering steelhead juveniles. Because green sturgeon do not depend on San Jose-San Francisco Bay watersheds for spawning purposes, they are somewhat unaffected by the water management decisions of the area.

2.4.3. Conservation and restoration efforts in the action area

The Santa Clara Valley Water District (SCVWD) is the primary water resource agency that operates water conveyance infrastructure (including the Stevens Creek reservoir), performs stewardship duties, and provides flood control services in and affecting the action area. Additionally, the SCVWD was in the process of drafting a Habitat Conservation Plan (HCP); however, progress on this effort is currently on hold. Additionally, CDFW has been active in performing stream surveys, and several public interest groups, including Santa Clara Valley Audubon Society, CLEAN South Bay, Santa Clara County Creeks Coalition, and the California Nature Conservancy, are active in the watershed.

Stanford University is the largest landowner in the San Francisquito Creek watershed, occupying 8,000 acres spanning both counties. Stanford operates several water facilities in the watershed for the purpose of diverting and storing water for landscape irrigation and fire control. In 2008, Stanford submitted applications to NMFS and the U.S. Fish and Wildlife Service for ESA section 10(a)(1)(B) incidental take permits, and a draft HCP was submitted in support of their applications. In December 2012, Stanford requested that NMFS suspend the processing of their application pending completion of the Searsville Dam alternatives study to address the long-term future of the dam and reservoir. There is substantial public interest in improving the habitat for steelhead in San Francisquito Creek and its tributaries. There have been several studies aimed at assessing and improving water quality and fisheries habitat in the watershed. Additionally, there are several watershed groups active in the watershed: Acterra, Beyond Searsville Dam, and the San Francisquito Watershed Coalition (a project of Acterra). These groups conduct education, outreach and restoration activities in the greater San Francisquito watershed area (The Coastal Conservancy 2004, NMFS 2016d, c).

There are also numerous federal, public, and non-governmental organization efforts underway to conserve or restore the SFBDE, too numerous to summarize here. Though outside of the action area (but to the benefit of green sturgeon that would use the action area), the South Bay Salt Pond Restoration Project is underway to restore over 15 thousand acres of industrial salt ponds (The South Bay Salt Pond Restoration Project 2022). The first salt pond reconnection was achieved in 2006 and since then over 3 thousand acres of tidal marshes have been restored (Pearlman 2019). The SFBDE is also one of 28 estuaries in the EPA's National Estuary Program, which are place-based programs that develop and implement a Comprehensive Conservation and Management Plan (CCMP) to establish priorities on activities, research, and funding needs in each estuary. The San Francisco Estuary Partnership is currently updating the 2016 CCMP (San Francisco Estuary Project Management Committee 1994, San Francisco Estuary Partnership 2016) with the 2022 Estuary Blueprint Update.

2.4.3.1 NMFS recovery plans

Recovery is the process by which listed species and their ecosystems are restored to the point that the protections provided by the ESA are no longer necessary to ensure their continued existence. Recovering anadromous species like steelhead in the San Francisco-San Jose Area is challenging due to the area's large and expanding human population, its large percentage of landscape being highly urbanized, the increasing demand for housing that leads to development of the remaining natural and pervious (agricultural) areas, the associated amount and extent of

water use and manipulation, and legacy habitat damage that still persists and continues to inhibit steelhead population recovery (NMFS 2013, 2016d, c, 2018).

In the recovery plans for these species (NMFS 2016d, 2018), NMFS established delisting/recovery criteria for CCC steelhead and sDPS green sturgeon, including that CCC steelhead must have robust, viable populations in San Francisquito Creek and its tributaries. Though there are many more recovery actions that are directed to restore the marine, estuarine, and freshwater systems that these species depend on (described fully in their respective recovery plans), there are a series of actions/efforts that must be completed specific to these populations for them to successfully establish and persist.

Pertinent DPS-wide recovery actions for CCC steelhead in the action area include:

- Rehabilitate and reclaim tidal marsh habitat through levee breaching and tidal channel creation, develop and implement estuary inflow and enhancement guidelines.
- Enhance floodplain connectivity by finding opportunities for planned retreat of current urban development due to sea level rise, and encouraging county zoning to consider the 20-year and 100-year flood zones to identify protective and compatible land use designations.
- Improve flow conditions by working with partners to reduce stormwater runoff by removing impervious surfaces and creating or expanding flood retention land and groundwater recharge basins, minimizing impacts to fisheries resources by integrating hydro-modification concerns into development planning, and improved coordination with SWRCB to establish and manage flows that fully protect salmonids.
- Modify or remove physical passage barriers at all new crossing and upgrades to existing bridges, culverts, fills, insufficient fish ladders, etc., to accommodate 100-year flood flows and use NMFS (2011) Salmonid Passage Guidelines in their designs or retrofits.
- Improve habitat complexity and riparian conditions through fish restoration projects and funding, by working with other agencies and landowners to keep beavers on the landscape with non-lethal damage management tactics, preserving older large diameter trees for canopy cover, and developing adequately sized riparian setbacks and buffers.
- Improving water quality by reducing toxicity, pollutants, and sediment.

For the San Francisquito Creek watershed specifically:

- Develop and implement steelhead passage at Searsville Dam on Corte Madera Creek and the Upper Diversion Dam on Bear Gulch; doing so would restore access to 11 miles of historical steelhead spawning and holding habitat of high quality.
- Increase habitat complexity for the benefit of summer and winter rearing juveniles in poor quality reaches by adding large woody debris in existing pool habitats, creating side channels and flood benches, and install wood/boulder structures to increase pool frequency and volume.

- Improve riparian vegetation composition and structure to increase stream shading and large woody debris recruitment by planting native riparian species and enforcing riparian buffers.
- Inset floodplain terraces where the creek is incised and disconnected from historic floodplain; reaches currently channelized should be enhanced with constructed meanders and installations of wood and rock habitat features.

For Stevens Creek watershed specifically:

- Address passage barriers downstream of Stevens Creek Dam systematically and opportunistically, specifically by remediating concrete flood control channels in lower reaches.
- Enable steelhead passage upstream of Stevens Creek Dam, including a biologically sound passage program and/or volitional passage facilities; doing so would restore access to approximately 12 miles of historical steelhead spawning and holding habitat of high quality.
- Operate Stevens Creek Reservoir for the benefit of all life stages of steelhead with considerations towards water temperature, velocity, ramping rates, sediment transport, channel maintenance, instream habitat maintenance, and adult and smolt migratory cues.
- Reconnect floodplain habitat and increase complexity by reconnecting side channels to the active channel, including retrofits in existing development when feasible.
- Improve instream habitat downstream of the reservoir by placing large woody material, rock weirs, and boulders designed to function within the known range of flows for the benefit of all life stages. Doing so will also increase the shelter ratings and pool volumes.
- Limit or treat urban runoff to improve water quality of the Stevens Creek system, specifically inputs of trash, pesticides, urban toxicity, mercury, and polychlorinated biphenyls (PCBs).

Pertinent DPS-wide recovery actions for sDPS green sturgeon in the action area include:

- Evaluate the effects of habitat modification and/or restoration (e.g., levee alteration, channel reconnection, floodplain connectivity measures) on green sturgeon recruitment and growth in the SFBDE.
- Improve compliance and implementation of (discharge/wastewater, industrial, and stormwater) BMPs to reduce input of point and non-point source contaminants within the Sacramento River Basin, the SFBDE, and coastal bays and estuaries.

- Conduct research to identify contaminants and their concentrations in all life stages of green sturgeon and their prey base; determine the physiological toxicity of identified contaminants in green sturgeon and their prey.
- Identify current and proposed water diversions posing significant risk to individual green sturgeon through entrainment.
- Conduct research on the effects of changes in turbidity and sediment load on green sturgeon habitat in coastal bays and estuaries and consequent effects on individual growth and survival.
- Conduct research on native and nonnative prey species in coastal bays and estuaries to increase understanding on ecological dynamics and connections to green sturgeon; how native/nonnative species may compete with green sturgeon in habitat use, or how green sturgeon prey bases may change under varying climate change scenarios.
- Determine the effects of water management on green sturgeon habitat in coastal bays and estuaries, and consequent effects, if any, on individual growth and survival, through research studies.
- Evaluate the effects of habitat modification and/or restoration (e.g., levee alteration, channel reconnection, floodplain connectivity measures) on green sturgeon recruitment and growth.

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).

This opinion will consider the consequences to CCC steelhead and sDPS green sturgeon, and to their critical habitats, caused by the proposed action as outlined in Section 1.3. These include consequences caused by construction activities, including modifying existing Caltrain tracks, widening bridges and other modifications to waterway crossings, existing station modifications/redesigns, and construction of the new Brisbane LMF, utility upgrades, ancillary alignment features, and electrical connections. In addition, these consequences include the long-term consequences of HSR structure permanence in the landscape, and consequences associated with its operation and maintenance in the action area. All of the project components and consequences are described in more detail in the 2021 HSR BA and impact table (Authority 2021i, j).

2.5.1. Consequences to individuals

2.5.1.1 General Construction activities

General construction encompasses work onsite necessary to build HSR structures or otherwise modify the existing Caltrain system to accommodate HSR operations. General construction includes activities like site preparation; creation of access ways and roads; creation of staging areas; vegetation clearing and grubbing; operation of heavy machinery (track and ballast movement/tamping); vehicles and tool use onsite; installation of falsework, BMPs, and fencing; and other types of out-of-water earthwork and excavation or fill. It also includes in-water activities such as installation of cofferdams and turbidity control curtains. General construction activities have the potential to introduce noise, vibration, artificial light, and other physical disturbances into the immediate environment in and around the construction zone that can result in the harassment of fish by disrupting or delaying their normal behaviors and use of areas, and in extreme cases causing injury or mortality. These outcomes could occur immediately or later in time. The potential magnitude of effects depends on a number of factors, including type and intensity of disturbance, the proximity of disturbance-generating activities to the water body, the timing of the activities relative to the use and occurrence of the sensitive species in question, the life stages of the species affected, and the frequency and duration of disturbance periods. Consequences associated with general construction activities are anticipated in any location in the action area where the proposed HSR alignment crosses over or is nearby waterways that contain listed individuals, and effects are considered temporary, in effect only as long as activities are ongoing.

Fish may exhibit avoidance behavior near construction activities that displace them from locations they would normally occupy due to the noise generated by the operation of construction machinery or movement of soils and rocks during earthwork periods. Depending on the innate behavior that is being disrupted, the adverse effects could vary. An example of an immediate adverse effect to individuals would be cessation or alteration of migratory behavior. For juvenile fish, this effect may also include alteration of behaviors that are essential to their maturation and survival, such as feeding or sheltering, which co-occur with their outmigration from freshwater systems. Construction interactions with tidally-influenced waters are likely to cause temporary cessation of foraging behaviors.

In the absence of migration pattern alterations, general construction disturbance may increase fish physiological stress and increase risk of mortality. Fish vacating protective habitat due to disturbance may experience increased predation rates and decreased survival rates compared to those left undisturbed, which is an example of an indirect adverse consequence from construction. In extreme cases, general construction-related effects may also include debris and/or equipment falling into the channel. Such instances could cause physical injury or death if a fish was struck or crushed, or at least, acute avoidance tactics would be taken, altering any normal behaviors and inducing a high degree of acute physiological stress.

To minimize the impacts of construction on listed salmonids, the Authority has proposed to adhere to specific seasonal work windows for in-water and near-water construction activities of the HSR system in the section (pile-driving activities and associated consequences will be discussed in Section 2.5.1.3. Vibratory and impact pile driving, below).

Proposed seasonal work windows:

- In-water work within the wetted channel for nontidal channels: June 15 – October 15
- Near-water or over-water work for nontidal channels: April 30 – December 1

Proposed daily work hours:

- In the channel or on the floodplain: 1 hour after sunrise until 1 hour before sunset

Proposed work window exceptions (with NMFS confirmation):

- When channels are dry, ponded, lack continuous flow, or
- Water temperatures average 75°F or more for 7 consecutive days

All construction activities occurring on land, such as preparing the construction footprint and staging areas, are expected to create a small amount of fugitive dust that may settle into nearby waterways. But, because of the expected small amount and limited duration (standard construction BMPs include watering dirt roads to suppress dust creation from vehicle/equipment movement), any turbidity increases caused by dust input will be a minimal impact to any fish occupying affected waters. Dust effects are expected to persist only as long as active construction is occurring and are therefore temporary.

Construction activity in or near waterways also includes the placement of structures, movement of materials, and disturbance of soils in the water channels and riparian corridor. Such disturbance is likely to temporarily mobilize sediment and increase the likelihood of erosion, possibly sending it into associated waterways at elevated rates, particularly after the first rain event. Localized increases in erosion and in-water turbidity are expected to have adverse effects on rearing steelhead present in the action area during the proposed construction windows.

CCC steelhead

Adult CCC steelhead in this area are expected to display a winter-run life history, and peak spawning activity would be expected to occur January to March. The downstream migration of kelt CCC steelhead can occur until as late as May. The action area does not contain spawning habitat, so interactions with redds and developing eggs or fry are not expected. At the locations within the action area where adult exposure could occur (Crossings #1 Stevens Creek and Crossing #2 San Francisquito Creek, and possibly Crossing #3 San Mateo Creek), the probability of adult presence during the proposed work windows is very low, almost zero. When the in-water work window commences June 15th, surviving kelts would be expected to have completed their return trip from upstream spawning areas and have exited to the ocean by May at the latest. Therefore, exposure of adult CCC steelhead to general construction effects during the in-water work window is not expected to occur. During the near- or over-water work period of April 30th through December 1st, overlap with adult migration timing would be expected to occur for a few days early in the work period (for the kelt outmigration) and for a few days in late November through December 1st as a few adult individuals may emigrate early to the spawning areas, depending on in-stream flows. Therefore, the probability of exposure increases slightly during

the near-water work window if suitable water flow and temperature conditions are also present; thus, a few adult CCC steelhead could be exposed to general construction effects during the near- or over-water work period.

Juvenile abundance in general is expected to be slightly greater than adult abundance in fish populations. In particular to steelhead, resident *O. mykiss* parents may also produce anadromous steelhead offspring in addition to juveniles produced by anadromous parents (McEwan 2001, Courter et al. 2013, Pearse and Campbell 2018) and the potential exposure probability is greater due to the fact that juvenile CCC steelhead must spend at least one year of rearing in freshwater/estuarine environments before smolting while adults mostly use freshwater streams for only limited time periods around spawning. If pools/ponding is present within the work area at any crossing or interaction location, there is a low probability juvenile CCC steelhead may be exposed during either proposed work windows since their life history requires juvenile overwintering in fresh or estuarine waters before smolting and leaving for the Pacific Ocean.

Because salmonid use of waterways is generally limited by warm water temperatures and adequate flows, the Authority has also requested an exception to the work windows for in-water and near-water construction if local water temperatures are on average 75°F or more for seven consecutive days. One study of juvenile steelhead in southern California streams reported survival and normal foraging and activity in waters that would be considered lethal (>77°F); however, cool water refugia were not available to steelhead in this study (Spina 2006), and the author notes that in other studies where microhabitat selection was possible steelhead were observed to move to their preferential water temperature ranges (Nielsen et al. 1994, Ebersole et al. 2001). If water temperatures exceed preferred steelhead temperature maximum (most studies show steelhead prefer water temperatures below 68°F) for a week or more, fish are likely to have already vacated the area to seek cool water refugia elsewhere and would no longer be present in the waterways near the construction sites to experience associated adverse effects. Seven consecutive days is ample time for individuals to move to other areas where water temperatures are more suitable or move to estuarine areas of lower temperatures. In such cases, there is no cause for construction to adhere to the work windows designed to avoid steelhead use if construction impacts to individual steelhead would not be likely. If such an environmental situation occurs prior to the in-water/near-water work window start, the Authority or its contractors will contact NMFS to confirm with staff that local water temperatures measured 75°F or more for at least seven consecutive days, that steelhead presence is not expected in the area, and that construction may commence outside of the stated work windows because additional interaction with steelhead is not expected to occur. Conversely, if water temperatures drop below 75°F again, the Authority and its contractors propose to revert back to the original work windows intended to minimize adverse construction effects to steelhead in the action area.

The typical fish responses to exposure to general construction activities described above, such as temporary disturbance and disruption of critical behaviors like migration, resting, or feeding; temporary increased physiological stress; temporary avoidance of affected areas; and increased risk of predation for juveniles, describe expected CCC steelhead juvenile responses. Any very 'late' or very 'early' adults that may travel Stevens Creek, San Francisquito Creek, or San Mateo Creek as migration corridors could be exposed to general construction activities for a few days each year in which there is overlap with the beginning and ending of the probable migration period and overwater or near-water construction (adults would not be expected during the in-

water construction work window). Since the potential exposure overlap occurs at the very extremes of observed adult steelhead migration periods, only a few individual fish displaying atypically or ‘outlier’ migration timing would be expected, at most. Adults exposed to daytime overwater or near water work activities would be expected to be startled and temporarily delay their migration through the active work area. Due to the adoption of daylight work hours for work in the channel or in a floodplain as a conservation measure, nighttime quiet hours will ensure that adult migration will not be delayed longer than one work day, in a worst-case scenario, and the potential for this effect to occur is greatly limited to a few days a year, at most. During the quiet periods each night, adult steelhead would be expected to continue their migration as normal. Therefore, general construction effects are not expected to significantly disrupt normal behavior patterns of adult CCC steelhead in the action area.

In regards to dust and sediment mobilization, high sedimentation and turbidity levels have been shown to decrease juvenile growth and survival as a result of reduced prey detection and availability, and individual physical injury rates increase in high turbidity due to increased activity in association with gill fouling and even peer aggression (Bash et al. 2001). Sigler et al. (1984), in a lab study using juvenile steelhead and coho salmon, found individuals to preferentially occupy parcels of water between 57 and 77 nephelometric turbidity units (NTU) when given a choice. This result suggests that juvenile salmonids may avoid waters of very low turbidities (i.e., very clear waters) but also have negative outcomes in turbidities higher than 77 NTU.

25 NTU is the threshold most often appearing in literature regarding the lowest amount of turbidity that will have a negative impact on salmonids, though there are inconsistencies with this generalization. Undisturbed freshwater streams not receiving active rain runoff (i.e., in flood stage) typically have average NTU readings between 20 and 50 NTUs (Klein 2003) and are considered to have relatively high water clarity and to be ideal for salmonid use. In addition, many of the affected waterways in this discussion are SFBDE waters or at least a mixture of SFBDE water and freshwater where waterways are tidally influenced, complicating estimation of background NTU levels. In a recent study, in-situ water measurements of NTUs in the eastern SFBDE showed readings on average ranging from 10 to 40 NTUs (Ade et al. 2021).

Adherence to the SWPPP and implementation and maintenance of erosion control BMPs will be especially important in preventing construction stormwater from adversely affecting steelhead even after active construction ceases for the winter period. The only channel bed disturbance expected in the action area is at Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon and Location #10 Visitacion Creek, and only juvenile CCC steelhead using estuarine habitat would be encountered at these locations. Disturbed areas are to be stabilized and re-contoured so as to not cause long-term sedimentation effects after construction activities are complete. Given the proposed development of a SWPPP and the other erosion control BMPs included in the project description (AMM-GEN-22 through 25) and general Authority construction guidelines, adverse effects are expected to be minimal and would cause steelhead to avoid the area for only as long as elevated turbidities persist.

In summary, juvenile CCC steelhead are expected to experience reduced fitness due to general construction activities through disruption of normal fish behaviors and their use of the wetted habitats near active construction zones. Equipment operation, construction noise, track and

ballast movement and modifications, bridge widening, soil disturbance, general human presence, etc., in and near waterways and tidal channels is expected to elicit these responses. Throughout the duration of general construction, and based on best available information regarding relative abundance, migration timing, and life history patterns, and with adoption of the proposed work windows, NMFS estimates that no more than 5 juvenile CCC steelhead would be exposed to and be adversely affected by general construction activities each year construction activities are occurring.

sDPS green sturgeon

Individual green sturgeon may be expected at any time in tidally influenced waters of the SFBDE, or crossings/locations #6 (Millbrae Station) through # 12 (China Basin/Mission Bay Channel), though there may be a slight peak in spawning adult presence from late winter through early spring as they head towards the Sacramento River Basin. Post-spawn adult outmigration is also variable between individuals, and juvenile use of estuarine and bay waters is continuous, so work windows are not as useful in avoiding green sturgeon interactions. Therefore, adults, subadults, and juveniles could be exposed in any tidally influenced waterbody with sufficient connectivity to the SFBDE in the action area even during the proposed work windows. Also, no strong hourly or diel patterns have been observed in green sturgeon movement within bays, instead green sturgeon seem to be active at all hours. It is generally accepted that they respond more to tidal cycles than daylight hours (Moser and Lindley 2006, Lindley et al. 2008, Lindley et al. 2011), so the daily hour work schedule as proposed will not necessarily avoid green sturgeon exposure.

Overall, adult green sturgeon abundance in the action area is expected to be very low, given the current estimate of total adult population abundance for the entire DPS range (NMFS 2021), and comparing the relatively small amount of SFBDE waters that are expected to be affected by general construction to the total amount of SFBDE waters available for green sturgeon use. Subadult and juvenile presence in the action area is also expected to be low but probability of exposure is increased as subadult and juvenile abundance estimates are approximately two to five times that of the adult population estimate (NMFS 2021). Where exposure to construction activities will occur to individual green sturgeon, the typical fish responses described above, such as temporary disturbance and disruption of feeding, temporary increased physiological stress, temporary avoidance of affected areas, and increased risk of predation for juveniles, describe expected green sturgeon responses. However, unlike CCC steelhead responses, temporary elevation of in-water turbidity due to construction is not expected to impact green sturgeon negatively since they are a bottom dwelling fish that forage specifically in fine sediment environments, like mudflats or tidal sloughs, for buried prey. Spawning green sturgeon seem to avoid turbidities above 10 NTUs (Poytress et al. 2011, Gruber et al. 2012, Poytress et al. 2015), but spawning is not expected in the action area. In addition, the development and implementation of a SWPPP and other erosion control BMPs referenced above are expected to sufficiently prevent or control erosion and sediment discharge. Therefore, adverse effects to individual green sturgeon from temporary elevations in turbidity are not expected.

In summary, sDPS green sturgeon are expected to experience reduced fitness due to general construction activities through disruption of normal fish behaviors and their use of the wetted habitats near active construction zones. Equipment operation, construction noise, track and

ballast movement and modifications, bridge widening, soil disturbance, general human presence, etc., in and near waterways and tidal channels are expected to elicit these responses. Throughout the duration of general construction, based on best available information regarding relative abundance, migration timing, and foraging behavior, NMFS estimates that no more than 5 juvenile and 2 adult/subadult sDPS green sturgeon would be exposed to and be adversely affected by general construction activities.

