APPENDIX C: NATIONAL MARINE FISHERIES SERVICE BIOLOGICAL OPINION

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: WCR--2018-10897/ WCRO-2018-00285

September 3, 2019

Mr. Mark McLoughlin
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 and Conference Opinion, and

Dear Mr. McLoughlin:

Thank you for your letter of October 3, 2018, requesting re-initiation of formal 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 California High Speed Rail Merced to Fresno Section, including the Central Valley Wye addition.

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 California Central Valley steelhead (*Oncorhynchus mykiss*) distinct population segment and a nonessential experimental population of threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*) evolutionarily significant unit, in accordance with Section 7 of the ESA. Based on the best available scientific and commercial information, NMFS concludes that the project is not likely to jeopardize the continued existence of the federally listed species, or jeopardize the reintroduction of nonessential experimental population Central Valley spring-run Chinook salmon into the San Joaquin River. NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary 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. This biological opinion also includes NMFS's review of the potential effects of the proposed action on EFH for Pacific Coast Salmon, as designated under the MSA. The document concludes that the project will adversely affect the EFH of Pacific Coast Salmon 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 Central Valley Office in Sacramento at (916) 930-3685, or katherine.schmidt@noaa.gov, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Maria Rea

Maria Rea
Assistant Regional Administrator
California Central Valley Office

Enclosure

cc: To the File No. 151422-WCR2018-SA00467

John Hunter, john.hunter@hsr.ca.gov
Chris Gurney, Christopher.Gurney@nfwf.org

UNITED STATES DEPARTMENT OF COMMERCE
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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 Consultation Number: WCR-2018-10897/WCRO-2018-00285

Action Agency: California High Speed Rail Authority

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
California Central Valley steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS)	Threatened	Yes	No	N/A[1]	N/A
Central Valley spring-run Chinook salmon (*O. tshawytscha*), Non-essential experimental population	Threatened	N/A[2]	No	N/A[1]	N/A

Fishery Management Plan That Identifies Essential Fish Habitat in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

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

Issued By:

Maria Rea
Assistant Regional Administrator

Date: **September 3, 2019**

[1] California Central Valley steelhead and Central Valley spring-run Chinook salmon critical habitats do not occur within the action area.

[2] Within the action area, non-essential experimental population Central Valley spring-run Chinook salmon are governed by a final rule under Endangered Species Act Section 10(j) and only a jeopardy determination can be made regarding a project's impact on the population. While take of this population is exempt from Section 9 prohibitions within the action area, the California High Speed Rail Authority has agreed to treat this population as a threatened species and receive this conferencing opinion to minimize or avoid impacting this population.

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°C	degrees Celsius
°F	degrees Fahrenheit
2012 NMFS BiOp	NMFS conference and biological opinion on the California High-Speed Train System for the Merced to Fresno section 2012 (PCTS# 2011/05974)
2016 NMFS MSA	NMFS Magnuson-Stevens Fishery Conservation and Management Act consultation and revised EFH response to the California High Speed Rail Merced to Fresno section 2016 (PCTS#WCR-2016-5387)
AMM	avoidance and minimization measure
Authority	California High Speed Rail Authority
BA	biological assessment
BMP	best management practice
BOR	Bureau of Reclamation
CCV	California Central Valley
CCVO	California Central Valley Office, NMFS
CDEC	California Data Exchange Center
CDFW/CDFG	California Department of Fish and Wildlife
cfs	cubic feet per second
CIDH	cast-in-drilled-hole
CMs	conservation measures
CRs	Conservation Recommendations
CV	Central Valley
CVP	Central Valley Project
CWA	Clean Water Act
dB	decibels
Delta	Sacramento-San Joaquin River Delta
DPS	distinct population segment
DQA	Data Quality Act
EFH	essential fish habitat
EINU	electrical interconnection and network upgrades
EIR/EIS	environmental impact report/environmental impact statement
EnSA	environmentally sensitive area
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionary significant unit
FHWG	Fisheries Hydroacoustic Working Group
FR	Federal Register
FRA	Federal Railway Administration
HAPCs	Habitat Areas of Particular Concern
HSR	high speed rail
ILF	in-lieu fee
ITS	incidental take statement
LID	low impact development
LWM	large woody material
MSA	Magnuson-Stevens Fishery Conservation and Management Act