Conclusion

The proposed in-water and near-/over-water work windows align with windows recommended by NMFS during early technical assistance meetings to avoid the majority of the time periods adult CCC steelhead would be expected to use freshwater habitats, but do not completely eliminate the probability of exposing adults and disturbing their behaviors or use of their freshwater habitats. Because juvenile steelhead utilize freshwater habitats for at least a year before leaving for the ocean, juvenile steelhead could be present in any waterbody or ponded pools near the work areas, if that waterbody is connected to a steelhead waterway at any point in the year and that waterbody has suitable water conditions, including estuarine waters. Given typical steelhead life history patterns for freshwater habitat use in the action area and the expected exposure probabilities during the proposed work windows, there is a low exposure risk to a very low number of individual adult CCC steelhead, and a moderate exposure risk to a low number of juvenile steelhead, from general construction disturbance and temporary elevations in turbidities. Adults or juveniles may be deterred from using waterways near work areas, may delay their migration, and may experience temporarily elevated stress levels due to active general construction occurring near, or over waterways. However, slight disruptions and delays to migration of less than a day are not considered significant alterations of the normal behavior of migration as adults will be able to travel through the work area undisturbed during quiet non-work nighttime periods. Juveniles may use the impacted waterways for freshwater or estuarine rearing throughout the year and may continue to be within the affected work area and be exposed throughout the work season, accumulating physiological stress from daily disturbance. Acute injury or mortality from general construction activity is not anticipated to occur because it would require an extreme event (e.g., overwater support failure resulting in debris and construction materials violently crashing down into a waterway containing listed species); a probability risk so low it is not likely to occur. Overall, adhering to the seasonal and daily work windows will substantially decrease the probability that CCC steelhead will be present in the waterways affected by construction by decreasing the amount of overlap between fish presence and construction activities, but NMFS still expects a low number of individual juvenile steelhead to experience disturbance and reduction in fitness from construction while it is ongoing.

As referenced above, the proposed work windows will not eliminate possible exposure for green sturgeon. There exists a low probability of exposing a small number of individual juvenile, subadult, or adult green sturgeon to effects of construction activities which occur over or near tidally-influenced waters. Again, acute injury is not expected, only behavioral changes and stress associated with disturbance, such as temporary cessation of foraging, movement out of the affected area, and/or elevated stress levels experienced by exposed individuals.

2.5.1.2 Contamination of waterways from construction, equipment operation, staging, storage, and equipment maintenance

All activities that involve construction near, in, or over water (including seasonally dry channels) have some potential to deliver contaminants to surface waters, likely in liquid or particulate forms. Contaminants originating from construction areas can also be delivered to surface waters through stormwater discharges or accidental spills. Contaminants may also enter the aquatic environment through disturbance, resuspension, or discharge of contaminated soil and sediments from construction sites. Introduced contamination or contamination originating from resuspension during construction activities would be expected to be temporary in nature, persisting as long as stormwater discharges continue or as long as construction is ongoing. The various locations along the proposed alignment and the Brisbane LMF location have sediments that have been affected by historical and current industrial uses such as past railroad activity, petrochemical refinement and storage, and landfill use at this location (see Authority (2019c) regarding potentially contaminated soils).

The operation of construction equipment/heavy machinery is also likely to deposit trace amounts of heavy metals throughout the construction area (Paul and Meyer 2001). Heavy metals, even in trace amounts, have been shown to alter juvenile salmonid behavior through disruptions of various physiological mechanisms including sensory dampening, endocrine disruption, neurological dysfunction, and metabolic disruption (Scott and Sloman 2004). Oil-based products used in combustion engines for both fuel and mechanical lubrication contain polycyclic aromatic hydrocarbons (PAHs), which have been known to bio-accumulate in other fish taxa and cause carcinogenic, mutagenic, and cytotoxic effects to fish (Johnson et al. 2002, Incardona et al. 2009, Hicken et al. 2011). Studies have shown that increased exposure to PAHs also results in reduced immunosuppression and therefore increases susceptibility to pathogens (Arkoosh et al. 1998, Arkoosh and Collier 2002). Resuspension of contaminated sediments may also have adverse effects on fish that encounter sediment plumes or come into contact with deposited or newly exposed sediment. Exposure to contaminated sediments, either through direct exposure (e.g., swimming through plumes of re-suspended sediment) or foraging on contaminated food sources, has the potential to harm steelhead and sturgeon (Linville et al. 2002, Lee et al. 2006, Linville 2006, Presser and Luoma 2010b, a, Linares-Casenave et al. 2015).

Though these substances can kill fish or elicit sub-lethal effects when introduced into waterways in sufficient concentrations, adverse effects from hazardous materials from HSR construction is not expected due to the proposed hazardous material and construction stormwater BMPs integrated into the proposed action to control such pollutants and the implementation of an appropriate spill prevention control and countermeasures plan (SPCCP) and adherence to a SWPPP. For example, since earthwork construction at the Brisbane LMF will involve movement and excavation of known contaminated soils (former class II landfill and former railroad freight yard: heavy metals, volatile organic compounds, methane, PAHs, PCBs, pesticides, and asbestos), onsite management, transport, and disposal of contaminated soils is anticipated and various conservation measures (HMW-IAMF#1 through 10) have been incorporated into the proposed action which pertain to the identification of contaminated areas, potential methane detection and personnel training, use of barriers to limit release of volatile subsurface contaminants, and clean-up work plans should undocumented contamination be discovered(Authority 2019c). Standard regulations regarding the proper and safe handling and

transport of hazardous materials will be followed during construction (the 1975 Federal Hazardous Materials Transportation Act, the California Hazardous Waste Control Act, the 1990 Federal Pollution Prevention Act, and the Federal Occupational Safety and Health Administration regulations). Personnel would be trained to work with hazardous materials and the appropriate type and amount of spill cleanup materials would be made available onsite. Also, the construction management plan developed for the area would contain a contingency procedure if undocumented contaminated groundwater or soil were extracted or excavated from the work area so that it is properly and safely identified, sequestered, and/or disposed of offsite at a facility equipped to handle the material (Authority 2019c). Because the Authority has anticipated the presence of existing contaminated soils at the Brisbane LMF location and has adopted multiple conservation measures, will adhere to hazardous waste and pollution prevention regulations, and is ready to prepare contingency clean-up plans should undocumented contaminated soils be encountered, release of disturbed contaminated soils into waterways and exposure to listed fishes is not expected.

In addition to handling explicitly hazardous materials, the Authority has also adopted conservation measures that are expected to avoid the introduction of construction pollutants to waterways (AMM-GEN-4, AMM-GEN-16, AMM-GEN-17, AMM-GEN-20, AMM-GEN-22, and AMM-GEN-25) and therefore will avoid exposing listed fishes to such contaminants. The construction staging areas will be established in the same footprints that will ultimately be occupied by permanent HSR facilities whenever possible to further reduce the amount of disturbance and temporary impacts to natural habitats and reduce the amount of area which may accumulate contaminants on its surface. All equipment entering work areas will be cleaned of mud and therefore also be cleaned of any adherent trace contaminant material. Equipment may enter channel areas for daily use but will be removed and stored outside areas subject to flooding or tidal influence at the end of each work day. Any equipment or vehicles to be driven/operated in the floodplain or over water will be checked and maintained daily to ensure proper working conditions and prevention of leaks, and collection pans or absorbent pads will be placed underneath stationary equipment. Construction will be limited to dry periods when waterbody flows are low or absent, whenever feasible. Refueling and other maintenance would be conducted in areas distant from surface water and equipment would be checked daily for leaks. Surface water quality would be maintained through the use of siltation fencing, wattle barriers, soil-stabilized construction entrances/exits, grass buffer strips, inlet protection, sediment traps, infiltration basins, etc. A spill prevention and emergency response plan will also be developed as part of the SWPPP. Furthermore, the Authority would comply with SWRCB general construction permit conditions to minimize the release of contaminants from the construction site to waterways. Therefore, introduction of typical construction pollutants like PAHs and heavy metals to waterways containing listed fishes will be prevented and exposure of individuals avoided.

Due to the construction pollution prevention BMPs/AMMs/CMs/IAMFs adopted by the Authority, adverse consequences to steelhead or green sturgeon from contamination associated with these activities is not expected to occur.

2.5.1.3 Vibratory and impact pile driving

Construction will require the use of both vibratory and impact pile driving at one location to install piles to support permanent structures within 200 feet of tidally influenced water (Crossing # 9 Guadalupe Valley Creek/Brisbane Lagoon), south of the Brisbane LMF. No pile driving for the installation of falsework is proposed.

Impact pile driving near or in water has the potential to kill, injure, and cause death of fishes through infection via internal injuries, or cause sensory impairments leading to increased susceptibility to predation. The pressure waves generated from driving piles into river bed substrate propagate through the water and can damage a fish's swim bladder and other internal organs by causing sudden rapid oscillations in water pressure, which translates to rupturing or hemorrhaging tissue in the bladder when the air in the swim bladder expands and contracts in response to the pressure oscillations (Gisiner 1998, McCauley et al. 2003, Hastings and Popper 2005, Popper et al. 2006, Popper and Hastings 2009). Sensory cells and other internal organ tissue may also be damaged by pressure waves generated during pile driving activities as sound reverberates through a fish's viscera (McCauley et al. 2003, Caltrans 2015). In addition, morphological changes (damage) to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings and Popper 2005). Smaller fish with lower mass are more susceptible to the impacts of elevated sound fields than larger fish, so acute injury resulting from acoustic impacts are expected to scale based on the mass of a given fish. Since juveniles and fry have less inertial resistance to a passing sound wave, they are more at risk for non-auditory tissue damage (Popper and Hastings 2009) than larger fish (yearlings, subadults, and adults) of the same species. Underwater sound may also damage hearing organs that may temporarily affect hearing sensitivity, communication, and ability to detect predators or prey (Popper and Hastings 2009).

Other activities such as vibratory pile installation and heavy equipment use can produce more continuous, lower energy sounds below the thresholds associated with direct injury but may cause physiological stress or behavioral changes. Multiple studies have also shown responses in the form of behavioral changes in fish due to human-produced noises in or near waterways (Wardle et al. 2001, Slotte et al. 2004, Hastings and Popper 2005, Popper and Hastings 2009, Vracar and Mijic 2011, Martin and Popper 2016, Pavlock McAuliffe 2016, Hawkins et al. 2017, Rountree et al. 2020). The observed startle responses or subsequent emigration from the areas affected by anthropogenic sounds disrupt the normal fish activities and behaviors that were previously occurring before the disturbance (e.g., migration, holding, or feeding). In the case of juvenile fish, unnecessary movement can expose individuals to increased predation risk as they leave areas with predator escapement cover.

Based on recommendations from the Fisheries Hydroacoustic Working Group, NMFS uses an interim dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (NMFS 2008, Caltrans 2015, 2019). The interim thresholds of underwater sound levels denote the expected instantaneous injury/mortality, cumulative injury, and behavioral changes in fishes. Impact pile driving is normally expected to produce underwater pressure waves at all three threshold levels. Vibratory pile driving generally stays below injurious thresholds but often introduces pressure waves that will incite behavioral changes. Even at great distances from the pile driving location underwater pressure oscillations/noises from pile driving is likely to induce

flight responses, hiding, feeding interruption, or area avoidance, effectively blocking natural fish movement and use of the affected area. For a single strike, the peak exposure level (peak) above which injury is expected to occur is 206 decibels [dB (1dB = 1 micro-pascal [$1\mu\text{Pa}$] squared per second)]. However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB. Therefore, the accumulated sound exposure level (SEL) above which injury of fish is expected to occur is 187 dB for fish greater than 2 grams in weight and 183 dB for fish less than 2 grams. If either the peak SEL or the accumulated SEL threshold is exceeded, then physical injury is expected to occur. Behavioral effects may still occur below the thresholds for injury. NMFS uses a 150 dB root-mean-square (RMS) threshold for behavioral responses in salmonids and it is assumed that pile driving sounds less than 150 dB do not result in injury. Though the dB value is the same, the 150 dB RMS threshold for behavioral effects is unrelated to the 150 dB effective quiet threshold.

The Authority included a hydroacoustic analysis in the submitted BA (Authority 2021i), using anticipated pile sizes, the current alignment design, and the hydroacoustic data available in Caltrans (2015) to estimate probable underwater pressure outcomes. All piles would be driven on land or tidal channel that had been dewatered so work could occur in the dry. The pile sizes proposed in the alignment design are 14-inch square concrete piles, 57 for the Tunnel Avenue access road bridge and 114 for a Tunnel Avenue overpass (171 14-inch piles total). Based on data provided by project engineers, the analysis assumes that up to 25 piles per day may be driven and that it would take 500 strikes to drive each pile. It is therefore assumed that up to 12,500 strikes per day could occur over the course of seven working days. Water depth in the Guadalupe Valley Creek channel is shallow, less than 3 meters.

There are no data in Caltrans (2015) for 14-inch concrete piles driven on land so underwater information was used to represent the worst-case scenario. The acoustic reference selected is 14-inch square concrete piles driven in-water at Noyo Harbor, California (Caltrans 2015), which produced a peak of 183 dB, 157 dB_{RMS}, and 146 dB_{SEL} at 10 meters. This source data is considered to reasonably and conservatively represent the sound level of a 14-inch concrete pile driven on land. Sound levels produced by piles being driven on land are typically less than those of the same size driven in water. Currently there are no data supporting fish tissue recovery between pile strikes so all strikes in one day in which the affected waterbody experiences pile driving are counted together regardless if there is a break in between strikes. After an overnight period, or after 12 hours, accumulated SEL is considered reset to zero.

Using the assumed worst-case scenario underwater sound levels above for 14-inch concrete piles driven in-water without attenuation, and 12,500 impact strikes per day, the Authority's provided hydroacoustic analysis and the NMFS Pile Driving Calculator (NMFS 2008) estimate that the distance that instantaneous mortality due to underwater pressures greater than or equal to the 206dB peak threshold is not expected to occur (peak (dB) $\geq 206 = 0$ meters). Since CCC steelhead or sDPS green sturgeon weighing less than 2 grams are not expected within the action area, the 187 dB SEL threshold will be used for this scenario. For fish above 2 grams, the distance at which injury is expected to occur due to cumulative SEL exposure greater than or equal to 187 dB is within 5 meters from the driven pile. The distance within which behavior changes are expected is 29 meters from the driven pile, where the RMS sound will be greater

than or equal to 150 dB RMS. SELs below 150 dB are assumed to not accumulate or cause fish injury, or be significantly different from ambient conditions (i.e., effective quiet).

Table 3. Estimated threshold distances to in-water adverse effects using assumed hydroacoustic metrics (183 dB peak, 146 dB SEL, 157 dB RMS) and 12,500 strikes/day, calculated by the NMFS pile driving calculator (NMFS 2008).

Underwater sound control measures	Peak (dB) ≥ 206	Cumulative SEL (dB) ≥187 Fish ≥ 2 g	RMS (dB) ≥150
No attenuation	0 meter	5 meters	29 meters
Attenuation/On-land	0 meters	3 meters	14 meters

Use of impact pile driving would be minimized through first being used only on land or in a dewatered area behind a cofferdam and then by using vibratory pile driving to the extent feasible before impact pile driving is employed. These piles are permanent structures and will not require removal. An Underwater Sound Control Plan (AMM-FISH-3), dewatering (AMM-FISH-4) and a Fish Capture and Relocation Plan (AMM-FISH-5) are also proposed as part of the project, which will help minimize exposure of fishes to underwater pressure waves from pile driving.

Underwater sound control measures/minimization measures are incorporated into CMs proposed by the Authority and to the extent feasible whenever impact pile driving is performed (e.g., dewatered cofferdams, bubble curtains, and vibration-damping pile caps). Given that at least one underwater sound measure would be employed during impact pile driving, 5 dB hydroacoustic dampening may be assumed at time of exposure (Table 3; 178 dB peak, 141 dB SEL, 152 dB RMS), which would result in reduction of the cumulative SEL threshold distance to only 3 meters from the driven pile and a reduction of RMS threshold distance to 14 meters from the driven pile (still considering 12,500 strikes per day).

The exposure, risk, and response to individual CCC steelhead and sDPS green sturgeon to pile driving effects are the same because both species have a low but equal probability of being exposed to the effects described above at the proposed location. Both green sturgeon (juvenile, subadult, or adult) and juvenile CCC steelhead may be present at any time in the Brisbane Lagoon or in tidally influenced parts of Guadalupe Valley Creek, though in low numbers, for rearing and feeding purposes. Since impact pile driving will only occur during the proposed in-water work window, it is unlikely pile driving activities will overlap with adult CCC steelhead presence. The number of individual fish affected by pile driving is expected to be small due to the life history patterns of the fishes and the existing environmental factors that limit fish use of the waterway (culverts and levees). Adverse effects associated with pile driving are potential injury and behavioral effects, for as long as the pile driving is occurring. The actual number of individuals to be adversely affected is expected to be very low with perhaps at most one or two individuals experiencing injury, especially since the injury threshold distance is within 3 meters of the driven pile when at least one attenuation minimization measure is employed or when the pile is driven on land, an extremely limited affect area. Otherwise, most fish that are exposed to elevated underwater noise will experience temporary increases to their risk of mortality from predation and reduced fitness from expending energy with a temporary reduction in feeding opportunity if they are disturbed by these activities and leave the area. Underwater noise levels would return to baseline levels following cessation of pile driving, and sound exposure would be

‘reset’ after 12 hours of effective quiet. These adverse effects would occur for a total of approximately seven days total while the required pile driving is completed.

2.5.1.4 Cofferdam installation, flow redirection, and dewatering

During the in-water work windows, cofferdams may be installed at Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon and Location #10 Visitacion Creek as part of the construction of the Brisbane LMF to isolate and dewater areas below the ordinary high water mark (OHWM) as necessary, and before pile driving. Cofferdams will be installed through placement of sandbags or equivalent structures, and channel the stream through an alternate course that may be either an artificial structure such as a pipe or a constructed artificial channel. The artificial or constructed structure will meet NMFS (2011) fish passage requirements. Pumped out water will be directed or trucked to nearby infiltration pits/basins that will allow the water to return to the local water table without affecting in-stream water quality. Pump intakes would be screened to prevent the entrainment of juvenile salmonids or sturgeon from entering the pump system, screen mesh size determined according to NMFS (1997) guidelines. At the end of the work season, prior to the rainy season, water will be allowed to re-enter the work area by the isolating structures and the alternate flow pathway will be decommissioned. At the conclusion of work, prior to the end of in-water work window, water is typically allowed to reenter the work area, the isolating structures are removed, and the alternate flow path is dewatered and decommissioned. However, at conclusion of work at Visitacion Creek, most of the affected channel would be permanently culverted.

Entrapment of adult CCC steelhead or subadult/adult green sturgeon are not anticipated during cofferdam establishment or dewatering activities. Adult CCC steelhead are not expected to be exposed to cofferdam installation due to their typical life history patterns within the action area not overlapping with the proposed in-water work window. Adult and subadult green sturgeon are large enough (>60 cm total length) that biological monitors are expected to be able to observe any individuals that may become entrapped by the cofferdam and stop potential entrapment before it occurs, or use seines to move individuals out of the area to be encircled by the cofferdam (following AMM-FISH-4, AMM-FISH-5). As discussed in Section 2.5.1.1, juveniles of each species do have a low chance of being entrapped in a cofferdam because they would be expected to be present in low abundance numbers within the action area during the in-water work windows and their smaller size would make them difficult to locate using visual surveys only. If juveniles are not moved out of the dewatering area via seining before becoming completely entrapped there is a low but not zero chance juveniles may be exposed to dewatering (see Section 2.5.1.5. on fish capture and relocation, below).

During active dewatering, entrainment of juveniles into the pump intakes will be prevented by using the screens specified by NMFS guidelines (NMFS 1997). As the pumping activities will all follow NMFS screening guidelines, injury to fish caused by impingement will be minimized. However, even if properly screened, a small number of juveniles remain at risk of being impinged upon the screen surface when intake velocity of the pump exceeds their swimming capabilities. Injury resulting from impingement may be minor and create no long-term harm to the fish, or result in injuries leading to mortality either immediately or at some time in the future, including predation or infections from wounds and abrasions associated with contact with the screen. As pumping activities may need to occur over a period of several years until construction

is complete, a small portion of fish exposed to the pumping activities are expected to experience injury or death from impingement.

Inside a cofferdam being dewatered, turbidity is expected to be elevated and trapped juveniles are likely to experience respiratory stress and potentially asphyxiate if not captured and relocated promptly (see Section 2.5.1.5. below). Similarly, it is expected that any water pumped out during dewatering will either be managed by collection into an infiltration basin or discharged behind an in-water turbidity curtain to control the impacts to downstream turbidity levels. Because of these CMs, and previously analyzed turbidity control BMPs, it is not expected that downstream turbidity will increase due to discharge water pumped from cofferdams. Turbidity may be temporarily elevated shortly after flows are restored to a dewatered area or channel, but in light of expected turbidity levels in the first rain flush of the season (expected to co-occur with rewetting the work area), the additional temporary elevation in turbidity associated with the proposed action is expected to be indistinguishable from background turbidity levels.

The portions of the channels dewatered will be temporarily unavailable for steelhead and green sturgeon use while the isolation barrier is intact and dewatered, primarily affecting the area available to them to forage. However, the relative amount of area removed from their access temporarily would be negligible when considering the size of Brisbane Lagoon. Because the Authority proposes to construct the artificial channels so that they meet NMFS fish passage criteria (NMFS 2011) to ensure they do not become passage barriers, changes to the movement patterns of fishes are not expected.

2.5.1.5 Fish capture, handling, and relocation associated with dewatering

As described above, there is also a low possibility that a small number of juvenile steelhead or juvenile green sturgeon may become entrapped or stranded during cofferdam installation and risk asphyxiation or experience mortality during dewatering. They may also become injured while entrapped and experience higher levels of physiological stress at sub-lethal levels. The Authority proposes to capture and relocate entrapped fish before dewatering begins to maximize their probability of survival and minimize the project's harm and injury to listed fishes from such activities. A fish relocation plan will be drafted and approved by NMFS before dewatering activities that may affect fish commence, and will include methods for minimizing stress and the risk of mortality from capture and handling of fish (see AMM-FISH-5 (Authority 2021i, c)).

Prior to any potential fish relocation or fish handling associated with dewatering, the Authority or its contractors will contact NMFS so that such activities can be coordinated, staff are aware and available to respond to the activities, and to help ensure minimal adverse effects to fish through appropriate capture and handling procedures. It is expected that the number of juveniles needing fish relocation and handling will be very low due to expected low abundance and limited amount of area enclosed by the cofferdam, and because dewatering and pumping should only occur at two locations (Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon and Location #10 Visitacion Creek) once per construction season during which cofferdam establishment is required.

The Authority proposes that cofferdam establishment would only commence when channels are seasonally or tidally dry; however, some juveniles may become entrapped in any ponded water

within the construction zone. Throughout the period of in-water work in which cofferdams may become established, based on best available information regarding relative abundance, migration timing, and life history patterns, and with adoption of the proposed work windows, NMFS estimates that no more than 5 juvenile CCC steelhead and no more than 5 juvenile sDPS green sturgeon would become entrapped in a cofferdam and require capture, handling, and relocation to increase their chance for survival. Though individual juveniles will experience increased stress and possible injury, it is preferable to capture and relocate them into connected aquatic habitat compared to the eventual mortality these individuals would otherwise likely experience if they remained in an area that is to be dewatered. Stranded juvenile CCC steelhead and sDPS green sturgeon would likely experience increased stress levels, shock, and suffer mild injuries during capture and handling, even if seasoned fisheries biologists perform the fish relocation with appropriate equipment under ideal conditions. Some juveniles may be killed during capture, handling, or transport, while others may be disoriented at release, leaving them more susceptible to predation. Furthermore, fish are more likely to develop serious infections from small wounds inflicted during handling compared to unhandled fish. The expected rate of immediate mortality due to capture and handling is expected to be low (i.e., no more than 3%, on average, of the total number of juveniles relocated when electrofishing is used (Dalbey et al. 1996, McMichael et al. 2011)). It is also possible that some juveniles will avoid the capture methods and die while hiding due to asphyxiation in extremely elevated turbidity in the available water, desiccation, or receive fatal wounds in the dewatering/fish capture process (see Section 2.5.1.4., above). Proposed CMs AMM-FISH-4 and AMM-FISH-5, which focus on dewatering and fish relocation, were developed with technical assistance from NMFS staff and duplicated measures established in prior opinions dealing with Central Valley salmonids (Term and Condition 1i, (NMFS 2019a)).

2.5.1.6 Curing new concrete

The proposed action includes culverting Visitacion Creek at Location #10. The pouring of new concrete may negatively affect water quality by increasing the pH of water in contact with curing surfaces, though the amount the curing cement will increase pH in water decreases over time as the concrete cures. These pH changes can affect fish to varying degrees through direct damage to gills, eyes, and skin, and interfere with fishes' ability to dispose of metabolic wastes (ammonia) through their gills (Washington Department of Fish and Wildlife 2009). In addition, alkali may leak from freshly cast concrete for some time after curing if in contact with water, up to several days to months depending on the water in the water-cement ratio of the mix (CTC & Associates 2015).

Because the casting and curing of concrete will be done "in-the-dry," the potential that the curing concrete will adversely affect water quality and fish health is greatly reduced. New concrete is expected to mature and be practically inert within six months after casting, but it is possible that raised water heights caused by rain or king tides in the months following project completion may cause SFBDE water to be in contact with the concrete before curing is complete. The relatively larger amount of mixing volume expected when the concrete is in the last stages of maturing *and* is in contact with raised water levels is expected to dampen any potential changes in pH of stream water from contact down to immeasurable differences due to volumetric dilution, even if listed fishes are present while the cement is still precipitating alkali. Once the concrete is completely cured and chemically inert, potential pH changes are expected to cease. Therefore,

adverse effects to steelhead or green sturgeon from chemical changes from new concrete are not expected to occur.

2.5.1.7 Vibration and noise from HSR train operations

Once the California HSR system is completely constructed and ridership commences complete with regular schedules, trains running on the viaducts and tracks may disrupt normal fish behavior due to the noise and vibration that comes from high speed operation of the rolling stock and passenger cars. Japan's Shinkansen HSR is reported as running up to thirteen trains in each direction at peak hours with (Central Japan Railway Company 2019), sixteen cars in tow each (likely out of the major metropolitan hub of Tokyo, Japan). While it is currently unknown if the California HSR system will eventually run as many trains as the Shinkansen system per hour over CCC steelhead and sDPS green sturgeon waterways, it is expected that daily disturbance due to the train's schedule could occur often throughout the day and night once the system is in operation.

Quantification of the effects of HSR systems on aquatic organisms or fish is lacking; however, it is generally accepted that transportation noise pollutes aquatic and marine environments (i.e., ship traffic in waterways and automotive and rail traffic over bridges permeating into the aquatic environment (Popper and Hastings 2009, Martin and Popper 2016, Pavlock McAuliffe 2016, Hawkins et al. 2017, Rountree et al. 2020)). Additionally, HSR systems regularly cause disturbance to human residents that live in close proximity to tracks in operation (Yokoshima et al. 2017); therefore, disturbance to fish utilizing habitat under viaduct crossings is similarly expected. Studying fish responses to varying levels and types of transportation/disturbance sounds have produced unclear results (Federal Railroad Administration 2012). However, based on the speed, wind shear, and vibrations that will be associated with the HSR operations (Hunt and Hussein 2007), fish are expected to be startled as engines and passenger cars pass overhead throughout a 24-hour period. A study of ambient noise in large rivers with variously-sized bridges carrying both automotive and train (passenger or freight was not specified) overhead (Vracar and Mijic 2011) observed a maximum of 22 hertz with a mean level of 95 dB approximately 3-5 kilometers from the bridges, roads, and railways at the most comparably-sized river. Rountree et al. (2020) quantified that brook/creek habitats contained averages of 99.4 dB RMS (re: 1 μ PA RMS) while river habitats contained averages of 101.1 dB RMS (re: 1 μ PA RMS). These situations are comparable to future HSR operations as all of the overcrossings in the action area will host blended services with other railway operations, and some HSR overcrossings will be in close proximity to highway and other roadways that currently support vehicular traffic. The train underwater sound contributions in Roundtree et al. (2020) were noted as being relatively brief and bolstered by any use of the train horn. The distance to the study railroad bridge was also noted as being approximately 500 meters. Therefore, it is expected that the sound environment under and near HSR crossings will not exceed 100 dB RMS (re: 1 μ PA RMS) underwater beyond 500 meters from the crossing location in the affected waterbody. While the waterbody sizes in this study were different than the areas being analyzed in this opinion, and while the trains running overhead in the study would likely be louder than the HSR system and though the measurement was taken from quite a distance away from sources, these estimates do offer some insight into the expected maximum impact to the underwater sound environment from regular HSR operations, which are expected to be much quieter but must be considered in combination with existing underwater sound conditions.

There are some mechanisms the Authority can incorporate to dampen operational vibration and sounds that transmit down the columns into the river channel and water column, but it is currently undecided which if any dampening tactics will be used and to what degree they will be incorporated into the track design or rolling stock selection (Federal Railroad Administration 2012, Authority 2014, 2016). Listed fishes that are temporarily startled by vibrations or sound are expected to leave the immediate area, moving either upstream or downstream. This is expected to alter their migration, holding, and foraging patterns to a small degree, though to what degree is difficult to quantify. Unwarranted startle responses would also make juveniles susceptible to attack from piscivorous predators and increase their risk of mortality. Cessation of foraging behaviors due to train operation disruptions will likely slightly decrease their growth rates as energy acquisition is exchanged for energy expenditure. Adverse effects associated with noise and vibration from train operation are expected to persist in perpetuity, as long as the HSR system is in operation.

2.5.1.8 Permanent HSR structures overwater and associated shading or night lighting

All HSR alignment waterway crossings will contribute to artificial waterway shading. Some crossings also entail bridge deck widening of existing railway crossings, which would increase the amount of shading proportionally. The only new overcrossings are the Tunnel Avenue access road bridge and overpass (Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon). The existing crossings' spans are regularly quite short as the waterways have already been channelized, often much less than 80 feet in length and 60 feet in width.

Overwater structures affect the amount of light that reaches the water column and the bottom of a streambed, which limits or prevents riparian and estuarine plant growth underneath and around the structure due to shading. Introduced shade has cascading effects on the benthic ecosystem immediately underneath the structure (Kahler et al. 2000). This changes the type and amount of prey available to foraging juvenile steelhead or green sturgeon that use these areas. Also, the shade created by artificial structures is drastic or sharp compared to that cast by overhanging vegetation (i.e., low and wide structures create stark high light and low light areas in the water column/substrate, versus the gradual and diffuse shading created by tree leaves). Predators are likely to hide in the shadowed areas to ambush prey, such as juvenile salmonids, coming in from bright light areas with greater success compared to predators not hiding in stark shadows (Helfman 1981, Lehman et al. 2019). In some cases, overwater structures can serve as novel roosting or nesting for piscivorous birds (PFMC 2014). However, at this time avian predators are not a notable source of mortality for juvenile steelhead in the recovery plan for the affected basin (NMFS 2016d). Therefore, the localized shading below the overhead crossings will slightly increase the risk of mortality from predation in ways that are expected to reduce the overall fitness and survivorship of juvenile steelhead and green sturgeon that must use the waterways over which structures are placed or maintained.

There is also a possibility that overwater HSR crossing structures may require permanent nighttime lighting for operational safety reasons. AMM-FISH-1 stipulates that temporary lighting for night construction on overwater structures will be designed so that illumination of the water is avoided, but this CM does not address operational effects. It is likely that both juvenile listed fishes and piscivorous predators will be attracted to night lighting over waterbodies in which they co-occur (Lehman et al. 2019). This will concentrate both predators

and juvenile steelhead in night lit areas. While green sturgeon juveniles may be less influenced by light levels in general, concentrating piscivorous predators around these structures and increasing the probability of encountering predators is expected to increase the mortality risk of juvenile steelhead and green sturgeon that use the affected area for foraging and rearing in perpetuity, for as long as water crossing structures use night lighting.

2.5.2. Consequences to critical habitat

2.5.2.1 Site preparation and vegetation removal

Site preparation is required and will likely occur early in the seasonal near-water work window periods (April 30 onward) and will include pre-construction surveys, sensitive habitat identification, installation of exclusionary fencing, and other similar BMPs intended to minimize impacts to natural habitats. Site preparation will also include earth moving, leveling, slope grading, excavation, road installation, and relocation or installation of HSR utilities. In the process of preparing the site for major construction, riparian vegetation and trees may be trimmed or removed for construction access at Crossing # 1 through Crossing #5. Of note, crossing locations #1 through #5 are freshwater riverine habitats which contain CCC steelhead freshwater migration corridor PBFs. The areas scheduled for vegetation removal are not considered green sturgeon critical habitat in this region, so adverse effects to green sturgeon PBFs from vegetation removal activities are not expected. The consequences to individual fish from general construction activities near waterways is discussed above in Section 2.5.1.1; this section will analyze the consequences of vegetation removal on the functionality of the critical habitat impacted by these activities.

The expected decreases in riparian vegetation will create physical changes in the habitat, which are expected to cumulatively result in degradation to the remaining migration and rearing habitat PBFs (Bjornn and Reiser 1991). Changes in vegetative cover can influence the macroinvertebrate prey assemblage, through alterations in shading, water temperatures, and nutrient inputs, to one less supportive of juvenile growth (Meehan et al. 1977). Removal of riverine vegetation will also reduce the natural cover that was previously available on site and reduce the general habitat complexity that would otherwise be beneficial to rearing steelhead's growth, survival, and eventual migration out of freshwater. Particularly, at major overcrossings #1 and #2 (Stevens Creek and San Francisquito Creek), riparian vegetation removals would decrease rearing and migration habitat PBFs complexity in stretches of streams that are already heavily impacted from anthropogenic modifications, channelization, and urbanization. Removing riparian trees also removes potential sources of LWM input over the long term, a legacy issue for CCC steelhead critical habitat in the action area. The Authority estimates that a total of 0.620 acres of riparian vegetation may be removed, including the loss of several trees (approximately eleven trees (Authority 2021i)).

The Authority proposes to replace all removed vegetation with native plants on-site to resemble the existing community, and to use 'soft' approaches to bank erosion where feasible, including vegetative plantings in bank stabilization efforts, or mitigate offsite for the same habitat type. Though the Authority has proposed to replant the disturbed areas with native riparian species to the extent practicable (plan forthcoming, anticipated at a higher ratio than what was removed, see CM-RIPN-1 BA Appendix 2-B (Authority 2021c)), there will be temporary reductions of

vegetative cover at all crossing construction locations discussed until the plantings establish and flourish, or a permanent loss of this habitat type in cases where HSR structures will permanently occupy habitat that before hosted native riparian vegetation and where previous urban development has limited the amount of area available for onsite replanting. The period of reduced riverine vegetation functionality will begin when site preparation commences and will persist for several years while construction is ongoing, until replanting occurs. The replanting will likely take at least one year to execute, and it will be several years to decades until the vegetation matures to the pre-disturbance state, depending on the age of the trees removed. During this lengthy interim, the riparian vegetation component of the freshwater migration corridor PBF for CCC steelhead will be degraded from its current baseline condition and the habitat's ability to support juvenile steelhead rearing is expected to be reduced due to these habitat changes. After the disturbed areas are fully restored with native plantings and 'soft' bank stabilization methods, there is potential for the critical habitat to be of greater complexity and functionality than its current baseline status in some of the more degraded areas.

2.5.2.2 Installing hard armoring, abutments, and bank/slope stabilization measures

Abutments will be placed at Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon to support the Tunnel Avenue access road and overpass. As previously stated, "soft" approaches which incorporate vegetative plantings and large woody debris into the stabilization and revetment designs will be used to the extent possible. A combination of both tactics will likely be used at each site to maintain a more natural riparian corridor and maintain or increase anadromous habitat functionality, while ensuring bank and slope stability.

The consequences of installing hard armoring, abutments, etc. on individual fish is covered under the discussion of general construction effects, as described in Section 2.5.1.1. Once installed, hard structures remove the marginal shallow water habitat at the water/bank interface that provides refugia for juveniles due to its shallow water prism, reduce the total amount of natural area that could be used by species through physical occupation of the habitat, change the prey base through alteration of the benthic substrate type and local water dynamics, and often provide ambush habitat for non-native piscivorous fishes which are attracted to artificial hard surfaces with stark shading (Kahler et al. 2000, Tiffan et al. 2016). In addition, the act of bank stabilization is expected to prevent normal shoreline processes from occurring (Munsch et al. 2017). Instead, the placement of any hard structure is expected to perpetuate the channelization and homogenization of affected areas and reduce foraging habitat of both species into the future (Knudsen and Dilley 1987, Fischenich 2003, Gedan et al. 2010). Therefore, the habitat changes that follow abutment placement are expected to have a negative impact on CCC steelhead estuarine and sDPS green sturgeon foraging PBFs.

2.5.2.3 Permanent HSR structures overwater and associated shading or night lighting

Overwater structures and associated shading or night lighting is expected to cause a cascade of changes in the habitat that result in negative outcomes for the affected waterbody, similar to those discussed in Section 2.5.1.8. for consequences to individuals. Regarding the consequences to affected critical habitat, these changes are expected to result in negative changes to the available PBFs in ways that are expected to reduce their ability to support the steelhead and green sturgeon populations that rely on the waterways.

The benthic habitat around and under the Tunnel Avenue bridge and overpass is expected to provide suitable habitat for the benthic prey of both rearing steelhead and foraging green sturgeon (part of CCC steelhead estuarine areas PBFs and the sDPS green sturgeon estuarine habitats food resources PBF). The footings of the support columns for the Tunnel Avenue access road bridge and overpass (Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon) will permanently and physically occupy estuarine habitat, and the column footings are likely to interact with the tidal flow from Brisbane Lagoon. These concrete piles will change the hydrodynamics in the area and affect sediment deposition rates upstream and downstream from the location (Oregon Water Resources Research Institute 1995, Dalrymple et al. 2012). Changing the sediment composition underneath and around the bridge is expected to change the prey composition available within the affected critical habitat accordingly, which will further degrade the available PBFs of CCC steelhead estuarine and sDPS green sturgeon estuarine foraging habitat.

The introduction of artificial structure shading and night lighting also increases risk of predation on juvenile fish, as noted in Section 2.5.1.8. As predation increases and local juvenile survivorship decreases, the value of the affected critical habitat to the DPSs is further reduced as less individual fish from these populations can effectively utilize the rearing and foraging PBFs. In summary, adverse effects to CCC steelhead estuarine and green sturgeon estuarine food resources critical habitat PBFs, especially to those necessary for juvenile fitness, are expected to occur due to the placement and continued use of permanent structure over waterbodies by causing shading or artificial nighttime illumination, which will slightly degrade the affected PBFs further in addition to their current degraded states, and this degradation will persist as long as the structures remain.

2.5.2.4 Installation of culverts

The Authority proposed to install a permanent culvert at Visitacion Creek at Location #10 as part of the Brisbane LMF design. The culverting of Visitacion Creek amounts to removal of most of the waterway upstream of the culvert (as the upstream habitat will be occupied by the Brisbane LMF) and permanent prevention of its potential use by either species in perpetuity. Modifications that confine and channelize streambeds like culverts also have the potential to restrict or prevent the movement of steelhead or sturgeon through the area. The Authority proposes to design the culvert so it will meet CDFG (2009) and NMFS (2011) fish passage requirements for the lower third of Visitacion Creek which will remain available to tidal flows and accessible to fish. Meeting fish passage criteria will prevent individual fish from being stranded upstream of its placement as water levels fluctuate with the tidal cycle, so changes to the functionality of migratory PBFs are not expected. This action will cause the same adverse effects as described above regarding the placement of hard armoring and abutments, and will reduce available CCC steelhead estuarine and green sturgeon estuarine food resources PBFs through occupation by an artificial hard structure as more shoreline is developed.

2.5.2.5 Impacts from HSR system operation over time

General HSR System Operation

Currently, the state of California's electricity grid would power the HSR system, and is expected to require less than 1% of the state's future projected energy demands (Authority 2016, Authority and FRA 2018, Authority 2019b). Because the power supplied by California's electricity grid is not necessarily from 100% renewable clean energy sources at this time, the Authority will instead obtain the quantity of power required for the HSR system by paying a clean-energy premium for the electricity consumed, with a goal of a net-zero rail system (Authority 2019b). Renewable energy sources such as sun, wind, geothermal, and bioenergy are cited as options. Over time, use of such renewable sources would be expected to decrease the amount of carbon released into the atmosphere; however, if hydropower is utilized, the perpetuation of greenhouse gas release from reservoirs could be considered an adverse effect of the HSR system (Deemer et al. 2016). Additionally, reliance on hydropower for electricity would likely be further linked to the decline of salmonids in California as dams continue to block salmonids from a majority of their spawning and holding habitats (Busby et al. 1996, NMFS 2013, 2014, 2016d, c, 2017a, 2018), as well as controlling and adversely altering the water flow and water temperature regimes downstream. Since hydropower is not cited as a possible renewable energy source for the HSR system, it is not expected that the creation of the electricity used to power the high speed trains will cause adverse effects to listed salmonids or their designated critical habitat beyond baseline conditions.

Operational Pollution and Stormwater

While the HSR system is a passenger train designed to run on electricity and will not carry any cargo composed of hazardous material (Authority and FRA 2018, Authority 2019b, 2021i), other sources of pollution are still expected to occur. While the exact vehicle type has not been selected, the HSR will use electronic propulsion power supplied by an overhead system on a steel-wheel-on-steel-rail track. Such systems are widely regarded as one of the least polluting transportation systems available, with the Japanese Shinkansen touting 1/8 to 1/12 the carbon emissions per passenger as an airplane for the same distance (Central Japan Railway Company 2019). However, all trains and machinery require lubricants that release PAHs, and the braking system will also release heavy metals and other compounds during braking as the braking pad materials are worn down and degraded by use (Brooks 2004, Bukowiecki et al. 2007, Burkhardt et al. 2008, Wilkomirski et al. 2011, Wilkomirski et al. 2012, Bobryk 2015, Levengood et al. 2015). Therefore, train operations are expected to contribute low-levels of heavy metals such as zinc, copper, lead, nickel, manganese, chromium, and iron to the environment adjacent to the tracks, and most studies indicate that the concentration of these metals and PAHs increases drastically at station platforms and at maintenance yards such as the Brisbane LMF (Bukowiecki et al. 2007, Wilkomirski et al. 2011, Wilkomirski et al. 2012). And because parking lots will be installed at the Brisbane LMF, in addition to typical railroad pollutants like PAHs and heavy metals, the project is also expected to contribute some amount of tire wear particles and 6-PPD quinone into the local ecosystems. 6-PPD quinone is known to be acutely toxic to coho salmon (Tian et al. 2021), and alter and reduce the freshwater prey base of juvenile salmonids (McIntyre et al. 2015). Adverse effects from this pollution would be similar to the outcomes described in Section 2.5.1.2. for construction-related pollution, only it would be more ubiquitous throughout

the system as small amounts would be received by the waterways throughout the entire action area and persist while operations continued.

The Authority proposes to capture all stormwater runoff from created impervious surfaces (Authority 2012, Authority and FRA 2018, Authority 2021i). The BA estimates that 117.5 acres of new impervious surface will be installed within the action area due to the proposed action, the largest amount being installed at one location will be at the Brisbane LMF (45 acres). In other sections, all stormwater runoff created by the HSR system, including the tracks, support structures, maintenance facilities, stations, passenger parking lots, and ROW access roads will be redirected as sheet flow into adjacent drainage systems or swales to infiltration basins designed as water quality control measures. No runoff from the proposed action will be directly discharged to any surface water body, including runoff from bridges, overpasses, underpasses, and aerial structures without prior treatment. The Authority is implementing low impact development (LID) designs and other stormwater BMPs to manage and treat stormwater and protect water quality as it leaves HSR station and passenger parking lot areas. Measures may include vegetated stream setbacks, vegetated buffer zones, tree planting and preservation, and/or vegetated swales (bioswales), in accordance with SWRCB's Phase II Small Municipal Separate Stormwater Permits. In addition, there are some studies that suggest that the green spaces created by railway ROW can be beneficial habitat for wildlife when not disturbed by regular railway operations (Lucas et al. 2017).

The exact stormwater control and treatment designs for this project section are still forthcoming. To date, the Authority has posted public stormwater outreach efforts on their website (Authority 2019d) and has incorporated LID stormwater control design plans into past station design and criteria documents (Authority 2012). It is anticipated the Authority will install significant treatment BMPs within the action area to control and treat a large portion of transportation pollution created by operation of the HSR system before discharge to critical habitat; however, it is nearly impossible to treat all stormwater pollutants before discharge at all times because there is always the possibility of a precipitation event occurring that produces more runoff volume than the stormwater treatment system is design to treat or contain. And, it is only through monitoring and regular maintenance of the installed stormwater treatment system that continued pollutant sequestration or removal can be known.

Therefore, the primary impact on critical habitat from stormwater is periodic increases in pollutant loads entering affected waters, despite a robust stormwater treatment approach. Some water quality contaminants are expected to be discharged into receiving waters due to treatment inefficiencies for certain pollutants and storm events which exceed facility design. This will cause a long-term, adverse effect to the critical habitat water quality PBFs for both species through the periodic addition of heavy metals, PAHs, tire wear particles, and other general transportation pollution created or introduced by the project.

HSR System Maintenance

As with any major transportation or infrastructure system that provides a service to the public, the Authority will perform regular structural, erosion, and disaster (flood, fire, and earthquake) safety checks to ensure the integrity of the tracks and support columns of the HSR system. Such protocol formations are in their infancy, and draft plans are not available to review; however, it is

assumed that some safety checks will be performed on these viaduct crossings and require personnel to be in close proximity to the river channels, and possibly require putting personnel or equipment in water. NMFS expects that the Authority will be in contact with staff (based on implementation of the EMMA environmental compliance system during operations) when draft safety check protocols are available so that a determination can be made with Authority staff at that time regarding whether such activities may affect listed species and critical habitat.