NEP	non-essential experimental population
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service
NRDC	National Resources Defense Council
NTU	nephelometric turbidity unit
OHWM	ordinary high water mark
opinion	biological opinion
PAHs	polyaromatic hydrocarbons
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas & Electric
RMS	root-mean-square
ROW	right-of-way
RPM	reasonable and prudent measures
RST	rotary screw trap
SEL	sound exposure level
SJR	San Joaquin River
SJRRP	San Joaquin River Restoration Program
SPCCP	spill prevention control and countermeasures plan
SR	State Route
SRA	shaded riverine aquatic
SWE	snow water equivalent
SWPPP	stormwater pollution prevention plan
SWRCB	State Water Resources Control Board
THMFP	total trihalomethane formation potential
TMDL	Total Maximum Daily Load
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VSP	viable salmonid population
WOUS	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 USC 1531 et seq.), and implementing regulations at 50 CFR 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). A complete record of this consultation is on file at the NMFS California Central Valley Office (CCVO), titled: “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”.

1.2 Consultation History

On September 23, 2009, the California High Speed Rail Authority (Authority) requested technical assistance regarding potential effects from the Merced to Fresno section of the high speed rail (HSR) system on special-status anadromous fish pursuant to Section 7 of the ESA, as well as the effects on EFH following the requirements of the MSA.

On November 17, 2010, the Authority requested a species list from NMFS for the waterways between the cities of Merced to Fresno, California.

On February 1, 2011, a species list letter was sent from NMFS indicating that at the time construction begins on the HSR, the San Joaquin River Restoration Program (SJRRP) will have been implemented and the Authority should consider the effects of the HSR system on:

- California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS),
- Non-essential experimental population (NEP) Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) and through extension, the entire evolutionary significant unit (ESU),
- Pacific Coast Salmon EFH.

On March 14, 2011, the Federal Railway Administration (FRA) sent a memorandum of understanding to NMFS and to the United States Fish and Wildlife Service (USFWS) designating the Authority to act on behalf of the FRA as a non-federal representative and the Authority has assumed FRA's responsibilities under Federal environmental laws.

Between this time and September 2011, multiple meetings and document exchanges occurred between the Authority, NMFS, and other resource agency representatives.

On October 17, 2011, NMFS received a draft biological assessment (BA) for the Merced to Fresno section of the HSR (NMFS 2012).

On April 17, 2012, NMFS concluded formal consultation on the Merced to Fresno section of the HSR project and for the construction of the HSR viaduct crossing over the San Joaquin River (SJR) north of Fresno. NMFS issued a Section 7 ESA biological and conference opinion, and EFH conservation recommendations (PCTS# 2011/05974), to the Authority and the FRA (this consultation hereto after referred to as the 2012 NMFS BiOp). The 2012 NMFS BiOp included required ESA terms and conditions and EFH conservation recommendations (CRs) to offset adverse impacts and reduce the amount of take attributed to the proposed action (NMFS 2012).

On June 16, 2016, a meeting was held between the Authority and NMFS staff, as the construction of the Merced to Fresno section covered by the 2012 NMFS BiOp was scheduled to begin within months from the meeting date. NMFS advised that because the project had been modified substantially compared to the project description submitted in the 2011 BA, and that construction effects had likely increased from those considered in the 2012 NMFS BiOp, that the consultation should be reinitiated regarding the HSR viaduct construction over the San Joaquin River specifically.

On July 27, 2016, the Authority requested technical assistance regarding guidance assessing the potential effects and impacts associated with a redesign of the HSR viaduct crossing over the SJR, and the inclusion of the temporary trestle and additional falsework, in relation to the construction activities previously addressed in the 2012 NMFS BiOp.

On August 2, 2016, NMFS responded with a technical assistance letter, advising that: 1) the Authority may proceed with construction actions associated with the HSR crossing over the SJR and still retain their ESA take coverage without needing to re-initiate the ESA consultation, if they adhered to the take limitations stated in the terms and conditions of the 2012 NMFS BO; 2) the Authority should instead request re-initiation of the EFH consultation regarding this action to account for the additional impacts to Pacific Coast Salmon EFH beyond those considered in the EFH section of the 2012 NMFS BiOp; and 3) NMFS could better serve the Authority's consultation needs if addressed in a programmatic fashion, thus the Authority should consider entering into a programmatic consultation agreement with NMFS regarding future actions.