Similarly, it is expected that vegetation control near HSR tracks and column footings will be required in the future. Vegetation control plans and protocols have not been officially drafted or adopted (though the Authority proposes to generally follow Caltrans (2014) vegetation control measures), but these activities would likely include manual removals, such as trimming and “weed whacking”, and also some forms of herbicide application. It is also likely that by the time the HSR system requires vegetation control (Phase 1 operations to begin in action area in approximately 2030), the 2014 Caltrans vegetation control manual will be obsolete and replaced with an updated version with a revised list of approved near-water or aquatic application herbicides. If vegetation control is required in the riparian corridor, in floodplain habitat, or near waterways containing listed fish, the Authority would request ESA section 7 consultation with NMFS regarding the effects of such activities on listed species and critical habitat.

Catastrophic Accidents

A catastrophic derailment in the action area while the system is running is possible and a crash from a viaduct would certainly affect the immediate riparian environment around and below the accident, if a derailment were to occur while crossing a waterway. However, rigorous safety testing, which will occur before passenger trips commence, and many safety protocols will be followed during regular operations, so a derailment occurring at all is extremely unlikely. The comparative Japanese Shinkansen system has been in operation since 1964 and has no record of fatalities, injuries, or derailments, despite some lapses in inspection protocols and material integrity safety checks before an oil leak was discovered and resolved on December 11, 2017 (Sim 2017). However, other HSR systems have experienced crashes or derailments, such as the Santiago de Compostela rail disaster in 2013, the Wenzhou train collision in 2011, and the Eschede train disaster in Germany in 1998 (Wikipedia 2019). Compared to the total number of HSR systems in operation worldwide and the number of their lines and daily trip schedules, and their overall safety record, a derailment or catastrophic crash in the California HSR system is not expected to occur.

2.5.2.6 Compensatory mitigation

As part of their proposed action, the Authority has committed to offsetting unavoidable adverse effects to CCC steelhead and sDPS green sturgeon habitat that will be permanently occupied by HSR structures, permanently over-shaded by HSR structures, or otherwise temporarily modified in adverse ways by HSR actions through offsite compensatory mitigation. The Authority also proposes compensatory mitigation for the permanent removal of waterbodies modeled as accessible to steelhead or green sturgeon. Impacted areas such as tributaries, canals, and other waterbodies not part of critical habitat designations which may occasionally host individual steelhead or sturgeon, or drain to or otherwise influence waterbodies that are critical habitat, are considered part of the modeled habitat.

However, as established in Section 1.3 Proposed Action, many of the overcrossings of the proposed HSR alignment will utilize already existing in the landscape and the corridor is already highly developed for rail transportation. Many require little to no modification to enable HSR use and electrification; therefore, the total amount of compensatory mitigation incurred is low compared to the size of the proposed action and action area involved.

Based on the steelhead model developed by the Authority and designated critical habitat layers, 0.205 acres of permanent impacts and 0 acres of temporary impacts will occur to CCC steelhead designated critical habitat, with an additional 1.663 acres of permanent (1.147 acres, Table 4) and temporary (0.516 acres, Table 4) impacts to habitat that is modeled to also support CCC steelhead but not included in the critical habitat designation for the DPS.

Table 4. CCC steelhead habitat amounts estimated to be impacted by the project (acres rounded from provided data (Authority 2021i, j), CH = designated critical habitat, SHH = steelhead habitat).

Habitat Impact Type	Habitat Removal (acres)	Riparian Vegetation Affected (acres)	Total (acres)
Temporary Impacts to CH	0	0	0
Temporary Impacts to Modeled SHH	0.207	0.309	0.516
Permanent Impacts to CH	0.161	0.044	0.205
Permanent Impacts to Modeled SHH	0.880	0.267	1.147

Green sturgeon habitat in the SFBDE overlaps with estuarine habitat for CCC steelhead. Table 5 shows a reduced amount of green sturgeon habitat requiring offset. Most of the impact acreage for green sturgeon habitat is incurred at Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon and Location #10 Visitacion Creek from placing new overwater structures and the removal of Visitacion Creek. Based on the habitat model developed by the Authority and designated critical habitat layers, 1.448 acres of green sturgeon critical habitat in total will be adversely affected (0.516 acres temporarily and 0.932 acres permanently, Table 5).

Table 5. sDPS green sturgeon habitat amounts estimated to be impacted by the project (acres rounded from provided data (Authority 2021i, j), CH = designated critical habitat, GSH = green sturgeon habitat).

Habitat Impact Type	Habitat Removal (acres)	Riparian Vegetation Affected (acres)	Total (acres)
Temporary Impacts to CH	0.207	0.309	0.516
Temporary Impacts to Modeled GSH	0	0	0
Permanent Impacts to CH	0.805	0.127	0.932
Permanent Impacts to Modeled GSH	0	0	0

CM-FISH-1 would provide compensatory mitigation that is commensurate with the type of habitat affected (rearing, migratory, or critical habitat) and the amount of habitat lost in the following ratios (Authority 2020a). Per CM-FISH-1, compensatory mitigation would be 2:1 (protected/restored:affected) for the loss of rearing and migratory aquatic and riparian habitat within critical habitat and 1:1 (protected/restored:affected) for all other modeled aquatic and riparian habitat. Unless agreed upon in coordination with NMFS, compensation would occur within the same DPS domain as the impact was incurred. Off-site mitigation would prioritize actions recommended in local or regional conservation plans where there is coordination and approval by NMFS.

The Authority estimates that the San Francisco to San Jose HSR Project Section will adversely affect approximately 1.868 acres of various anadromous fish habitat types in total (Authority 2021i, j). In estuarine areas that were modeled as both CCC steelhead and green sturgeon habitat, it is assumed that incurred impact acreages would be offset only once if the chosen mitigation option sufficiently provides dual estuarine benefits to both DPSs simultaneously. Due to the differing ratios of offset required by the habitat type and whether the habitat affected is critical habitat or not, the Authority proposes to provide 2.007 acres of aquatic and riparian habitat (likely to be offset by estuarine habitat types designed to benefit/be accessible to both of the affected species) and 1.085 acres of riparian habitat (likely for the benefit of CCC steelhead only). However, if less habitat acreage is impacted through complete avoidance through design/route decisions, or if on-site habitat restoration, rehabilitation, or augmentation is incorporated to a degree that maintains or enhances habitat functionality to pre-project condition or better, then the total amount of acres incurring mitigation need would be reduced.

When any of these compensatory mitigation options are undertaken and implemented in full, NMFS expects these actions to have temporary adverse effects and permanent beneficial effects to CCC steelhead and sDPS green sturgeon. As described in Section 1.3.6 **Error! Reference source not found.** of this opinion (Proposed Compensatory Mitigation), currently there are no NMFS-approved mitigation banks that offer steelhead, green sturgeon, or appropriate habitat

type credits that also include the action area of the project within their service areas, and there is currently no in-lieu fee program that could provide credits suitable to offset impacts either. Because of the lack of available mitigation options, the Authority expects to conduct permittee responsible restoration to offset unavoidable impacts to CCC steelhead and sDPS green sturgeon habitats from project impacts (Authority 2021i, c). However, the CMP has not been drafted and no sites have yet been proposed. As specific offset options have not been identified, there is not enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze what temporary adverse effects are expected to occur as a consequence of that component. Nor is there enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze the expected relevance of any beneficial effects of that component to the listed steelhead, green sturgeon, and critical habitat that would be adversely affected by other components of the proposed action. Nor is there enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze the expected reliability and effectiveness of any beneficial effects of that component. Nor is there enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze whether there would be any potential delay between the expected adverse effects of other components of the proposed action and the expected beneficial effects of the compensatory mitigation component. In the future, when a site(s) for compensatory mitigation is confirmed and additional information about the proposed compensatory mitigation is available, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center's programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017a) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

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.

Continued urbanization and human population growth will continue to put increasing pressure on the federally listed species that occur in the action area. Continued urban growth and human population density increases are likely to result in an increase in invasive species and sound, light, and nonpoint-source pollution in the local environment. The increased urban density is also likely to further affect hydrology, water quantity, and water quality experienced by the species. Development tends to lead to the rerouting, straightening, and hardening of creeks, streams, and rivers, which will continue to degrade wetland, stream, and estuarine habitats for steelhead and green sturgeon.

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 in the environmental baseline (Section 2.4).

2.7. Integration and Synthesis

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

2.7.1. Summary of Effects of the Proposed Action on Listed Species

Most adverse effects to CCC steelhead and sDPS green sturgeon individuals analyzed in this opinion will occur during the construction period of the proposed action, and are expected to be short-term disturbances; disruptions of normal behaviors, migration, and habitat use; temporary decreases in survivorship probabilities; and for very few individuals of each DPS, a short period in which some fish are expected to be injured or be killed during cofferdam dewatering, and fish capture and relocation. There are at least twelve major overcrossings across the landscape in the action area at which these behavioral effects will occur, and a period of one to three years during construction when the effects may occur at any one construction site. One continuing effect of operations of the HSR system will be the disturbance associated with running high speed trains over waterways containing listed anadromous fishes. Rail operations are expected to disrupt individual behaviors in perpetuity (foraging or migration) and will slightly increase the risk of predation if those individuals are juveniles when escapement cover is not readily available, resulting in reduced survival at HSR crossings, or disrupt foraging behavior which will result in a loss of energy intake and slightly decrease the fitness of affected individuals.

2.7.2. Summary of Effects of the Proposed Action on PBFs of Designated Critical Habitat

The implementation of the proposed action will unavoidably alter a small amount of CCC steelhead designated critical habitat. The riparian vegetation removal and railroad bridge widening at Crossing Location #1 Stevens Creek and Crossing #2 San Francisquito Creek are expected to remove proportional amounts of critical habitat through additional spatial occupation in the habitat, change the aquatic ecosystem structure below the structures due to shading, create additional ambush predator habitat, and degrade freshwater habitat functionality locally by further reducing riparian vegetation. These impacts will in turn reduce the fitness and survivorship of juvenile steelhead using rearing and migratory habitat PBFs at each site within the action area. Once the HSR system is operational, railway and roadway pollution sourced from HSR properties and impervious surfaces (e.g., parking lots) will be mostly controlled or prevented from entering waters containing critical habitat water quality PBFs through the incorporation of LID designs, green stormwater infrastructure, and effective stormwater treatment and control devices, including use of bioretention technology.

Several locations within the action area also contain SFBDE tidally-influenced waters, which is designated critical habitat for CCC steelhead (estuarine PBFs) and sDPS green sturgeon (estuarine habitats food resources PBF). The only direct disturbance to estuarine critical habitat will occur at Crossing #9 Guadalupe Valley Creek/Brisbane Lagoon where a new access road bridge and overpass is being installed across the creek mouth and at Crossing #10 Visitacion Creek that is being culverted and most of the portion upstream of the culverted area will be removed based on the location of the Brisbane LMF. Otherwise, all other interactions with tidally-influenced habitat occur as the proposed alignment crosses over or near them on existing train bridges with little to no modifications to the bridge deck, or construction occurs outside of designated critical habitat boundaries. Cofferdam adverse effects to habitat functionality (temporarily removes access to foraging area while cofferdam remains) is relatively negligible compared to the total area available for feeding; however, the adverse effects of bridge piles and shading in the landscape will be permanent and are expected to further reduce the habitat's ability to provide natural forage to listed species locally.

As described in Effects of the Action: Section 2.5.2.6. Compensatory Mitigation, there is not enough information on the compensatory mitigation component of the proposed action at this time to determine and analyze temporary adverse effects and permanent beneficial effects expected to occur as a consequence of that component. Therefore, we do not consider any effects expected to occur as a consequence of that component in our jeopardy and adverse modification conclusions in this opinion. In the future, when a site(s) for compensatory mitigation is confirmed and additional information about the proposed compensatory mitigation is available, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center's programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017a) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

2.7.3. Summary of Environmental Baseline

Both Stevens Creek and San Francisquito Creek CCC steelhead populations are considered essential to the recovery of the DPS and are top priority within the Coastal San Francisco Bay Diversity Strata. Current critical habitat conditions in these watersheds within the action area are considered poor for rearing because of channelization and removal of riparian vegetation, but good for migration purposes though there are passage limitations not far upstream due to existing dams on both waterways. Of note, CCC steelhead designated critical habitat within the action area has been degraded due to human modifications associated with water resource development for human use, urbanization, and transportation installations (particularly due to railways), and numerous passage impediments occur throughout the region. Because of its limited availability in the extensively developed region, all designated critical habitat, including all SFBDE waters, are considered to have high intrinsic value to the viability and recovery of both species.

A continuing pressure on steelhead freshwater habitat in the action area is the full development of local watersheds for human uses and continued reliance on this resource, which is heavily dependent on annual precipitation. Because of this, local water supplies are already limited for all other water uses and the area depends heavily on imported freshwater; increased stormwater

harvesting is planned for the future. The expectations of climate change in the action area are that precipitation, which already comes in ‘boom and bust’ events, will begin to fluctuate evermore so between extreme highs and lows, and that dry year types may become more frequent, in addition to becoming more severe; and that overall averages will be warmer, with the area becoming more chaparral-like with less fog cover (Ackerly et al. 2018). Better water quality control and adequate treatment of new sources of urban stormwater discharges throughout the action area are needed to ensure that the water quality of remaining aquatic habitats will be maintained at sufficient levels into the future to sustain listed salmonids and human populations through all water year types.

In the face of legacy habitat degradation, isolation, and contamination, there are numerous conservation efforts ongoing in the action area. More than a third of South San Francisco Bay tidal marshes have been isolated through dikes or levees for various human uses but many restoration and conservation projects are planning on, or have, reconnected some of these areas to be managed for the benefit of fish and wildlife species again.

2.7.4. Summary of Cumulative Effects

Further urban development in the communities around HSR stations is expected to increase in general as commuters and businesses capitalize on the convenience of being near a mode of transportation that provides fast access between the San Francisco and San Jose Area. And as the local human population increases, cumulative water quality impacts are also expected to increase, through increased urbanization effects, increased impervious surface cover, increased stormwater runoff and contaminant loads, increased discharges from wastewater treatment plants, and an increase in the demand for drinking water. This carries the potential of overdrawing local surface and groundwater supplies available for human use and not protecting sufficient amounts for CCC steelhead life history needs in surface waterbodies during dry and drought periods. Estuarine water quality is expected to decrease and contaminant introduction into the benthic food chain is expected to slightly increase with the associated increases in wastewater discharges.

2.7.5. Effects of the Proposed Action on the Survival and Recovery and on Designated Critical Habitat at the DPS scale

Both CCC steelhead and sDPS green sturgeon are listed as threatened under the ESA and the most recent 5-year status reviews for the DPSs concluded that the threatened status is still applicable (NMFS 2016a, 2021). They remain listed as threatened in large part because of widespread freshwater and estuarine habitat degradation and land use conversion for urban development and human use. The ubiquitous artificial modifications to, and destruction of, the freshwater and estuarine habitats upon which these species depend still persist and adverse effects are expected to increase as the human population continues to grow in the San Francisco-San Jose Area. Specifically, railroad and transportation bridges and infrastructures have been identified as a threat to the CCC steelhead DPS due to the habitat changes associated with the infrastructure and several railroad bridges and culverts impeded fish passage in the region (however, none of the bridges utilized in the proposed action area currently rated as fish passage impediments). Large scale restoration actions that improve the amount, quality, and access to freshwater and estuarine rearing/foraging habitats; remedy adult and juvenile steelhead passage

conditions at impeding structures; allocate surface water for fish and wildlife uses at sufficient quantities and qualities; and install large woody material in streams are necessary to recover these species as self-sufficient, viable, wild breeding populations.

As another railroad/transportation project, the HSR system has the potential to further negatively impact the survival and recovery potential of the CCC steelhead DPS in particular. However, because the project is largely utilizing existing railway bridge crossings with few deck/track modifications, the proposed action adds only a small amount of additional degradation to the existing environmental baseline and its current degraded condition. While the Stevens Creek and San Francisquito Creek populations are important to the recovery of the diversity strata, no injuries or mortality are expected at these interaction points, and the construction work window is expected to avoid adult exposure. At most, the consequences of construction are mostly attributed to temporary disturbances to a few individual juveniles per year for each DPS at two locations (#9 Guadalupe Valley Creek/Brisbane Lagoon and #10 Visitacion Creek), and at most a few individuals would experience injury or mortality in a worst-case scenario per year that construction is ongoing due to dewatering cofferdams. Therefore, the total numbers of fish anticipated to be adversely affected during construction of the proposed action is expected to be relatively small compared to the respective populations in each DPS, and have little measurable effect to the productivity potential of each DPS as a whole. Furthermore, since the construction phase of the project is temporary, once the HSR section is complete, most pathways of effects expected to result in injury or mortality of individuals will cease.

The potential for long-term adverse changes to the freshwater habitats of CCC steelhead is also relatively small, and limited to riparian vegetation removal. The impact to estuarine designated critical habitat for both CCC steelhead and green sturgeon is larger, with pile occupation and overshadowing effects of the Tunnel Avenue access road and overpass. When the size of the altered area is compared to the total amount of estuarine and nearshore foraging habitat available in Brisbane Lagoon, it is not expected to cause the total local benthic productivity levels to decrease. As described above, because the project is largely utilizing existing railway bridge crossings with few deck/track modifications, the proposed action adds only a small amount of additional degradation to the existing environmental baseline and its current degraded condition. The conservation measures proposed by the Authority acknowledge the utility of large woody material and vegetative riparian plantings in bank/slope stabilization measures where needed (though an installation location has not yet been identified) and to meet NMFS fish passage requirements when installing bridges and culverts in accessible habitat. Therefore, the proposed action is not expected to appreciably diminish the value of designated critical habitat as a whole for the conservation of the species.

Combining the minor adverse effects associated with this proposed action, the environmental baseline and the cumulative effects, and taking into account the status of the species and critical habitat affected by the project, the proposed action is not expected to appreciably reduce the likelihood of survival or recovery of the listed species, or appreciably diminish the value of designated critical habitat as a whole for the conservation of the species.

2.8. Conclusion

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

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by 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 the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

1. General construction activities described in Section 2.5.1.1 occurring in, near, or over waterways are expected to harass juvenile CCC steelhead and juvenile, subadult, and adult sDPS green sturgeon by causing them to alter their normal behaviors associated with migration, feeding, or sheltering due to disturbance. Because of the very low amount of adult abundance in these watersheds for each DPS overall, and reduced exposure probability during the proposed work windows for adult steelhead presence, it is expected that no more 2 subadult/adult green sturgeon would be harassed by general construction activities per year when construction is occurring. Green sturgeon juveniles may be exposed at any time in any tidally-influenced waterways. Similarly, juvenile CCC steelhead maybe exposed to harassment stemming from general construction activities at any time, though the risk of exposure is somewhat reduced due to the adoption of the proposed work windows. Therefore, it is expected that no more than 5 juvenile CCC steelhead and no more than 5 juvenile sDPS green sturgeon would be harassed by general construction activities per year construction is occurring.

2. In-water activities, such as the installation of cofferdams and turbidity control curtains, cofferdam dewatering, fish capture and relocation efforts, and in-water pile driving, that contact the stream banks, stream margin, and tidal channel bottom are expected to result in elevated turbidities (described in Sections 2.5.1.1, 2.5.1.3, 2.5.1.4, 2.5.1.5), which are expected to harm and harass juvenile CCC steelhead by causing them to alter their normal behaviors, alter their migration patterns, induce respiratory stress, and cause displacement.
3. Vibratory and impact pile driving in or near waterways (Section 2.5.1.3) is expected to harass, wound, or kill juvenile CCC steelhead and sDPS green sturgeon by introducing underwater pressure waves into the aquatic environment. While the calculated underwater pressure waves are not expected to cause instantaneous mortality to exposed individuals, sublethal internal injuries may lead to death following infection or temporary sensory impairments due to damage to sensory structures following sublethal underwater pressure wave exposure, and the underwater pressure waves will decrease the ability of juvenile fish to detect and avoid predators, thereby increasing their vulnerability to mortality by predation. The pressure waves created by pile driving activities are expected to persist only as long as these activities are ongoing and it is expected at least one underwater sound attenuation measure will be used.
 - a. The underwater pressure waves from vibratory and impact pile driving that are not expected to reach injurious or mortalities levels (≥ 150 dB_{RMS}), but which will harass fish by significantly disrupting normal fish behaviors, will occur up to 14 meters both upstream and downstream from the pile driving/tunneling location (Table 3).
 - b. The underwater pressure waves from impact pile driving are expected to exceed injurious levels (≥ 187 dB_{SEL} cumulative for fish greater than 2 grams bodyweight and ≥ 150 dB_{RMS}) and harm listed fish (from calculations in Section 2.5.1.3). Injury, potentially leading to death due to cumulative SEL exposure greater than or equal to 187 dB is expected out to a 3-meter radius from the driven pile (Table 3).
4. Cofferdam dewatering (Section 2.5.1.4) is expected to harass, wound, or kill juvenile CCC steelhead and sDPS green sturgeon by entrapping them, necessitating their capture, handling, and relocation (Section 2.5.1.5), which is likely to stress, shock, and injure them, resulting in immediate or delayed death, or susceptibility to predation. The number of juveniles entrapped by cofferdams, requiring capture and relocation is expected to be low, no more than 5 individuals from the CCC steelhead DPS and no more than 5 individuals from the sDPS of green sturgeon over the course of construction of the San Francisco to San Jose Project Section. It is also estimated that no more than 3% of the total number of juveniles entrapped (which is no more than one juvenile from the CCC steelhead DPS and one juvenile from the sDPS of green sturgeon) will result in mortality due to capturing, handling, and relocation by the Authority or its contractors each time a cofferdam is installed and dewatered. It is also possible that fish will evade capture and become impinged on the intake screen or be wounded in other ways during dewatering. The construction timeline estimates that active construction will be complete within 5 years (Authority 2021i, b).

5. Regular HSR operations (Section 2.5.1.7.) are expected to harass and cause behavioral changes and increased stress in individual CCC steelhead and sDPS green sturgeon as trains running overhead introduce sudden noise and vibrations into the underwater environment below. Disturbing fish will cause a net energy loss by unnecessarily expending energy through either interrupting resting or feeding, or delaying migration timing. Juveniles are expected to be startled by vibrations and noise created when high speed trains pass over waterways, causing them to flee when they otherwise may be resting or foraging, creating situations in which they are more likely to be predated upon in these areas over the long-term.
6. Site preparation, relocation of utilities, permanent waterbody removal, and vegetation removal in and near waterways in association with proposed activities (Sections 2.5.2.1, 2.5.2.2., 2.5.2.3., and 2.5.2.4.) are expected to harm adult and juvenile CCC steelhead and juvenile, subadult, and adult sDPS green sturgeon by reducing habitat quality (vegetation removal, temporary and permanent land disturbance and alteration, permanent natural waterbody removal, changes in natural shading), and these alterations are expected to reduce the fitness, growth and survival of listed anadromous fishes in the action area. Effects are expected to persist for several years until the aquatic habitats are restored and vegetative plantings mature to pre-disturbance functionality, or indefinitely, depending on the alteration.
7. Placement of permanent overwater structures and associated shading (Sections 2.5.1.8. and 2.5.2.3.) is expected to harm juvenile CCC steelhead and sDPS green sturgeon because the permanent structure occupation of habitat effectively reduces the amount of estuarine feeding habitat locally and the additional shading over the channels will change the local estuarine ecosystem composition/available prey base, and create ambush habitat for predators of juvenile steelhead, in perpetuity.
8. The creation of new impervious surface and the operation of HSR service and Brisbane LMF is expected to decrease the water quality PBFs of critical habitat for CCC steelhead and sDPS green sturgeon and harm CCC steelhead and sDPS green sturgeon by increasing the amount of surface area generating transportation pollution within the action area (Section 2.5.2.5). Despite incorporation of recommended stormwater treatment options, operational BMPS, and LID designs into the proposed action, it is expected that some storm events will produce runoff volumes greater than the stormwater treatment design storm volumes at times and allow for discharge of transportation pollution into the aquatic environments upon which these species depend, in perpetuity.

Ecological Surrogates

For incidental take avenues 2, 3, 5, 6, 7, and 8, NMFS cannot, using the best available information, quantify and track the amount or number of individuals that are expected to be incidentally taken because of the variability and uncertainty associated with the population sizes of the species, annual variation in the timing of migration, and variability regarding individual habitat use and importance within the action area. However, it is possible to express the extent of incidental take in terms of ecological surrogates for those elements of the proposed action that are expected to result in incidental take.

These ecological surrogates are measurable, and the Authority or its contractors can monitor them to determine whether the level of anticipated incidental take is exceeded over the course of project implementation. All incidental take, including ecological surrogates, are summarized in Table 6.

2.9.1.1 Incidental take associated with elevated in-water turbidity plumes

The most appropriate ecological surrogate for incidental take consisting of CCC steelhead disturbance and sub-lethal effects associated with elevated turbidity is the amount of increase in turbidity generated by in-water activities such as pile driving, channel bottom disturbance, and cofferdam establishment and dewatering (incidental take avenue #2). Increased turbidity is expected to cause harm and harass juvenile CCC steelhead through elevated stress levels and disruption of normal habitat use locally. These responses are linked to decreased growth, survivorship, and overall reduced fitness as described in Section 2.9.1.2 for underwater noise avoidance, up to respiratory distress and reduced gill function.

The ecological surrogate for turbidity increases will be based on juvenile salmonid sensitivity to raised turbidity levels. Juvenile salmonids have been found to prefer water between 57 and 77 NTUs (Sigler et al. 1984), despite potentially experiencing reduced growth rates (beginning at 25 NTUs), but would be expected to sustain physical injuries in higher turbidity areas (Bash et al. 2001). NTU ranges in undisturbed freshwater streams and estuaries, like those within the action area, are generally between 10 to 50 NTUs during non-flood conditions (Klein 2003, Ade et al. 2021). With expected maximum background turbidity levels up to 50 NTUs, project activity increases to turbidity should be controlled so that in-water readings do not exceed 77 NTUs and cause juvenile CCC steelhead to actively avoid the impacted area, within a reasonable distance from the work location. As the cofferdam installation, fish capture and relocation activities, dewatering, and pile driving are all occurring in tidally influenced waterbodies, it is expected that turbidity increases will be greater and have a greater spatial impact to adjacent water parcels compared to turbidity increases downstream of work locations in impacted freshwater streams.

Therefore, water 100 meters downstream of construction activities in tidally influenced areas would be 50 NTU (or less) above the turbidity levels observed naturally outside of this zone. In freshwater streams, in water 50 meters downstream of the construction activities, turbidity would measure 25 NTU (or less) above the ambient turbidity level in water measured immediately upstream of project activities. Exceeding these tiered turbidity thresholds will be considered as exceeding the expected incidental take levels for this effect.

2.9.1.2 Incidental take associated with underwater sound, pressure waves, and vibration from construction activities

The most appropriate ecological surrogate for incidental take consisting of harassment (avenue #3a) and injury (avenue #3b) as a result of vibratory and impact pile driving are the threshold sound levels and distances of underwater sounds produced by these activities, since underwater pressure waves illicit these responses and outcomes at certain threshold sound levels and distances.

Both vibratory pile driving and impact pile driving are expected to produce underwater pressure levels greater than or equal to 150 dB RMS out to 14 meters from the location of the activities when at least one attenuation measure is employed (Table 3). Though these elevated underwater sound levels are not expected to injure or kill fish directly, they are expected to cause disruption of normal habitat utilization and elicit temporary behavioral effects in juvenile CCC steelhead and adult and juvenile sDPS green sturgeon that may be in the area, leading to harassment as described in Section 2.5.1.3 pile driving analyses. Any behavioral alterations in juvenile fish are expected to decrease their fitness and ultimate survival by decreasing feeding opportunities that will decrease their growth, and by causing area avoidance, which will delay their downstream migration and increase their predation risk. Adult/subadult/juvenile green sturgeon fitness is expected to decrease as they avoid the area and miss feeding opportunities within the affected area. This surrogate will apply to incidental take avenue #3a and is defined by the boundary of the location of the disruptive activity out to 14 meters from the pile driving location (Table 3). All other types of temporary disturbance effects related to noise or vibrations created by equipment operation, construction noise, and human presence are expected to also be contained within this boundary of anticipated incidental take, during the proposed work windows. Meeting or exceeding 150 dB RMS underwater sound beyond 14 meters from the active construction or pile driving site will be considered exceeding expected incidental take levels for this effect.

Impact pile driving is expected to produce underwater pressure levels greater than or equal to 187 dB SEL cumulative out to 3 meters from the driven pile when at least one attenuation measure is employed (Table 3) and cause sublethal injuries potentially leading to death within this boundary, in addition to causing stress, disturbance, behavioral changes, and migration delays. In addition, the distance that instantaneous mortality due to underwater pressures greater than or equal to the 206 dB peak threshold are not expected to occur (peak (dB) $\geq 206 = 0$ meters). Therefore, meeting or exceeding 187 dB SEL cumulative beyond 3 meters from the driven pile, or meeting or exceeding 206 dB peak at any distance, will be considered exceeding expected incidental take levels from this effect.

2.9.1.3 Incidental take associated with vibration and noise from regular HSR train operations

The most appropriate ecological surrogate for incidental take associated with repetitive fish disturbance from HSR passenger trains running overhead during operations (avenue #5) is the amount of additional underwater sound and vibration to the underwater sound environment from the proposed action above current baseline noise levels experienced by fish in the action area. Quantifications of the underwater sound signature emanating from high speed train operation specifically are not directly available in scientific literature, but estimates are available of overall underwater sound environments currently affected by anthropogenic noise over and near monitored waterways near passenger car railways. Roundtree et al. (2020) quantified that brook/creek habitats contained averages of 99.4 dB RMS (re: 1 μ PA RMS) while river habitats contained averages of 101.1 dB RMS (re: 1 μ PA RMS). These situations are comparable to future HSR operations as all of the overcrossings in the action area will host blended services with other railway operations, and some HSR overcrossings will be in close proximity to highway and other roadways that currently support vehicular traffic. The train underwater sound contributions in Roundtree et al. (2020) were noted as being relatively brief and bolstered by any use of the train horn. The distance to the study railroad bridge was noted as being approximately 500

meters. Therefore, it is expected that the sound environment under and near HSR crossings will not exceed 100 dB RMS (re: 1 μ PA RMS) underwater beyond 500 meters from the crossing location in the affected waterbody. This is similar to the disturbance limit established for vibratory pile driving, the main difference being that this disturbance is expected to occur regularly in perpetuity, affecting all future generations of steelhead and green sturgeon in the action area. Causing the underwater sound environment to regularly exceed 100 dB RMS (re: 1 μ PA RMS) beyond 500 meters from the mid-line of the overcrossing bridge/culvert/viaduct structure will be considered exceeding expected incidental take levels from this effect.

2.9.1.4 Incidental take associated with habitat occupation by HSR permanent overwater structures and artificial materials, shading, waterway and vegetation removal, and other habitat alterations

The most appropriate ecological surrogate for harm to CCC steelhead and sDPS green sturgeon through further degradation of the functionality of their habitats as associated with site preparation, utility placement, vegetation removal, permanent waterbody removal (avenue #6); and permanent structure and otherwise occupation by artificial material and associated shading (avenue #7) is the total amount of area adversely affected. The artificial hard structures and materials will occupy benthic substrates that would have otherwise supported benthic prey of juvenile steelhead and green sturgeon in estuarine areas, which will reduce the overall forage habitat available and will negatively affect the potential local productivity and its ability to bolster fish growth rates and fitness. The hard structures placed in channel beds will introduce new water velocities proportional to the amount of structure placed, and reduce the possibility of natural processes from otherwise occurring in the area, like aquatic vegetation establishment or normal sedimentation movement. Any shading from overwater structures like bridges is related and proportional to the amount the artificial structures that will cover the wetted channel/riparian corridor, and will change the local ecosystem structure below and increase the amount of water column ambush predator habitat, negatively affecting juvenile survivorship. While habitat functionality will not be lost completely in most cases, except for the permanent removal of natural waterbodies, the habitat alterations are expected to result in functional decreases that will be maintained in perpetuity; therefore, the adverse effects associated with these structures will also remain as long as the overwater structure and hard surfaces remain in the landscape.

Based on the acres estimated by the Authority, NMFS estimates that a total of approximately 0.205 acres of CCC steelhead designated critical habitat will be permanently adversely affected by the project section but that none will be temporarily affected by the proposed action. We also estimate that approximately 0.932 acres of sDPS green sturgeon designated critical habitat will be permanently and 0.512 acres will temporarily be affected by the proposed action. The affected amounts are relatively small because much of the alignment relies on existing bridges whose permanent adverse effects are already part of the environmental baseline of the area. While oblique shading would cause a greater amount of area to be affected under the overwater structures caused by differing sunlight angles throughout the day, these amounts are not included in these totals, because it is not practical to calculate them relative to meaningful biotic responses and because the area directly under the structure will experience the greatest reduction in surface lighting. Exceeding this acreage total for direct alterations to designated critical habitat stated above as a surrogate threshold for incidental take described in #6 and #7 above will be considered as exceeding the expected incidental take levels from these effects. If NMFS later

determines that onsite restoration, plantings, installed habitat augmentations, ‘soft’ bank armoring, or other habitat improvements undertaken, funded, or implemented by or on the behalf of the Authority are expected to adequately restore habitat functionality to prior levels or better, the improved/rehabilitated acreages will not be counted in the amount totaled towards the ‘permanently adversely affected’ CCC steelhead habitat limits above. These ecological surrogates are expected to function as an effective reinitiation trigger, because these surrogates would limit the amount of area of habitat occupation or other permanent adverse habitat alterations and associated incidental take that would be expected to occur from site preparation, utility placement, vegetation removal, permanent waterbody removal (avenue #6); and permanent structure and otherwise occupation by artificial material and associated shading (avenue #7).

2.9.1.5 Incidental take associated with post-construction operational stormwater pollution

The most appropriate ecological surrogate for harm to CCC steelhead and sDPS green sturgeon through periodic degradation of the water quality PBFs associated with stormwater generation and discharge during the operational phase of the HSR in this section is the amount of pollution generating surface installed as part of the proposed action (avenue #8) because the amount of transportation pollution that will be generated is proportional to the total surface area that will be a source of pollution. This is especially true for the operation of the Brisbane LMF, which will require installation of impervious surface in an area that is currently mostly pervious, uncovered ground and because the Brisbane LMF is expected to be the greatest new source of train-associated pollution (rolling stock off ramps, stockyard, and maintenance areas) and vehicular pollution, including 6-PPD quinone in tire wear particles (staff parking lot) above what currently enters the habitat during stormwater runoff in the action area. The Authority has proposed to implement stormwater treatment BMPs to contain the transportation pollution generated by the new impervious surfaces before discharge for at least average sized storms for the region but some percentage of storm volumes will exceed the design criteria periodically and lead to runoff entering waterways untreated. These impacts are likely to impair rearing and foraging by affecting the water quality PBF, but quantifying the amount of incidental take resulting from the pollution is not practicable, even if the exact amount of increase in stormwater pollution was known.

Based on the impervious surface acres estimated by the Authority, NMFS estimates that a total of 117.5 acres of new impervious surface will be installed within the described action area, and 45 of those acres will be new impervious surface in association with the Brisbane LMF. Exceeding these acreages of new impervious surface stated above as a surrogate threshold for incidental take described in avenue #8 will be considered exceeding the expected incidental take levels for this effect. If NMFS later determines through technical assistance that use of permeable pavements, LID designs, urban greening, or other stormwater BMPs to be implemented by the Authority are expected to adequately reduce or treat the generated stormwater pollution to levels that are not known to cause harm to CCC steelhead or sDPS green sturgeon critical habitat, said new acres will not be counted in the amount totaled towards ‘new impervious surface’ limits. This ecological surrogate is expected to function as an effective reinitiation trigger, because this surrogate would limit the amount of new impervious surfaces and associated incidental take that would be expected to occur from operational stormwater pollution (avenue #8).

Table 6. Summary of incidental take, including ecological surrogates.

Incidental Take Avenue (#)	Form of Incidental Take	Amount or Extent, including Ecological Surrogate Limits	Duration
#1 General construction activities	Harassment	5 juvenile CCC steelhead 2 adult/subadult sDPS green sturgeon 5 juvenile sDPS green sturgeon	Per year construction is ongoing
#2 Elevated turbidity	Harassment Harm (through short-term reductions in survival and fitness)	Compared to local unaffected/upstream measurements: In-water turbidity elevated up to 50 NTUs within 100 meters from construction in estuarine areas; In-stream turbidity elevated up to 25 NTUs within 50 meters downstream from construction in freshwater streams	While construction is ongoing
#3a Vibratory pile driving; #3b Impact pile driving	Harassment Injure	Underwater noise/pressure up to: ● 150 dB RMS within 14 meters from driven pile or tunneling location ● 187 dB SEL cumulative within 3 meters from driven pile	While pile driving is ongoing (estimate 7 working days)
#4 Cofferdam dewatering and fish capture/relocation	Capture Injure Kill	5 juvenile CCC steelhead 5 juvenile sDPS green sturgeon Up to 3% mortality at immediate release or one individual per DPS per construction year	Over the course of construction of the section, expected up to 5 years
#5 HSR operation noise/vibration	Harassment	Underwater noise up to 100 dB _{RMS} (re: 1μPA RMS) within 500 meters from all major crossing locations due to regular HSR operations	Permanent intermittent
#6 General habitat alteration/vegetation removal/waterbody removal; #7 Permanent structures and shading	Harm (through reduced survival and fitness)	Up to 0.205 acres of permanent impacts to CCC steelhead designated critical habitat Up to 0.932 acres of permanent impacts to sDPS green sturgeon designated critical habitat Up to 0.512 acres of temporary impacts to sDPS green sturgeon designated critical habitat	Maximum amount of permanently affected habitat section implementation

Incidental Take Avenue (#)	Form of Incidental Take	Amount or Extent, including Ecological Surrogate Limits	Duration
#8 Post-construction operational stormwater	Harm (through periodic degradation of critical habitat water quality PBF)	Up to 117.5 acres of new impervious surface Up to 45 acres of new impervious surface for Brisbane LMF	Maximum amount of new impervious surface placed

2.9.2. Effect of the Take

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

2.9.3. Reasonable and Prudent Measures

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

1. Measures shall be taken by the Authority and its contractors to minimize the extent of disturbance, harassment, injury, and mortality to CCC steelhead and sDPS green sturgeon caused by construction activities and HSR operation in the action area related to the consequences of the proposed action as discussed in this opinion.
2. Measures shall be taken by the Authority and its contractors to minimize the extent of harm as a result of degradation and alteration to the designated critical habitats of CCC steelhead and sDPS green sturgeon, and other habitats which support these species, in the action area related to the consequences of the proposed action as discussed in this opinion.
3. The Authority or its contractors shall prepare and provide NMFS with updates, reports, and plans pertinent to monitoring and documenting the impacts to and amount of incidental take of listed species under NMFS jurisdiction in the action area.

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 Authority 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. The Authority and its contractors shall adaptively manage all CMs, AMMs, and BMPs with technical assistance from NMFS staff as they pertain to protecting listed species under NMFS jurisdiction to the extent those CMs, AMMs, and BMPs are applicable during the life of the project to ensure their effectiveness.
 - b. The Authority and its contractors shall work in coordination with NMFS throughout HSR project active construction phases by holding meetings between NMFS, USFWS, CDFW, Authority, and design-build contractor staff at least once a year that construction is ongoing so that impacts on and interactions with listed fishes can be reduced or avoided to the greatest extent possible.
 - c. The Authority and its contractors shall work in coordination with NMFS before and during active HSR operations and maintenance activities to develop specific BMPs and standard maintenance protocols so that impacts on, and interactions with, listed fishes can be reduced or avoided to the greatest extent possible.
 - i. The Authority shall request NMFS review on draft plans for vegetation removal activities and herbicide use as regular maintenance near waterways containing listed anadromous fishes prior to undertaking said activities. NMFS comments shall be addressed in vegetation removal and maintenance plans.
 - ii. The Authority shall request NMFS review on drafts of HSR safety check protocols prior to establishing the protocols if implementation of the protocols may affect listed fishes or their habitats.
 - d. In the course of monitoring the construction portion of the proposed action, the Authority or its contractors shall contact and coordinate with NMFS within 24 hours after direct observation that exceedance of the amount or extent of incidental take of a listed fish or exceedance of its ecological surrogate has occurred (Table 6), or is suspected of being exceeded, so that both agencies can discuss how or whether incidental take levels can return back below applicable levels. Construction shall cease until coordination takes place and an adaptive management plan is adopted.
 - e. The Authority shall ensure its contractors comply with the terms and conditions in this opinion by including them in future contracts through specific requirements that address:

- i. Adherence to the NMFS terms and conditions identified in this opinion as part of the award packages as necessary to reduce and limit the amount of incidental take of listed anadromous fishes;
 - ii. Explicit assignment of the responsibilities of implementation of the environmental CMs/AMMs/BMPs proposed for this action and related to NMFS trust resources as part of the award packages; and
 - iii. Explicit assignment of responsibilities of the monitoring of NMFS resources, associated ecological surrogates, and the implementation and effectiveness of the CMs/AMMs/BMPs associated with NMFS resources as stated in the terms and conditions below as part of project award packages.
- f. Prior to deviations from the proposed work windows or daily work windows, the Authority shall obtain technical assistance approval from NMFS staff before the change is adopted into the construction schedule.
- g. During construction activities, but especially pertaining to impact and vibratory pile driving periods, the Authority and its contractors shall implement the following measures:
 - i. If any steelhead or sturgeon is observed injured or killed within the action area in relation to project activities, the Authority and its contractors shall cease construction actions and contact NMFS staff immediately to assign species identity.
 - ii. If dead, the fish shall be recovered and placed on ice or frozen until transfer to NMFS can occur. If injured, the fish shall be gently handled only to take a photograph to enable later species assignment. Then it shall be immediately released back into the waterbody it was taken in, preferably in a shaded area with overhanging or in-water vegetation. However, the injured individual shall not be pursued if it proceeds to exit the immediate area under its own volition before being photographed.
 - iii. Construction activities shall not resume until NMFS can evaluate the situation and determine if the take could have been avoided.
- h. During in-water pile driving for installation/removal of cofferdams and permanent structures, the Authority and its contractors shall implement the following measures:
 - i. Piles and sheet piles shall be driven as far as possible with vibratory hammering before using an impact hammer.
 - ii. The underwater sound environment shall be monitored whenever in-water impact pile driving is employed to ensure ecological surrogates are not exceeded.

- iii. At least one underwater sound control measure shall be employed whenever in-water impact pile driving is used, such as cushion blocks, bubble curtains, de-watered cofferdams, or de-watered caissons around the pile being driven.
- iv. Piles and cofferdams shall be inspected daily for accumulated debris and debris shall be removed. If the debris is natural large woody material, the Authority shall return the large woody material back to the waterway downstream of their structure or make the material available for restoration activities, preferably for fish habitat onsite.
- i. The Authority shall ensure that a qualified biologist conducts water quality monitoring upstream and downstream of the location of in-water construction activities to ensure turbidity plumes created by construction do not exceed 25 NTUs above natural upstream measurements within 50 meters from the location of in-water activities in freshwater stream environments, or 50 NTUs above the turbidity levels observed naturally outside of this zone within 100 meters from construction in estuarine environments. If a turbidity reading exceeds these thresholds due to construction, construction shall cease and turbidity/sedimentation control AMMs/BMPs shall be adjusted until turbidity readings downstream cease exceeding the established thresholds.
- j. During the in-water work windows, if cofferdams require dewatering, the Authority shall ensure that the enclosed area is checked for steelhead, according to the recommendations of the assigned, on-site fish biologist. In addition, the Authority shall ensure that the following measures are implemented:
 - i. A final dewatering and fish capture/relocation plan shall be submitted to NMFS for review no later than 30 days prior to implementation.
 - ii. NMFS staff shall be notified of any planned fish relocation activities at least two business days before fish capture and handling activities begin, so that staff can advise these efforts or make a field visit to observe, if deemed necessary.
 - iii. Juvenile steelhead entrapped shall be captured using nets (seines) or electrofishing of enclosed areas, water temperatures permitting (less than 65°F). Fishing equipment used shall be in good condition and decontaminated if used outside of the watershed prior to the fish salvage event.
 - iv. Persons performing salmonid captures shall be experienced juvenile salmonid handlers and be familiar with the fishing equipment in use.
 - v. If electrofishing is selected to be used in fish capture, the operator of the equipment shall have at least 100 hours of practical experience using such equipment in the field.
 - vi. Clean relocation equipment and containers shall be available and ready to receive fish on site during all fishing/fish salvage activities, preferably under shade.