On August 8, 2016, the Authority sent NMFS a letter requesting re-initiation of the MSA consultation portion of the 2012 NMFS BiOp, to include an extensive in-river support trestle, cofferdams, and a hydraulic analysis of these structures.

On August 16, 2016, NMFS concluded the MSA consultation for the SJR viaduct crossing (PCTS#WCR-2016-5387) and provided the Authority with a revised EFH response and modified

EFH CRs (hereto after referred to as 2016 NMFS MSA) more appropriate to offset impacts and restore the Pacific Coast Salmon habitat affected by the project (NMFS 2016e).

On November 7, 2016, NMFS provided the Authority letter correspondence as proof of receipt of the Authority's response to receiving the 2016 NMFS MSA EFH CRs as an outcome of the reinitiation of the 2016 MSA consultation.

On December 12, 2017, NMFS sent the FRA and cc'd the Authority comments regarding the envisioned environmental review timelines for HSR projects presented at a multi-agency meeting on October 26, 2017. In response to Executive Order 13783, the Department of Commerce is committing to improvement in processing times of informational consultation, reducing steps in the review process, and increasing the use of programmatic and batched consultations, increasing tracking management, and potentially seeking legislative amendments to improve efficiency.

On January 24, 2018, the Authority requested a species list from NMFS regarding the action area for the CV Wye, a proposed addition to the Merced to Fresno section of the HSR system.

On January 25, 2018, NMFS provided the Authority with a species list for the CV Wye Section of the HSR. It identified that CCV steelhead and NEP spring-run Chinook salmon were expected to occur in the action area, and also that the action area contained EFH for Pacific Coast Salmon.

On August 16, 2018, NMFS replied to a letter from the Authority notifying NMFS of their intent to re-initiate the 2012 NMFS formal ESA Section 7 consultation and the 2016 NMFS MSA consultation in the near future via formal consultation as the Merced to Fresno section now included a new design component, the CV Wye, west of Chowchilla, California. NMFS agreed that construction activities at the SJR viaduct crossing north of Fresno may proceed while the consultations are re-initiated, as long as the construction proceeds as proposed without further changes and that all best management practices (BMPs), avoidance and minimization measures (AMMs), terms and conditions, and EFH CRs previously identified were followed or fulfilled.

On October 3, 2018, the Authority sent NMFS a request to re-initiate formal consultation pursuant to section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.) and the MSA regarding the Merced to Fresno section of the HSR, including new design component CV Wye. The re-initiation package included a request letter, a BA for the Merced to Fresno Section: CV Wye (Authority and FRA 2018), with Appendix A: HSR System Infrastructure summary, Appendix B: Conservation Measures Crosswalk, Appendix C: Preliminary Compensatory Mitigation Plan for the section, and Appendix D: USFWS and NMFS species lists. More information was transmitted via a CD-ROM that contained construction plan views of the SJR viaduct crossing and the new CV Wye waterway crossings, the 2016 SJR Restoration and Revegetation Plan, the 2017 SJR Viaduct Pile Driving Underwater Sound Monitoring Report, site photos of the SJR viaduct crossing construction in progress, and three underwater fish field surveys reporting salmonids were not detected within the project area of the SJR viaduct crossing north of Fresno. The request letter identified that the proposed project may adversely affect:

- CCV steelhead (*Oncorhynchus mykiss*) DSP,
- NEP CV spring-run Chinook salmon (*O. tshawytscha*) and the CV spring-run Chinook salmon ESU, and
- Pacific Coast EFH.

On October 16, 2018, NMFS sent the Authority an insufficiency letter and requested that more information before consultation could be initiated.

On October 29, 2018, NMFS re-initiated the 2012 NMFS BiOp and 2016 NMFS MSA, having received the lacking information via in-person meetings and emails with Authority staff and contractors.

On March 25, 2019, NMFS and Authority staff agreed to a consultation extension date of June 28, 2019, to account for time lost due to the 35-day federal government furlough and internal Authority/FRA delays.