- vii. Captured *O. mykiss* shall be counted and assessed visually for immediate health condition and tentatively assigned to steelhead or resident life history group.
- viii. If a steelhead dies, see retaining and reporting a listed fish mortality procedures above (Term and Condition 1g).
- ix. The water quality of the transport water shall be monitored to ensure sufficient oxygen and temperature levels are maintained. Transport water shall be within 5°F of the stream water to minimize shock and transport stress, and less than 64°F overall.
- x. Captured juvenile steelhead shall be held in transport containers for no more than 30 minutes before release. Release locations shall be nearby and the same water body from which they were removed, and the selected release area shall have complex shaded habitat if available, so juveniles may rest or hide after release.
- xi. A report on fish relocation efforts and results shall be submitted to NMFS within 30 days of conclusion of the activities, indicating the number of salmonids that were handled, the number injured or killed, the transport water quality readings, total time in transport, and the location they were released into.
- k. The Authority and its contractors shall incorporate into and adhere to measures in a SPCCP and SWPPP for each construction site discussed in this opinion to minimize the probability of introducing construction pollution into waterways and to reduce the amount discharged should an accidental or uncontrolled discharge occur. Such measures shall include:
 - i. Construction stormwater and erosion AMMs and BMPs shall be established prior to the start of construction and earthwork, and be maintained and monitored regularly to ensure effectiveness.
 - ii. Accidental spill containment and clean-up materials shall be present at all work locations and be accessible to construction crews at all times, to ensure rapid response to events. Materials and available amounts shall be adequate for the machinery and chemicals expected onsite.
 - iii. All equipment maintenance and fueling shall occur in paved areas whenever possible, and occur at least 200 feet away from the wetted channel, using full spill or leak containment systems.
 - iv. Equipment shall be checked for leaks and maintained regularly to ensure proper function before entering water channels or traveling over water channels. Equipment to be used stationary over water for long periods shall have drip pans or absorbent pads placed underneath to catch any and all leaks.
 - v. Should an accidental spill or discharge into riparian or estuarine habitat occur, NMFS shall be contacted within 24 hours with information regarding the event, including type of spill or breach, event duration, estimates on the amount and

concentration of materials discharged, Authority/contractor immediate response, and the Authority's and their contractors proposed long-term resolution to avoid such events. Environmental samples shall be taken and documentation made to track the efficacy of containment and clean-up efforts.

2. The following terms and conditions implement reasonable and prudent measure 2:
 - a. The Authority and its design-build team shall work with NMFS staff to ensure viaduct and crossing footings placed within the OHWM will have minimal hydraulic effects and not significantly alter the hydrology of critical habitat in ways that may impede the migration of CCC steelhead or sDPS green sturgeon or cause changes in geomorphic processes through holding working group meetings when 75% and 90% project designs are available for the sections interacting with NMFS trust resources.
 - b. The Authority and its design-build team shall seek technical assistance from NMFS during the design phase (before construction) of crossings that involve alterations to stream bed bottoms such as in association with culverts or box culverts to be placed in designated CCC steelhead or sDPS green sturgeon critical habitat to ensure the selected designs sufficiently meet fish passage criteria appropriate to the species affected (NMFS 2001, CDFG 2010, NMFS 2019b) and will not impede fish passage.
 - c. The Authority and its design-build team shall provide final crossing designs of each major overcrossing to NMFS at least one year prior to construction mobilization and site preparation start dates for consultation and coordination purposes to determine whether new information or project design changes warrant consultation re-initiation or in-depth technical assistance.
 - i. If consultation reinitiation or opinion changes are not required, the Authority and its construction contractors shall again contact NMFS at least two months ahead of construction mobilization to discuss adaptively managing or avoiding interactions with special status anadromous fishes and the habitats they use in the upcoming construction season.
 - d. The Authority shall ensure that decreases to the riparian vegetation available locally are minimized through implementation of the following measures.
 - i. Riparian vegetation removal shall be limited to the extent practicable for structure placement and construction access, and both trimming and removal shall be limited to the absolute minimum amount required for construction.
 - ii. Riparian vegetation not planned for removal shall be clearly marked and areas of special biological significance that contain native, over-hanging riverine trees, floodplain habitat, or other habitat features that offer in-water heterogeneity such as large woody debris shall be fenced off or clearly marked before removal activities begin to ensure those resources are avoided and preserved.
 - iii. Remaining riparian trees shall be protected from damage during construction activities and during riprap placement to ensure their continuing survival as part

of the riverine habitat. Protective measures may include wrapping their trunks with burlap and/or creating a scaffold buffer of scrap timber around the trunks, in both cases to buffer against damage. A qualified biologist shall confirm proper application of these protective measures and tree survival through the construction and restoration process.

- e. The Authority shall ensure that trees to be removed for the project are surveyed for species and number. The Authority or its contractors shall replant native species, onsite to the maximum extent practical, at minimum a 3:1 ratio in-kind for the number of individual trees removed once construction is complete. Plantings shall be monitored, cared for, and watered as necessary for at least three years after planting to ensure survival.
- f. The Authority shall ensure that native trees and large woody material removed for the project during site preparation are either placed back into the waterway to provide cover and habitat for listed salmonids, secured in an affected waterway as fish habitat augmentation near major overcrossings, or incorporated into bank stabilization and other 'soft' armoring designs for the project (FEMA 2009).
- g. The Authority shall place and secure in-stream woody material refugia within 500 meters of overcrossing and viaduct footings in affected streams to minimize the rate of successful predation on juveniles expected from artificial structures attracting more piscivorous predators to the area in combination with the regular disturbance of HSR trains running over the river channel on the viaducts and bridges. The Authority shall contact NMFS for technical assistance on the placement and amount needed to provide optimal refuge for juveniles to hide in and avoid predation.
 - i. The Authority shall estimate the distance to which 100 dB (re: 1 μ PA) occurs in the underwater environment due to the normal operation of high speed trains running over waterways using empirical underwater sound monitoring taken once track sections are complete and the HSR system is operational, to better inform placement of fish habitat augmentation structures relative to HSR structures in and around streams.
- h. The Authority shall submit preliminary designs of temporary and permanent night lighting of overwater structures to NMFS for approval via technical assistance prior to their implementation.
- i. The Authority shall ensure that temporary construction materials and BMPs consist of natural biodegradable materials and the use of plastic (such as monofilament and Visqueen) is minimized to the extent practicable. All materials intended for temporary use onsite shall be removed within 60 days post construction/project completion or at least three days before anticipated rainfall to reduce pollution and trash from entering the waterways.

- j. The Authority shall ensure that temporary construction areas utilized for staging, storage, parking, and stockpiling are outside of the water channels, floodplains, and riparian areas whenever practicable.
- k. The Authority shall ensure that the amount of new impervious surfaces placed or created in the action area by the proposed project is minimized, and the use of permeable pavements or surfaces in lieu of pavement or gravel is considered whenever feasible.
- l. The Authority shall ensure that no environmental designs or project features include the incorporation or use of new or recycled tire particles or materials, especially not in stormwater infrastructure, bank stabilization, or aquatic habitat restoration designs.
- m. The Authority shall ensure that disturbed areas that were graded are re-contoured and stabilized at the end of the construction year to ensure erosion and sediment mobilization into steelhead waterways will be avoided. Once construction is complete, all disturbed areas shall be restored to pre-project condition or better, in the context of functioning riparian corridors, to the extent practicable.
- n. The Authority shall ensure that the placement of artificial structures in the riparian corridor and on the river banks is limited to the extent practicable, both above and below the OHWM, by implementation of the following measures.
 - i. The placement of riprap on the river bank shall be limited to the amount described in the submitted project BA or less. “Soft” or green approaches to bank stabilization shall be utilized to the extent practicable, hard bank protection methods shall be avoided whenever feasible, and all bank stabilization tactics shall include the placement of large woody material.
 - ii. Wood treated with creosote or copper-based chemicals shall be avoided for use in bank stabilization efforts.
 - iii. Whenever revetment/riprap must be used, quarry stone, cobblestone, or their equivalents shall be used and complemented with native riparian plantings and other natural stabilization alternatives with the goal of maintaining a natural riparian corridor (FEMA 2009).
 - iv. Temporarily disturbed areas shall be revegetated with native plants that resemble or improve the existing native vegetation diversity based on historical, locally appropriate assemblages.
 - v. When revetment/riprap is placed, voids created by the boulders shall be filled by smaller diameter rocks/gravel when below the OHWM to avoid supporting piscivorous predator ambush habitat.
- o. The Authority shall ensure that the use of pesticides and herbicides is avoided near wetted channels, floodplains, and uplands during weed control activities, and amounts used are minimized, to the extent practicable.

- p. The Authority shall ensure that temporary sheet piles are completely removed from streams once construction is complete.
 - i. Sediment suspension created during the removal of temporary sheet piles and cofferdams shall be controlled by encircling the in-water work area with a silt curtain, pulling the piles out slowly, and filling any streambed holes left by the piles with clean, native sediment, or appropriately-sized spawning gravel following pile removal.
- q. The effectiveness of stormwater facilities to treat and manage runoff relies on monitoring and maintenance to ensure facilities are performing as intended. The Authority and its contractors shall develop a Post-Construction Stormwater Management Plan for the project alignment which identifies:
 - i. The amounts of impervious surfaces placed by the program and where the amount was reduced through use of LID design components (e.g., a map delineating project and non-project impervious surfaces, use or retention of permeable surface within project footprint, etc., in acres);
 - ii. All stormwater basins that receive stormwater from impervious surface in the project footprint installed by the project and areas of impervious surface contiguous to the project that also drain into project impervious surfaces and stormwater facilities;
 - iii. A description of stormwater treatment and management facilities in each basin;
 - iv. The effectiveness and capacity of the stormwater facilities, based on expected runoff volumes (design storm, BMP geometry, and residence time);
 - v. The post-treatment pre-discharge water quality monitoring program sample techniques, frequency, and constituents to be measured;
 - vi. Identification of the staff member responsible for stormwater monitoring and maintenance, and their contact information;
 - vii. The maintenance, repair, and replacement program for each facility, with descriptions of the routine maintenance schedule and activities; and
 - viii. The conditions which trigger maintenance, inspection, or sampling outside of those routinely scheduled.
- 3. The following terms and conditions implement reasonable and prudent measure 3:
 - a. The Authority and its contractors shall coordinate with NMFS, whenever NMFS requests, to allow staff safe and reliable access through HSR ROW and construction sites when site visits, in-stream monitoring, or fish relocation activities are required or necessary.

- i. The Authority shall designate an on-site point of contact who can facilitate access and ensure safety through HSR construction sites and ROW, and update NMFS of their contact information regularly.
- b. The Authority shall submit operational stormwater monitoring reports to NMFS annually for at least the first five years after the HSR system is built and being tested, when station and LMF construction is complete, and as ridership/passenger use is increasing (operational phases), to ensure stormwater conveyance and treatment designs adequately contain generated stormwater volumes and pollutant concentrations.
- c. The Authority shall prepare and submit a plan to monitor the amount or extent of incidental take as a result of the proposed action (in relation to proposed AMM-GEN-35), including ecological surrogates as described in Section 2.9.1. of this opinion, for NMFS review at least one year before project construction is scheduled to begin. The Authority shall address NMFS comments on the plan and finalize the monitoring plan before construction begins. After construction commences, the Authority shall submit an annual report to NMFS with the results of said monitoring described in the plan.
- d. The Authority shall submit annual updates and reports proposed as part of the action (listed fish observations and interactions, outcomes of fish capture and relocation efforts, general construction biological monitoring reports, and annual construction progress updates) and those required by these terms and conditions by December 31st of each year of construction.
- e. Monitoring reports shall include record of adherence to project schedules, project milestone completion dates, and details regarding CM, AMM, and BMP implementation and effectiveness, as well as any observed incidental take, incidents such as unplanned equipment failures or accidental spills that occur within the OHWM of work areas, or encounters and observations of individuals of listed or protected species relating to NMFS resources or their ecological surrogates.
- f. Updates and reports required by these terms and conditions shall be sent to:

California Central Valley Office – c/o Cathy Marcinkevage
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814
Monica.Gutierrez@noaa.gov

California Coastal Office – c/o Gary Stern
National Marine Fisheries Service
777 Sonoma Avenue, Room 212
Santa Rosa, CA 95404
Gary.Stern@noaa.gov

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of 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).

- The Authority and its contractors should incorporate LID/green infrastructure designs and features into HSR ROW and access roads, stations, maintenance facilities, utilities, and parking areas to the maximum extent, including tree plantings, vegetated roofs, stormwater planters, infiltration or lined rain gardens, bioswales, vegetated strips, bioretention devices, and the enhancement of onsite hydrologic features that maximize the amount of water evapotransport and groundwater infiltration to in turn minimize watershed degradation impacts to CCC steelhead and sDPS green sturgeon designated critical habitat water quality and habitat function. Doing so would aid in the restoration of the functionality of existing critical habitat water quality and water quantity PBFs in general, and improve the resiliency and probability of recovery of CCC steelhead and sDPS green sturgeon in the region.
- The Authority and its contractors should notify NMFS if any steelhead or salmonid juveniles are observed to be naturally isolated in disconnected or ponded water within their ROW and the Authority or its contractors anticipate the fish being in danger of dying from receding water levels so that appropriate wildlife and fishery agencies may coordinate a fish relocation effort. The Authority and its contractors should enable and facilitate site and area access through the ROW/construction zone until the fish salvage efforts conclude. Any steelhead juveniles handled, injured, or killed by other organizations in this manner will not be tallied toward the incidental take associated with the Authority's incidental take for the proposed action; instead any incidental take associated with the relocation effort would be covered by any permit or other exceptions to take prohibitions held by or applicable to the fish and wildlife agency sponsoring the relocation effort. Doing so will improve the probability the individuals are relocated if necessary and will survive to adulthood and improve the cohort productivity of the CCC steelhead populations involved.
- The Authority and its contractors should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local land management groups to identify opportunities for cooperative analysis, monitoring, and funding to otherwise support steelhead and watershed restoration projects and recovery action projects in the action area. For example, consider taking part as either lead action agency or funding projects which will remedy existing fish passage barriers for CCC steelhead populations of tributaries of South San Francisco Bay. NMFS recommends the Authority use existing fish passage evaluation reports (e.g., Inventory of Barriers to Fish Passage in California's Coastal Watersheds (The Coastal Conservancy 2004) or the Multispecies Recovery Plan (NMFS 2016c)) to identify waterway crossings that currently impede salmonid access to EFH in the region. Replace any barriers to fish passage that are part of the existing train infrastructure the HSR is relying on or will modify in preparation for

operations. Use weirs, grade control structures, and low flow channels to provide the proper depth and velocity for fish in new or replacement infrastructure. Provide an update on which sites have been remediated and which will remain a barrier, which would be important information for future restoration and recovery actions. Doing so would aid restoration of the functionality of existing critical habitats in general, and improve the resiliency and probability of recovery of CCC steelhead in the region.

- The Authority should use biodegradable oil in equipment and onsite vehicles. Doing so will reduce the amount of construction equipment contamination resultant from the project, and available critical habitat quality will be better maintained, in support of CCC steelhead and sDPS green sturgeon.
- The Authority should submit a final CMP to NMFS prior to implementation of the proposed action. The final CMP should demonstrate that the compensatory mitigation plan for unavoidable impacts to steelhead and green sturgeon habitat adequately meets the Authority’s conservation goals and ratio targets proposed in CM-FISH-1. The final CMP should include:
 - Updated and accurate acreage estimates of types of steelhead/green sturgeon habitat (designated critical habitat or other habitat, by DPS) to be temporarily and permanently impacted by the project (examples of project components that are of concern in this context: permanent structures and bank/slope stabilization measures).
 - Updated and accurate acreage estimates of planned on-site restoration, including riparian replantings, incorporation of large woody material, enhancement of fish habitat, and where “soft” bank/slope stabilization designs were selected for use over hard revetment or riprap.
 - Identification of the property or properties selected to provide compensatory offsets for unavoidable impacts to CCC steelhead habitats, and identification of the conservation partners and agencies that will be responsible for holding and maintaining the conservation easements or fee-title to the identified parcels in perpetuity.
 - Consider supporting NMFS-identified recovery actions or information needs for the DPSs instead of, or in addition to, impact-offset acre based compensatory mitigation. For example, sDPS green sturgeon Monitoring Priority 3 (NMFS 2018) identifies the need to monitor trends in annual production and habitat use of juvenile sDPS green sturgeon in the SFBDE. Funding or otherwise facilitating investigations that address this monitoring priority, and widely sharing the results, may have more recovery benefit to the population than a mitigation bank acreage purchase.

2.11. Reinitiation of Consultation

This concludes formal consultation for the California HSR San Francisco to San Jose Project Section.

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.”

An example of when reinitiation of consultation will likely be warranted under 50 CFR 402.16 is if the Authority or its contractors do not adhere to the work windows or daily work hours as proposed or when stormwater treatment designs do not perform adequately to avoid or minimize harm to listed species as considered in this opinion. In addition, when a site(s) for compensatory mitigation is confirmed and additional information about the proposed compensatory mitigation is available, reinitiation of consultation may be warranted to analyze the effects of the compensatory mitigation portion of this proposed action, *or* the restoration component of the compensatory mitigation could be included under NOAA Restoration Center’s programmatic approach for fisheries habitat restoration projects in California Coastal counties (NMFS 2017a) if a United States Army Corps of Engineers Clean Water Act section 404 permit is required, and ESA section 7 review would occur through that programmatic opinion process.

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 Authority and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council (PFMC) 2005), coastal pelagic species (CPS; PFMC (1998)), and Pacific Coast salmon (PFMC 2014); contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

Effects of the proposed project will impact EFH for Pacific Coast Salmon (for Chinook and coho salmon; PFMC (2014)), Pacific Coast groundfish (PFMC 2019b, 2020), and CPS (PFMC 1998, 2019a) within the action area.

The EFH identified within the action area is identified in the Pacific Coast salmon fishery management plan (PFMC 2014) for both marine and freshwater components. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). In the estuarine and marine areas, Pacific Coast Salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception. Habitat Areas of Particular Concern (HAPCs) for salmon that will be impacted are: complex channel and floodplain habitat (approximately from Crossing #1 Stevens Creek through Crossing #5 Mills Creek) and estuaries (approximately from Location #6 Millbrae Station through Location #12 China Basin/Mission Bay Channel).

The Pacific Coast Groundfish FMP manages 90-plus species over a large and ecologically diverse area. Groundfish species are comprised of flatfish, rockfish, roundfish (e.g., lingcod, Pacific cod, cabezon), and elasmobranchs (sharks and skates). The overall extent of groundfish EFH is identified as all waters and substrate within depths less than or equal to 3,500 m (1,914 fathoms) to mean higher high water level or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 parts per thousand during the period of average annual low flow, seamounts in depths greater than 3,500 meters, and areas designated as habitat areas of particular concern not already identified by the preceding criteria. The Pacific Coast Groundfish and CPS EFH in the action area are the tidal waters of the SFBDE (approximately Location #6 Millbrae Station through Location #12 China Basin/Mission Bay Channel). The HAPC for groundfish in the action area is: estuaries.

The fishery management plan for Pacific Coast CPS includes five species: northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel, and market squid. EFH for these fish is defined both by geographic boundaries and sea-surface temperature ranges (PFMC 1998). Pelagic fish live in the water column as opposed to living near the sea floor. They can generally be found anywhere from the surface to 1,000 meters (547 fathoms) deep. EFH for CPS is based on a thermal range bordered by the geographic area where CPS occur at any life stage, where CPS have occurred historically during periods of similar environmental conditions, or where environmental conditions do not preclude colonization by CPS. The identification of EFH for CPS takes into account that the geographic range of CPS varies widely over time in response to the temperature of the upper mixed layer of the ocean. The east-west geographic boundary of EFH for CPS is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to 200 nautical miles and above the thermocline where sea surface temperatures range between 50°F to 79°F. The southern boundary is the United States-Mexico maritime boundary. The northern boundary is more dynamic and is defined as the position of the 10°C isotherm, which varies seasonally and annually (PFMC 2019b).

3.2. Adverse Effects on Essential Fish Habitat

The potential adverse effects of the proposed action on EFH have been described in the preceding biological opinion. Those described for CCC steelhead habitat effects generally apply to Pacific Coast Salmon freshwater EFH and sDPS green sturgeon habitat effects generally apply to Pacific Coast Salmon estuarine EFH, Pacific Coast Groundfish EFH, and CPS EFH. There are many instances where the action area buffer overlaps with EFH; direct project effects from activities or alterations are not expected.

For Pacific Coast Salmon freshwater EFH, adverse effects include:

1. Reduction or removal of riparian vegetation will reduce the habitat complexity of freshwater complex channel habitat (HAPC), both in the short and long-term.
2. Continued or increased channelization by additional armoring of complex channels (HAPC).

3. Sedimentation and turbidity, and exposure to hazardous materials and contaminants, from temporary minor disturbances to the stream beds and banks, or from dewatering.
4. Potential water quality degradation through nonpoint transportation stormwater discharges.
5. Creation or expansion of predator cover and visual barriers.
6. Temporary effects of underwater sound propagation from vibratory and impact pile driving.
7. Additional conversion/removal of natural areas for transportation needs.

For Pacific Coast Salmon estuarine EFH, Pacific Coast Groundfish EFH, and CPS EFH:

1. Additional conversion/removal of estuarine areas for transportation needs (estuaries HAPC).
2. Sedimentation and turbidity, and exposure to hazardous materials and contaminants, from temporary minor disturbances to tidal mudflats and channel bottoms (estuaries HAPC).
3. Dewatering that results in a temporary loss of habitat.
4. Temporary changes to substrate that remove/alter/disturb benthic macroinvertebrate organisms within the project area; thus disrupting the prey base for EFH species (estuaries HAPC).

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. Many of the EFH concerns presented above are expected to be addressed through the ESA consultation RPMs 1-3 (section 2.9.3). In addition to the RPMs, NMFS determined that the following conservation recommendations are also necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

For Pacific Coast Salmon freshwater EFH:

1. Minimize or offset decreases to riparian vegetation and corridors (freshwater complex channel habitat HAPC): Protect existing riparian buffer zones or establish new zones on all permanent and ephemeral streams that include or influence Pacific Coast Salmon EFH. Re-vegetate sites to resemble the natural ecosystem community and maintain buffers that support shading, LWD and leaf litter input, sediment and nutrient control, and bank stabilization function. To address long-term reductions in riparian vegetation in areas where channels are under the jurisdiction of the United States Army Corps of Engineers or any other flood management agency, apply for a vegetation variance which will allow for the Authority or its contractors to re-plant the area with native species as described, or at least in the lower one-third of the waterside of the managed channel.

2. Maintain or increase channel complexity (complex channels HAPC): Enhance in-stream fish habitat by providing root wads and deflector logs below the stabilized bank, and by planting shaded riverine aquatic cover vegetation (in conjunction with EFH conservation recommendation #1, above, regarding seeking a vegetation variance where needed), as part of bank revitalization in conjunction with support footings so that the likelihood of scour caused by structure placement is reduced. The Authority should work with NMFS staff to ensure LWM installations are placed in arrangements and in sufficient numbers so that maximal benefits and use of salmon juveniles are likely and expected (Dollof and Melvin 2003).
3. Avoid creation of predator cover or provide refuge: Install in-river LWM around or adjacent to the HSR crossing and footings so that juvenile Chinook and coho salmon may have access to cover and predator escapement nearby areas under constant train operation as described above.
4. Avoid creating barriers to fish passage when installing new infrastructure or when modifying existing structures for HSR service, using passage metrics designed for Chinook salmon passage (CDFG 2009, NMFS 2011). Provide an update on which project designs, if any, have been changed after considering salmonid passage needs.
5. Address the increase in impervious surface cover and general urbanization of natural habitat in the action area: NMFS recommends the Authority examine its ROW, parking lots, Brisbane LMF, and access road designs of the project area to maintain the maximum amount of natural hydrologic connectivity and to maintain remaining floodplain habitat connectivity whenever possible. Minimize the placement of new impervious surface as much as possible and remove impervious surfaces as feasible (e.g., unused parking lots). New designs could also include incorporation of stormwater treatment/LID tactics to treat project-associated stormwater before discharge and use of permeable pavements to the maximum extent possible.
6. Address potential decreases in water quality due to nonpoint stormwater discharge: A program should be established to address non-point and stormwater pollution from the proposed action. Install and monitor vegetated buffers along stormwater drains to streams, compost based bioretention filters, or bioswales in upland areas with the goals of trapping sediment, removing nutrients, tire wear particles, and metals, and moderating water temperatures, as feasible. Allow zero net increase in annual loading of stormwater pollutants into EFH. If allowing zero net increase is not possible, take efforts beyond HSR properties to help the local communities, in conjunction with local watershed conservation or restoration groups, perhaps through permitting guidance, knowledge exchanges, or funding community projects as a mitigation offset option.
7. Minimize or eliminate potential effects of bank armoring/stabilization: Utilize alternatives to traditional riprap and hard armoring where streambank stabilization is needed, such as designing compacted fill lifts and vegetation plantings to stabilize banks while also enhancing Pacific Coast Salmon EFH. This could involve placing granular soil under compost socks above the OHWM. The compacted fill lifts would consist of compost socks, would have a minimum durability of one year and would be composed of biodegradable jute,

sisal, burlap, or coir fiber fabric. A 12-inch diameter compost sock would be installed on the face of each lift and then the compost sock and soil at each lift would be wrapped with biodegradable material. The process would be repeated until the top of the site is reached. Once the compost socks and soil wraps have been placed, two 6-foot live willow branch cuttings would be placed per linear foot in each of the lifts and a 2-inch layer of topsoil would be placed over the cuttings. Hard bank protection should be a last resort and the following options should be explored beforehand for efficacy (tree revetments, stream flow deflectors, and vegetative riprap (FEMA 2009)). Exchanging riprap placement or channelization practices for these recommendations helps restore the disturbed ground, decreases the chance of future erosion events, and moves the riverbank back to a more natural state while still providing the stabilization needed for the continuous operations of the HSR system.

For Pacific Coast Salmon estuarine EFH, Pacific Coast Groundfish EFH, and CPS EFH:

1. Minimize loss or alteration of habitat (estuaries HAPC): Maintain and restore functioning estuarine conditions. The removal, diking, or draining of tidal marshlands and estuaries should not be undertaken unless a satisfactory compensatory mitigation plan is in effect and monitored. Work with watershed or estuary conservation groups to focus resources on conservation and restoration of estuarine habitats on public or private lands. Ensure alignment crossings allow for free movement of organisms, sediment, and water. Use vegetation methods or “soft” approaches (beach nourishment, vegetative plantings, placement of large woody debris) for bank stabilization if necessary, instead of “hard” modifications, or use manmade structures in combination with ecosystem-based methods (e.g., oyster domes) to promote both shoreline protection and ecological benefits (Gedan et al. 2010)). Decrease shading impacts by using light transmitting material on overwater structures, such as grated decking when feasible. Filling of any estuarine or tidally influenced waterway should be curtailed as much as reasonably possible, and avoid filling native eelgrass beds. Protect or restore vegetated buffer zones with the natural ecosystem community around estuarine areas. Design bridge abutments or modifications to minimize disturbance to EFH; place abutments outside of current and predicted floodplain areas.
2. Address potential siltation and contamination (estuaries HAPC): A program should be established to address non-point and stormwater pollution from the proposed action. Discharge outfalls should be treated to avoid further contamination of the receiving waters and be located only in areas that have good mixing characteristics. Install bioretention or biofiltration features along all types of transportation drainage systems. Allow zero net increase in annual loading of stormwater pollutants into EFH. Use natural untreated materials to avoid releasing additional contaminants. Remove piles with a vibratory hammer only and remove slowly so sediment can slough off near the mudline; place clean sand around base of pile to contain some of the sediment.

Fully implementing these nine EFH conservation recommendations and RPMs 1-3 (section 2.9.3 of the Opinion) would protect, by avoiding or minimizing the adverse effects described in section 3.2 above, for Pacific Coast salmon, Pacific Coast groundfish, and CPS EFH and associated HAPCs.

3.4. Statutory Response Requirements

As required by section 305(b)(4)(B) of the MSA, the Authority 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's 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 Authority 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 California High Speed Rail Authority. Other interested users could include the United States Army Corps of Engineers, USFWS, California Department of Fish and Wildlife, EPA, citizens of California, and others interested in the conservation of the affected DPSs. Individual copies of this opinion were provided to the Authority. The document will be available within two weeks at the [NOAA Library Institutional Repository](#). The format and naming adheres 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 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.

5. REFERENCES

- Abdul-Aziz, O. I., N. J. Mantua, K. W. Myers, and M. Bradford. 2011. Potential Climate Change Impacts on Thermal Habitats of Pacific Salmon (*Oncorhynchus spp.*) in the North Pacific Ocean and Adjacent Seas. *Canadian Journal of Fisheries and Aquatic Sciences* 68(9):1660-1680.
- Ackerly, D., A. Jones, M. Stacey, and B. Riordan. 2018. San Francisco Bay Area Summary Report. California's Fourth Climate Change Assessment.
- Ade, C., E. L. Hestir, and C. M. Lee. 2021. Assessing Fish Habitat and the Effects of an Emergency Drought Barrier on Estuarine Turbidity Using Satellite Remote Sensing. *Journal of the American Water Resources Association* 57(5):752-770.
- Allen, C. D., A. K. Macalady, H. Chenchouni, D. Bachelet, N. McDowell, M. Vennetier, T. Kitzberger, A. Rigling, D. D. Breshears, E. H. Hogg, P. Gonzalez, R. Fensham, Z. Zhang, J. Castro, N. Demidova, J.-H. Lim, G. Allard, S. W. Running, A. Semerci, and N. Cobb. 2010. A Global Overview of Drought and Heat-Induced Tree Mortality Reveals Emerging Climate Change Risks for Forests. *Forest Ecology and Management* 259(4):660-684.
- Allen, P. J. and J. J. Cech. 2007. Age/Size Effects on Juvenile Green Sturgeon, *Acipenser medirostris*, Oxygen Consumption, Growth, and Osmoregulation in Saline Environments. *Environmental Biology of Fishes* 79(3-4):211-229.
- Anderson, J. T., G. Schumer, P. J. Anders, K. Horvath, and J. E. Merz. 2018. Confirmed Observation: A North American Green Sturgeon *Acipenser medirostris* Recorded in the Stanislaus River, California. *Journal of Fish and Wildlife Management* 9(2):624-630.
- Arkoosh, M. R. and T. K. Collier. 2002. Ecological Risk Assessment Paradigm for Salmon: Analyzing Immune Function to Evaluate Risk. *Human and Ecological Risk Assessment: An International Journal* 8(2):265-276.
- Arkoosh, M. R., E. Casillas, E. Clemons, A. N. Kagley, R. Olson, P. Reno, and J. E. Stein. 1998. Effect of Pollution on Fish Diseases: Potential Impacts on Salmonid Populations. *Journal of Aquatic Animal Health* 10:182-190.
- Authority and FRA. 2018. Merced to Fresno Section: Central Valley Wye Final Biological Assessment. Submitted April 2018 to U.S. Fish and Wildlife Service, Revised September 2018 for National Marine Fisheries Service. California High-Speed Rail Authority and U.S. Department of Transportation Federal Railway Administration.
- Authority, F. 2012. Stormwater Management Plan, Merced to Fresno Section, Final High-Speed Train Project EIR/EIS. California High Speed Rail Authority and Federal Railway Administration, pp. 92.
- Authority. 2009. Independent Utility. Dated: 2/10/09. California High Speed Rail Authority, pp. 6.

- Authority. 2014. California High Speed Train Project Design Criteria Rev. 1. January 13, 2014 Rolling Stock Procurement pp. 230.
- Authority. 2016. Sustainability Policy Poli-Plan-03. California High Speed Rail Authority.
- Authority. 2019a. California High Speed Rail Authority San Francisco to San Jose Project Section Administrative Draft Project EIR/EIS Chapter 8: Preferred Alternative. December 2019. pp. 18.
- Authority. 2019b. California High Speed Rail Authority San Francisco to San Jose Project Section Administrative Draft Project EIR/EIS: Executive Summary. December 2019. pp. 102.
- Authority. 2019c. California High Speed Rail Authority San Francisco to San Jose Project Section Hazardous Materials and Wastes Technical Report. December 2019. pp. 137.
- Authority. 2019d. Stormwater Management Program.
https://www.hsr.ca.gov/Programs/Environmental_Planning/stormwater.html. June 4, 2019.
- Authority. 2020. Sustainability Policy. POLI-007. California High Speed Rail Authority. April 2020. pp. 18.
- Authority. 2021a. Biological Assessment Appendix 1-B: Nmfs Listed Species. June 2021. Reproduction of NMFS Species List Sent October 14, 2020, for the California High Speed Rail San Francisco to San Jose Project Section. pp. 4.
- Authority. 2021b. Biological Assessment Appendix 2-A: Constructability Assessment Report. June 2021. pp. 98.
- Authority. 2021c. Biological Assessment Appendix 2-B: Conservation Measures. June 2021. pp. 40.
- Authority. 2021d. Biological Assessment Appendix 3-A: Covered Activity Groupings. pp. 8.
- Authority. 2021e. Biological Assessment Appendix 3-B: Land Cover Maps. June 2021. pp. 42.
- Authority. 2021f. Biological Assessment Appendix 3-C: Habitat Model Parameters. June 2021. pp. 3.
- Authority. 2021g. Biological Assessment Appendix 4-B: Nmfs Species Affected Maps. June 2021. pp. 4.
- Authority. 2021h. Biological Assessment Appendix 4-C: Affected Steelhead and Green Sturgeon Habitat Mapbook. June 2021. pp. 23.
- Authority. 2021i. California High Speed Rail Authority San Francisco to San Jose Project Section Biological Assessment. September 2021. pp. 188.

- Authority. 2021j. Table 5-3 Revised Impact Table with Mitigation for the California High Speed Rail San Francisco to San Jose Project Section Biological Assessment.
- Bash, J., C. Berman, and S. Bolton. 2001. Final Research Report. Research Project T1803, Task 42: Effects of Turbidity and Suspended Solids on Salmonids. Washington State Transportation Commission, Department of Transportation, in cooperation with U. S. Department of Transportation Federal Highway Administration.
- Bedsworth, L., D. Cayan, G. Franco, L. Fisher, and S. Ziaja. 2018. California's Fourth Climate Change Assessment. Statewide Summary Report. California Governor's Office of Planning and Research. Scripps Institution of Oceanography. California Energy Commission. California Public Utilities Commission.
- Bjornn, T. C. and D. W. Reiser. 1991. Chapter 4. Habitat Requirements of Salmonids in Streams. Pages 83-138 *in* Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication.
- Bobryk, N. 2015. Spreading and Accumulation of Heavy Metals in Soils of Railway-Side Areas. Visnyk of Dnipropetrovsk University. Biology, ecology 23(2):183-189.
- Brooks, K. M. 2004. Polycyclic Aromatic Hydrocarbon Migration from Creosote-Treated Railway Ties into Ballast and Adjacent Wetlands. United States Department of Agriculture, FPL-RP-617, pp. 53.
- Bukowiecki, N., R. Gehrig, M. Hill, P. Lienemann, C. N. Zwicky, B. Buchmann, E. Weingartner, and U. Baltensperger. 2007. Iron, Manganese and Copper Emitted by Cargo and Passenger Trains in Zürich (Switzerland): Size-Segregated Mass Concentrations in Ambient Air. *Atmospheric Environment* 41(4):878-889.
- Burkhardt, M., L. Rossi, and M. Boller. 2008. Release of Various Substances to the Environment by Regular Railway Operation. Pages 1-7 *in* Swiss Federal Institute of Aquatic Science and Technology. Dübendorf, Switzerland.
- Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarinso. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. NMFS-NWFSC-27.
- California State Transportation Agency. 2019. Documentation of Memorandum of Understanding for National Environmental Policy Act Assignment between the Federal Railroad Administration and the State of California Acting through Its California State Transportation Agency and Its California High Speed Rail Authority for the State of California's Participation in the Surface Transportation Project Delivery Program Pursuant to 23 U.S.C. 327, Signed July 1, 2019. California High Speed Rail Authority, pp. 25.
- Caltrans. 2014. Maintenance Manual. Chapter C2: Vegetation Control. California Department of Transportation, pp. 50.

- Caltrans. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Division of Environmental Analysis, California Department of Transportation. CTHWANP-RT-15-306.01.01., Sacramento, California.
- Caltrans. 2019. Hydroacoustics. <http://www.dot.ca.gov/env/bio/hydroacoustics.html>. March 25, 2019.
- Cayan, D., M. Tyree, and S. Iacobellis. 2012. Climate Change Scenarios for the San Francisco Region. Scripps Institution of Oceanography. University of California, San Diego. California Energy Commission.
- CDFG. 2004. Part Ix: Fish Passage Evaluation at Stream Crossings. California Salmonid Stream Habitat Restoration Manual. California Department of Fish and Game.
- CDFG. 2009. Part Xii: Fish Passage Design and Implementation, in California Salmonid Stream Habitat Restoration Manual. California Department of Fish and Game, Wildlife and Fisheries Division.
- CDFG. 2010. California Salmind Stream Habitat Restoration Manual. 4th Edition. California Department of Fish and Game, Wildlife and Fisheries Division.
- CDFW. 2016. California Department of Fish and Wildlife, Aquatic Invasive Species Disinfection/Decontamination Protocols (Northern Regions). California Department of Fish and Wildlife.
- Central Japan Railway Company. 2019. About the Shinkansen. https://global.jr-central.co.jp/en/company/about_shinkansen/. June 4, 2019.
- Cohen, S. J., K. A. Miller, A. F. Hamlet, and W. Avis. 2000. Climate Change and Resource Management in the Columbia River Basin. *Water International* 25(2):253-272.
- Colway, C. and D. E. Stevenson. 2007. Confirmed Records of Two Green Sturgeon from the Bering Sea and Gulf of Alaska. *Northwestern Naturalist* 88(3):188-192.
- Courter, I. I., D. B. Child, J. A. Hobbs, T. M. Garrison, J. J. G. Glessner, S. Duery, and D. Fraser. 2013. Resident Rainbow Trout Produce Anadromous Offspring in a Large Interior Watershed. *Canadian Journal of Fisheries and Aquatic Sciences* 70(5):701-710.
- Cox, P. and D. Stephenson. 2007. Climate Change. A Changing Climate for Prediction. *Science* 317(5835):207-208.
- CTC & Associates. 2015. Preliminary Investigation: Determining the Appropriate Amount of Time to Isolate Portland Cement Concrete from Receiving Waters. Caltrans Division of Research, Innovation, and System Information.
- Dalbey, S. R., McMahon, T. E., and W. Fredenberg. 1996. Effect of Electrofishing Pulse Shape and Electrofishing-Induced Spinal Injury on Long-Term Growth and Survival of Wild Rainbow Trout. *North American Journal of Fisheries Management* (16): 560-569.

- Dalrymple, R. A., L. C. Breaker, B. A. Brooks, D. R. Cayan, G. B. Griggs, W. Han, B. P. Horton, C. L. Hulbe, J. C. McWilliams, P. W. Mote, W. T. Pfeffer, D. J. Reed, and C. K. Shum. 2012. Chapter 6: Responses of the Natural Shoreline to Sea-Level Rise. Pages 109-136 in *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present and Future*, National Research Council, editor. The National Academies, Washington, DC.
- Deemer, B. R., J. A. Harrison, S. Li, J. J. Beaulieu, T. DelSontro, N. Barros, J. F. Bezerra-Neto, S. M. Powers, M. A. dos Santos, and J. A. Vonk. 2016. Greenhouse Gas Emissions from Reservoir Water Surfaces: A New Global Synthesis. *BioScience* 66(11):949-964.
- Dettinger, M. D. and D. R. Cayan. 1995. Large-Scale Atmospheric Forcing of Recent Trends toward Early Snowmelt Runoff in California. *Journal of Climate* 8(3):606-623.
- Dollof, C. A. and L. Melvin, Jr. 2003. Fish Relationships with Large Wood in Small Streams. *American Fisheries Society Symposium* 37:179-193.
- Doney, S. C., M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. *Ann Rev Mar Sci* 4:11-37.
- Dumbauld, B. R., D. L. Holden, and O. P. Langness. 2008. Do Sturgeon Limit Burrowing Shrimp Populations in Pacific Northwest Estuaries? *Environmental Biology of Fishes* 83(3):283-296.
- Ebersole, J. L., W. J. Liss, and C. A. Frissell. 2001. Relationship between Stream Temperature, Thermal Refugia and Rainbow Trout (*Oncorhynchus mykiss*) in Abundance in Arid-Land Streams in the Northwestern United States. *Ecology of Freshwater Fish* 10(1):1-10.
- Erickson, D. L. and J. E. Hightower. 2007. Oceanic Distribution and Behavior of Green Sturgeon. *American Fisheries Society Symposium* 56:197-211.
- Federal Railroad Administration. 2012. High-Speed Ground Transportation Noise and Vibration Impact Assessment. U.S. Department of Transportation, Office of Railroad Policy and Development, Washington, DC.
- Feely, R. A., C. L. Sabine, K. Lee, W. Berelson, J. Kleypas, V. J. Fabry, and F. J. Millero. 2004. Impact of Anthropogenic CO₂ on the CaCO₃ System in the Oceans. *Science* 305(5682):362-366.
- FEMA. 2009. Engineering with Nature: Alternative Techniques to Riprap Bank Stabilization. Department of Homeland Security, Federal Emergency Management Agency, pp. 36.
- Fischenich, J. C. 2003. Effects of Riprap on Riverine and Riparian Ecosystems. Engineer Research and Development Center and Wetlands Regulatory Assistance Program, ERDC/EL TR-03-4, pp. 63.

- Fukushima, L. and E. W. Lesh. 1998. Adult and Juvenile Anadromous Salmonid Migration Timing in California Streams. *California Fish and Game* 84:133-145.
- Gedan, K. B., M. L. Kirwan, E. Wolanski, E. B. Barbier, and B. R. Silliman. 2010. The Present and Future Role of Coastal Wetland Vegetation in Protecting Shorelines: Answering Recent Challenges to the Paradigm. *Climatic Change* 106(1):7-29.
- Gisiner, R. C. 1998. Workshop on the Effects of Anthropogenic Noise in the Marine Environment Proceedings 10 - 12 February 1998. Page 145p. Office of Naval Research.
- Gruber, J. J., Z. J. Jackson, and J. P. Van Eenennaam. 2012. 2011 San Joaquin River Sturgeon Spawning Survey. United States Fish and Wildlife Service, pp. 28.
- Hastings, M. C. and A. N. Popper. 2005. Effects of Sound on Fish. For the California Department of Transportation, Contract No. 43A0139 Task Order 1.
- Hawkins, A. D., A. N. Popper, and H. Browman. 2017. A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates. *ICES Journal of Marine Science* 74(3):635-651.
- Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. Emissions Pathways, Climate Change, and Impacts on California. *Proc Natl Acad Sci U S A* 101(34):12422-12427.
- Helfman, G. S. 1981. The Advantage to Fishes of Hovering in Shade. *Copeia* 1981(2):392-400.
- Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, and S. T. Lindley. 2008. Migration of Green Sturgeon, *Acipenser medirostris*, in the Sacramento River. *Environmental Biology of Fishes* 84(3):245-258.
- Hicken, C. E., T. L. Linbo, D. H. Baldwin, M. L. Willis, M. S. Myers, L. Holland, M. Larsen, M. S. Stekoll, S. D. Rice, T. K. Collier, N. L. Scholz, and J. P. Incardona. 2011. Sublethal Exposure to Crude Oil During Embryonic Development Alters Cardiac Morphology and Reduces Aerobic Capacity in Adult Fish. *Proc Natl Acad Sci U S A* 108(17):7086-7090.
- Hunt, H. E. M. and M. F. M. Hussein. 2007. Ground-Borne Vibration Transmission from Road and Railway Systems: Prediction and Control. Pages 1458-1469 *in Handbook of Noise and Vibration Control*, M. J. Crocker, editor. John Wiley & Sons, Inc.
- Incardona, J. P., M. G. Carls, H. L. Day, C. A. Sloan, J. L. Bolton, T. K. Collier, and N. L. Scholz. 2009. Cardiac Arrhythmia Is the Primary Response of Embryonic Pacific Herring (*Clupea pallasii*) Exposed to Crude Oil During Weathering. *Environ Sci Technol* 43(1):201-207.

- Johnson, L. L., T. K. Collier, and J. E. Stein. 2002. An Analysis in Support of Sediment Quality Thresholds for Polycyclic Aromatic Hydrocarbons (Pahs) to Protect Estuarine Fish. *Aquatic Conservation: Marine and Freshwater Ecosystems* 12(5):517-538.
- Kadir, T., L. Mazur, C. Milanes, and K. Randles. 2013. Indicators of Climate Change in California. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, California.
- Kahler, T., M. Grassley, and D. A. Beauchamp. 2000. Final Report: A Summary of the Effects of Bulkheads, Piers, and Other Artificial Structures and Shorezone Development on ESA-Listed Salmonids in Lakes. The Watershed Company and University of Washington, , City of Bellevue Washington,.
- Kayumov, L., R. F. Casper, R. J. Hawa, B. Perelman, S. A. Chung, S. Sokalsky, and C. M. Shapiro. 2005. Blocking Low-Wavelength Light Prevents Nocturnal Melatonin Suppression with No Adverse Effect on Performance During Simulated Shift Work. *J Clin Endocrinol Metab* 90(5):2755-2761.
- Kelly, J. T. and A. P. Klimley. 2011. Relating the Swimming Movements of Green Sturgeon to the Movement of Water Currents. *Environmental Biology of Fishes* 93(2):151-167.
- Kelly, J. T., A. P. Klimley, and C. E. Crocker. 2006. Movements of Green Sturgeon, *Acipenser medirostris*, in the San Francisco Bay Estuary, California. *Environmental Biology of Fishes* 79(3-4):281-295.
- Klein, R. 2003. Duration of Turbidity and Suspended Sediment Transport in Salmonid-Bearing Streams, North Coastal California. A Report to the US Environmental Protection Agency (USEPA) Region IX. Interagency Agreement #DW-1495553501-0. Arcata, California. Redwood National and State Parks. pp. 45.
- Knudsen, E. E. and S. J. Dilley. 1987. Effects of Riprap Bank Reinforcement on Juvenile Salmonids in Four Western Washington Stream. *North American Journal of Fisheries Management* 7:351-356.
- Kogut, N. J. 2008. Overbite Clams, *Corbula Amurensis*, Defecated Alive by White Sturgeon, *Acipenser transmontanus*. *California Fish and Game* 94(3):143-149.
- Lee, B. G., J. S. Lee, and S. N. Luoma. 2006. Comparison of Selenium Bioaccumulation in the Clams *Corbicula fluminea* and *Potamocorbula amurensis*: A Bioenergetic Modeling Approach. *Environmental Toxicology and Chemistry* 25(7):1933-1940.
- Lehman, B., M. Gary, N. Demetras, and C. Michel. 2019. Where Predators and Prey Meet: Anthropogenic Contact Points between Fishes in a Freshwater Estuary. *San Francisco Estuary and Watershed Science* 17(4).
- Levengood, J. M., E. J. Heske, P. M. Wilkins, and J. W. Scott. 2015. Polyaromatic Hydrocarbons and Elements in Sediments Associated with a Suburban Railway. *Environ Monit Assess* 187(8):534.

- Linares-Casenave, J., R. Linville, J. P. Van Eenennaam, J. B. Muguet, and S. I. Doroshov. 2015. Selenium Tissue Burden Compartmentalization in Resident White Sturgeon (*Acipenser transmontanus*) of the San Francisco Bay Delta Estuary. *Environmental Toxicology and Chemistry* 34(1):152-160.
- Lindley, S. T., D. L. Erickson, M. L. Moser, G. Williams, O. P. Langness, B. W. McCovey Jr., M. Belchik, D. Vogel, W. Pinnix, J. T. Kelly, J. C. Heublein, and A. P. Klimley. 2011. Electronic Tagging of Green Sturgeon Reveals Population Structure and Movement among Estuaries. *Transactions of the American Fisheries Society* 140:108-122.
- Lindley, S. T., M. L. Moser, D. L. Erickson, M. Belchik, D. W. Welch, E. L. Rechisky, J. T. Kelly, J. Heublein, and A. P. Klimley. 2008. Marine Migration of North American Green Sturgeon. *Transactions of the American Fisheries Society* 137(1):182-194.
- Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. *San Francisco Estuary and Watershed Science* 5(1):26.
- Linville, R. G. 2006. Effects of Excess Selenium on the Health and Reproduction of White Sturgeon (*Acipenser transmontanus*): Implications for San Francisco Bay-Delta. PhD dissertation. University of California Davis, Davis, CA.
- Linville, R. G., S. N. Luoma, L. Cutter, and G. A. Cutter. 2002. Increased Selenium Threat as a Result of Invasion of the Exotic Bivalve *Potamocorbula amurensis* into the San Francisco Bay-Delta. *Aquatic Toxicology* 57(1-2):51-64.
- Longcore, T. and C. Rich. 2016. Ecological and Organismic Effects of Light Pollution. eLS:1-8.
- Lucas, P. S., R. Gomes de Carvalho, and C. Grilo. 2017. Chapter 6. Railway Disturbances on Wildlife: Types, Effects, and Mitigation Measures. Pages 81-99 in *Railway Ecology*, L. Borda-de-Agua, editor. Setor Ecologia, Departamento Biologia, Universidade Federal de Lavras, Lavras 37200-000, Brazil.
- Martin, S. B. and A. N. Popper. 2016. Short- and Long-Term Monitoring of Underwater Sound Levels in the Hudson River (New York, USA). *J Acoust Soc Am* 139(4):1886.
- McCarthy, S. G., J. J. Duda, J. M. Emlen, G. R. Hodgson, and D. A. Beauchamp. 2009. Linking Habitat Quality with Trophic Performance of Steelhead Along Forest Gradients in the South Fork Trinity River Watershed, California. *Transactions of the American Fisheries Society* 138(3):506-521.
- McCauley, R. D., J. Fewtrell, and A. N. Popper. 2003. High Intensity Anthropogenic Sound Damages Fish Ears. *J Acoust Soc Am* 113(1):638-642.
- McClure, M. 2011. Status Review Update for Pacific Salmon and Steelhead Listed under the ESA: Pacific Northwest. . Climate Change. In M.J. Ford (Ed.), pp. 281.

- McClure, M. M., M. Alexander, D. Borggaard, D. Boughton, L. Crozier, R. Griffis, J. C. Jorgensen, S. T. Lindley, J. Nye, M. J. Rowland, E. E. Seney, A. Snover, C. Toole, and V. A. N. H. K. 2013. Incorporating Climate Science in Applications of the Us Endangered Species Act for Aquatic Species. *Conserv Biol* 27(6):1222-1233.
- McEwan, D. 2001. Central Valley Steelhead. Pages 1-44 *in* Contributions to the Biology of Central Valley Salmonids, R. L. Brown, editor. CDFW Sacramento, CA, Fish Bulletin.
- McIntyre, J. K., J. W. Davis, C. Hinman, K. H. Macneale, B. F. Anulacion, N. L. Scholz, and J. D. Stark. 2015. Soil Bioretention Protects Juvenile Salmon and Their Prey from the Toxic Impacts of Urban Stormwater Runoff. *Chemosphere* 132(5):213-219.
- McIntyre, J. K., R. C. Edmunds, M. G. Redig, E. M. Mudrock, J. W. Davis, J. P. Incardona, J. D. Stark, and N. L. Scholz. 2016. Confirmation of Stormwater Bioretention Treatment Effectiveness Using Molecular Indicators of Cardiovascular Toxicity in Developing Fish. *Environ Sci Technol* 50(3):1561-1569.
- McMicheal, G. A., A. L. Anthony, and T. N. Pearsons. 2011. Electrofishing Injury to Stream Salmonids; Injury Assessment at the Sample, Reach, and Stream Scales. *North American Journal of Fisheries Management* 18(4): 894-904.
- Meehan, W. R., F. J. Swanson, and J. R. Sedell. 1977. Influences of Riparian Vegetation on Aquatic Ecosystems with Particular Reference to Salmonid Fishes and Their Food Supply. Oregon State University, Symposium on the Importance, Preservation, and Management of the Riparian Habitat.
- Mora, E. A., R. D. Battleson, S. T. Lindley, M. J. Thomas, R. Bellmer, L. J. Zarri, and A. P. Klimley. 2018. Estimating the Annual Spawning Run Size and Population Size of the Southern Distinct Population Segment of Green Sturgeon. *Transactions of the American Fisheries Society* 147(1):195-203.
- Mora, E. A., S. T. Lindley, D. L. Erickson, and A. P. Klimley. 2015. Estimating the Riverine Abundance of Green Sturgeon Using a Dual-Frequency Identification Sonar. *North American Journal of Fisheries Management* 35(3):557-566.
- Moser, M. L. and S. T. Lindley. 2006. Use of Washington Estuaries by Subadult and Adult Green Sturgeon. *Environmental Biology of Fishes* 79(3-4):243-253.
- Moser, S., J. Ekstrom, and G. Franco. 2012. Our Changing Climate 2012: Vulnerability and Adaptation to the Increasing Risks from Climate Change in California. A Summary Report on the Third Assessment from the California Climate Change Center.
- Moyle, P. B., J. A. Israel, and S. E. Purdy. 2008. Salmon, Steelhead, and Trout: Status of an Emblematic Fauna. Center for Watershed Sciences. UC Davis, Davis, California.
- Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. Fish Species of Special Concern in California. Report Contract# 2128IF, California Department of Fish and Game, Rancho Cordova.

- Munsch, S. H., J. R. Cordell, J. D. Toft, and V. Trenkel. 2017. Effects of Shoreline Armouring and Overwater Structures on Coastal and Estuarine Fish: Opportunities for Habitat Improvement. *Journal of Applied Ecology* 54(5):1373-1384.
- Nakamoto, R. J., T. T. Kisanuki, and G. H. Goldsmith. 1995. Age and Growth of Klamath River Green Sturgeon (*Acipenser medirostris*). USFWS #93-FP-13:20.
- Nielsen, J. L., T. E. Lisle, and V. Ozaki. 1994. Thermally Stratified Pools and Their Use by Steelhead in Northern California Streams. *Transactions of the American Fisheries Society* 123:613-626.
- NMFS. 1997. Fish Screening Criteria for Anadromous Salmonids. Southwest Region, National Marine Fisheries Service, Santa Rosa, California.
- NMFS. 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act. National Marine Fisheries Service, Department of Commerce, pp. 5p.
- NMFS. 2001. Guidelines for Salmonid Passage at Stream Crossings. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.
- NMFS. 2008. NMFS Pile Driving Calculations Excel. <http://www.dot.ca.gov/env/bio/docs/bio-nmfs-pile-driving-calculations.xls>. March 25, 2019.
- NMFS. 2011. Anadromous Salmonid Passage Facility Design. N. R. National Marine Fisheries Service, Portland, Oregon, pp.
- NMFS. 2013. South-Central California Coast Steelhead Recovery Plan. National Marine Fisheries Service. West Coast Region. California Coastal Office, Long Beach, California.
- NMFS. 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. National Marine Fisheries Service. West Coast Region, pp. 427.
- NMFS. 2015. 5-Year Review: Summary and Evaluation of the Southern Distinct Population Segment of the North American Green Sturgeon (*Acipenser medirostris*). National Marine Fisheries Service. West Coast Region, pp. 42p.
- NMFS. 2016a. 5-Year Review: Summary and Evaluation of Central California Coast Steelhead. National Marine Fisheries Service. West Coast Region. California Coastal Office. Santa Rosa, California.
- NMFS. 2016b. 5-Year Review: Summary and Evaluation of South-Central California Coast Steelhead Distinct Population Segment. National Marine Fisheries. West Coast Region. California Coastal Office, Santa Rosa, California.

- NMFS. 2016c. Coastal Multispecies Recovery Plan. Volume I: Chapters 1-8. National Marine Fisheries Service. West Coast Region. Santa Rosa, California.
- NMFS. 2016d. Final Coastal Multispecies Recovery Plan. Volume IV: Central California Coast Steelhead. National Marine Fisheries Service. West Coast Region. Santa Rosa, California.
- NMFS. 2017a. NOAA Restoration Center's Programmatic Approach to ESA/EFH Consultation Streamlining for Fisheries Habitat Restoration Projects. National Marine Fisheries Service. California Coastal Office. Santa Rosa, California.
- NMFS. 2017b. Recovering Threatened and Endangered Species, Fy 2015 - 2016 Report to Congress. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD.
- NMFS. 2018. Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (*Acipenser medirostris*). Sacramento, CA, Central Valley Office.
- NMFS. 2019a. Endangered Species Act Section 7(a)(2) Biological and Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the California High Speed Rail Merced to Fresno Section, Including the Central Valley Wye. Nmfs Pcts #WCR-2018-10897/WCRO-2018-00285. Central Valley Office, Sacramento, California.
- NMFS. 2019b. Guidelines for Salmonid Passage at Stream Crossings: Addendum. National Marine Fisheries Service, Santa Rosa, California.
- NMFS. 2021. 5-Year Review: Summary and Evaluation of the Southern Distinct Population Segment of the North American Green Sturgeon (*Acipenser medirostris*). National Marine Fisheries Service. West Coast Region, California Central Valley Office. Sacramento, California. pp. 63p.
- Oregon Water Resources Research Institute. 1995. Gravel Disturbance Impacts on Salmon Habitat and Stream Health. Volume I: Summary Report. Oregon State University, For the Oregon Division of State Lands.
- Osgood, K. E. e. 2008. Climate Impacts on U.S. Living Marine Resources: National Marine Fisheries Service Concerns, Activities, and Needs. United States Department of Commerce. NOAA Technical Memorandum: NMFS-F/SPO-89.
- Paul, M. J. and J. L. Meyer. 2001. Streams in the Urban Landscape. Annual Review of Ecology and Systematics 32:333-365.
- Pavlock McAuliffe, M. 2016. The Ambient Soundscape of Inland Waters in Seattle, Washington: Bridge Traffic as a Source of Urban Underwater Noise Pollution? University of Washington, Seattle, Washington.
- Pearlman, I. 2019. Bay Area's Massive Marsh Restoration Project Takes Root. Sierra, The Magazine of the Sierra Club,.

- Pearse, D. E. and M. A. Campbell. 2018. Ancestry and Adaptation of Rainbow Trout in Yosemite National Park. *Fisheries* 43(10):472-484.
- PFMC (Pacific Fishery Management Council). 1998. Description and identification of essential fish habitat for the Coastal Pelagic Species Fishery Management Plan. Appendix D to Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon. December.
- PFMC. 1998. Description and Identification of Essential Fish Habitat for the Coastal Pelagic Species Fishery Management Plan. Appendix D to Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon.
- PFMC. 2005. Amendment 18 (bycatch mitigation program), Amendment 19 (essential fish habitat) to the Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington groundfish fishery. Pacific Fishery Management Council, Portland, Oregon. November.
- PFMC. 2014. Appendix a to the Pacific Coast Salmon Fishery Management Plan as Modified by Amendment 18 to the Pacific Coast Salmon Plan: Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. 219p., pp.
- PFMC. 2019a. Coastal Pelagic Species Fishery Management Plan as Amended through Amendment 17. Pacific Fishery Management Council.
- PFMC. 2019b. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery. Appendix D: Nonfishing Effects on West Coast Groundfish Essential Fish Habitat and Recommended Conservation Measures. Pacific Fishery Management Council, Portland, Oregon.
- PFMC. 2020. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery. Pacific Fishery Management Council, Portland, Oregon.
- Popper, A. N. and M. C. Hastings. 2009. The Effects of Human-Generated Sound on Fish. *Integr Zool* 4(1):43-52.
- Popper, A. N., T. J. Carlson, A. D. Hawkins, B. L. Southall, and R. L. Gentry. 2006. Interim Criteria for Injury of Fish Exposed to Pile Driving Operations: A White Paper.
- Poytress, W. R., J. J. Gruber, and J. P. Van Eenennaam. 2011. Annual Report: 2010 Upper Sacramento River Green Sturgeon Spawning Habitat and Larval Migration Surveys. US Fish and Wildlife Service. Bureau of Reclamation, pp. 48.
- Poytress, W. R., J. J. Gruber, J. P. Van Eenennaam, and M. Gard. 2015. Spatial and Temporal Distribution of Spawning Events and Habitat Characteristics of Sacramento River Green Sturgeon. *Transactions of the American Fisheries Society* 144(6):1129-1142.

- Presser and Luoma. 2010a. Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California. A. Report, pp. 56.
- Presser and Luoma. 2010b. A Methodology for Ecosystem-Scale Modeling of Selenium. *Integrated Environmental Assessment and Management* 6(4):685-710.
- Regional Water Management Group. 2019. Bay Area Integrated Regional Water Management Plan.
- Rich, A. and E. A. Keller. 2013. A Hydrologic and Geomorphic Model of Estuary Breaching and Closure. *Geomorphology* 191:64-74.
- Rosales-Casian, J. A. and C. Almeda-Jauregui. 2009. Unusual Occurrence of a Green Sturgeon (*Acipenser medirostris*) at El Socorro, Baja California, Mexico. *California Cooperative Oceanic Fisheries Investigations Report* 50:169-171.
- Rountree, R. A., F. Juanes, and M. Bolgan. 2020. Temperate Freshwater Soundscapes: A Cacophony of Undescribed Biological Sounds Now Threatened by Anthropogenic Noise. *PLoS One* 15(3):e0221842.
- Ruggiero, P., P. D. Komar, and J. C. Allan. 2010. Increasing Wave Heights and Extreme Value Projections: The Wave Climate of the U.S. Pacific Northwest. *Coastal Engineering* 57(5):539-552.
- San Francisco Estuary Partnership. 2016. Comprehensive Conservation and Management Plan for the San Francisco Estuary: Estuary Blueprint. Goals for 2050. Actions for 2021., San Francisco, California.
- San Francisco Estuary Partnership. 2022. About Us. <https://www.sfestuary.org/about-us/>. 1/4/2022.
- San Francisco Estuary Project Management Committee. 1994. San Francisco Estuary Project. Comprehensive Conservation and Management Plan. United State Environmental Protection Agency, pp. 230.
- Santer, B. D., C. Mears, C. Doutriaux, P. Caldwell, P. J. Gleckler, T. M. L. Wigley, S. Solomon, N. P. Gillett, D. Ivanova, T. R. Karl, J. R. Lanzante, G. A. Meehl, P. A. Stott, K. E. Taylor, P. W. Thorne, M. F. Wehner, and F. J. Wentz. 2011. Separating Signal and Noise in Atmospheric Temperature Changes: The Importance of Timescale. *Journal of Geophysical Research: Atmospheres* 116(D22):n/a-n/a.
- Scavia, D., J. Field, D. Boesch, R. Buddemeier, V. Burkett, D. Cayan, M. Fogarty, M. Harwell, R. Howarth, C. Mason, D. Reed, T. Royer, A. Sallenger, and J. Titus. 2002. Climate Change Impacts on U.S. Coastal and Marine Ecosystems. *Estuaries* 25(2):149-164.
- Schreier, A., O. P. Langness, J. A. Israel, and E. Van Dyke. 2016. Further Investigation of Green Sturgeon (*Acipenser medirostris*) Distinct Population Segment Composition in Non-Natal

- Estuaries and Preliminary Evidence of Columbia River Spawning. *Environmental Biology of Fishes* 99(12):1021-1032.
- Scott, G. R. and K. A. Sloman. 2004. The Effects of Environmental Pollutants on Complex Fish Behaviour: Integrating Behavioural and Physiological Indicators of Toxicity. *Aquat Toxicol* 68(4):369-392.
- Sharpovalov, L. and A. C. Taft. 1954. The Life Histories of Steelhead Rainbow Trout (*Salmo gairdneri gairdneri*) and Silver Salmon (*Oncorhynchus kisutch*) with Special Reference to Waddell Creek, California and Recommendations Regarding Their Management. *Fish Bulletin* 98:376.
- Sigler, J. W., T. C. Bjornn, and F. H. Everest. 1984. Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon. *Transactions of the American Fisheries Society* 113:142-150.
- Sim, W. 2017. Japan's Pristine Bullet Train Safety Record Derailed by Crack, Oil Leak. *The Straits Times, Asia*. SPH Digital News, Online.
- Slotte, A., K. Hansen, J. Dalen, and E. Ona. 2004. Acoustic Mapping of Pelagic Fish Distribution and Abundance in Relation to a Seismic Shooting Area Off the Norwegian West Coast. *Fisheries Research* 67(2):143-150.
- Sogard, S. M., T. H. Williams, and H. Fish. 2009. Seasonal Patterns of Abundance, Growth, and Site Fidelity of Juvenile Steelhead in a Small Coastal California Stream. *Transactions of the American Fisheries Society* 138(3):549-563.
- Spina, A. P. 2006. Thermal Ecology of Juvenile Steelhead in a Warm-Water Environment. *Environmental Biology of Fishes* 80(1):23-34.
- Stuphin, Z. 2020. Adult Green Sturgeon in Sjrrp Restoration Area. pers. comm. K. Schmidt. April 11, 2020.
- The Coastal Conservancy. 2004. Inventory of Barriers to Fish Passage in California's Coastal Watersheds. State Coastal Conservancy, Oakland, California.
- The South Bay Salt Pond Restoration Project. 2022. The Restoration Project. <https://www.southbayrestoration.org/page/restoration-project>. 1/4/2022.
- Tian, Z., H. Zhao, K. T. Peter, M. Gonzalez, J. Wetzel, C. Wu, X. Hu, J. Prat, E. Mudrock, R. Hettinger, A. E. Cortina, R. G. Biswas, F. V. C. Kock, R. Soong, A. Jenne, B. Du, F. Hou, H. He, R. Lundeen, A. Gilbreath, R. Sutton, N. L. Scholz, J. W. Davis, M. C. Dodd, A. Simpson, J. K. McIntyre, and E. P. Kolodziej. 2021. A Ubiquitous Tire Rubber-Derived Chemical Induces Acute Mortality in Coho Salmon. *Science* 371(6525):185-189.
- Tiffan, K. F., J. R. Hatten, and D. A. Trachtenbarg. 2016. Assessing Juvenile Salmon Rearing Habitat and Associated Predation Risk in a Lower Snake River Reservoir. *River Research and Applications* 32(5):1030-1038.

- Turley, C. 2018. Impacts of Changing Ocean Chemistry in a High-Co₂ World. *Mineralogical Magazine* 72(1):359-362.
- U.S. Department of Transportation and Federal Railroad Administration. 2011. Designation of the California High-Speed Rail Authority as a Non-Federal Representative under Section 7 of the Endangered Species Act for the California High-Speed Train System. Dated March 14, 2011. pp. 4.
- Van Eenennaam, J. P., J. Linares, S. I. Doroshov, D. C. Hillemeier, T. E. Willson, and A. A. Nova. 2006. Reproductive Conditions of the Klamath River Green Sturgeon. *Transactions of the American Fisheries Society* 135(1):151-163.
- Vracar, M. S. and M. Mijic. 2011. Ambient Noise in Large Rivers (L). *J Acoust Soc Am* 130(4):1787-1791.
- Wade, A. A., T. J. Beechie, E. Fleishman, N. J. Mantua, H. Wu, J. S. Kimball, D. M. Stoms, and J. A. Stanford. 2013. Steelhead Vulnerability to Climate Change in the Pacific Northwest. *Journal of Applied Ecology* 50(5):1093-1104.
- Walter, R. 2018. Visitation Creek History and Existing Conditions. December 16, 2018. For California High Speed Rail Authority. ICF Consultants, Inc.
- Wardle, C. S., T. J. Carter, G. G. Urquhart, A. D. F. Johnstone, A. M. Ziolkowski, G. Hampson, and D. Mackie. 2001. Effects of Seismic Air Guns on Marine Fish. *Continental Shelf Research* 21(8-10):1005-1027.
- Washington Department of Fish and Wildlife. 2009. Section 7.6 Direct and Indirect Effects: Water Quality Modifications. pp. 66.
- Westerling, A. L. and B. P. Bryant. 2007. Climate Change and Wildfire in California. *Climatic Change* 87(S1):231-249.
- Westerling, A. L., B. P. Bryant, H. K. Preisler, T. P. Holmes, H. G. Hidalgo, T. Das, and S. R. Shrestha. 2011. Climate Change and Growth Scenarios for California Wildfire. *Climatic Change* 109(S1):445-463.
- Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. *Science* 313(5789):940-943.
- Wikipedia. 2019. Wenshou Train Collision. https://en.wikipedia.org/wiki/Wenzhou_train_collision. June 4, 2019.
- Wilkomirski, B., B. Sudnik-Wojcikowska, H. Galera, M. Wierzbicka, and M. Malawska. 2011. Railway Transportation as a Serious Source of Organic and Inorganic Pollution. *Water Air and Soil Pollution* 218(1-4):333-345.

- Wilkomirski, B., H. Galera, B. Sudnik-Wójcikowska, T. Staszewski, and M. Malawska. 2012. Railway Tracks-Habitat Conditions, Contamination, Floristic Settlement- A Review. *Environment and Natural Resources Research* 2(1):86.
- Williams, T. H., B. C. Spence, D. A. Boughton, R. C. Johnson, L. Crozier, N. J. Mantua, M. O'Farrell, and S. T. Lindley. 2016. Viability Assessment for Pacific Salmon and Steelhead Listed under the Endangered Species Act: Southwest. National Marine Fisheries Service. West Coast Region, pp.
- Yokoshima, S., T. Morihara, T. Sato, and T. Yano. 2017. Combined Effects of High-Speed Railway Noise and Ground Vibrations on Annoyance. *Int J Environ Res Public Health* 14(8).