1.3 Proposed Federal Action

Under ESA implementing regulations, "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 MSA implementing regulations, 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). The Authority has assumed the FRA's environmental permitting responsibilities through the signing of a memorandum of understanding signed March 14, 2011, and the Authority has also applied for National Environmental Policy Act (NEPA) assignment May 2, 2018 (83 FR 19395). The FRA is funding 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 section). On July 23, 2019, the Authority was granted NEPA assignment by the FRA and the State of California Governor Gavin Newsom.

The Authority proposes to construct a HSR system that would connect the major population centers of San Francisco-Bay Area with the Los Angeles metropolitan region at final build out (Authority and FRA 2018). The HSR system as a whole would be an electronically powered, steel-wheel-on-steel-passenger rail system with state of the art safety, signaling, and automated train control systems. The trains would be capable of operating at speeds up to 220 miles per hour on a fully grade-separated, dedicated track alignment.

The Merced to Fresno section of the HSR is one of a total of ten sections that will create the state-wide HSR system. This section consists of approximately 80 miles of straight track, 2 railroad passenger stations, associated railway support facilities, power transmission lines, right-of-way (ROW), and access roads. As the first section to be implemented on the ground, it is currently under construction throughout Merced, Madera, and Fresno counties, having received ESA consultations in 2012 from both NMFS (NMFS 2012) and USFWS prior to breaking ground. The previously reviewed project components regarding interactions with anadromous species under NMFS jurisdiction include the viaduct crossing of the HSR over the SJR, north of

Fresno, California. At the time of this writing, this viaduct crossing consists of an elevated structure supported by two cast-in-drilled-hole (CIDH) concrete column extensions that straddle the river at ordinary high water mark (OHWM). Temporary cofferdams and an in-water temporary support trestle were required to complete this structure. The temporary cofferdams and trestle are currently still in place though they are slated for removal during the 2019 construction season as viaduct structure construction has been completed and the site moves into the clean-up and restoration phases.

The CV Wye component was added to the Merced to Fresno section, which consists of tracks that follow the State Route (SR) 152 north to Road 11, has the same purpose as a roadway 'roundabout' that will enable trains to turn west to the Bay Area, or continue north to Merced or south to Bakersfield, and vice versa for all directions. This design component also includes associated electrical interconnection and network upgrades (EINU) necessary to operate the HSR system. The CV Wye component alone is comprised of approximately 51 miles of dual HSR track, 24 road over- and under-crossings, and railway support structures like traction power substations, switching/paralleling stations, and maintenance-of-way facilities. The EINU include: 1) new 230 kilovolt (kV) tie-line double circuit to the existing Wilson substation, 2) reconfiguring of existing 230 kV at the Wilson substation within the fence line, 3) network upgrades to 16.9 miles of existing Panoche-Junction-Oro Loma 115 kV powerline, 4) network upgrades to 13.3 miles of existing Los Banos-Oro Loma-Canal 70 kV powerline, and 5) expansion of existing El Nido substation by approximately 3 acres. The HSR ROW would also be fenced to prevent public access, with a minimum of 100 feet of separation between the two tracks and the fence.

Parts of the Merced to Fresno section that are reasonably certain to interact with species under NMFS jurisdiction are crossings of above-grade or elevated track segments that span over waterways. Specifically, the construction of the HSR crossings over the SJR (both the viaduct north of Fresno that is already constructed and the crossing west of Chowchilla, California, that is still in its design phase) and the HSR crossing over the Eastside Bypass west of Chowchilla, parallel to the San Joaquin River channel (Reach 4A) also in its design phase. All of these components will be analyzed in this opinion. For a full description of the construction activities and components of the other parts of the proposed action (i.e., EINU, state highway and local roadway modifications, freight/passenger railroad modifications, traction power substations components, and communication system installation), see Authority and FRA (2018): Chapter 2.

The precast segmental construction method is proposed for the elevated track sections. In this construction method, large concrete bridge segments would be mass-produced at a temporary on-site casting yard. Precast segments would then be transported atop already completed portions of the elevated track and installed using a special gantry crane positioned within the HSR footprint. These precast segments would be installed on supports like pre-cast, pre-stressed concrete box girders, CIDH box girders, or steel box girders (final design components may be any of these options). The height of the elevated track sections, or viaducts, depends on the height of existing structures below or at the 100-yr flood height, and may range from 35 to 90 feet above grade. Support columns would be spaced 100 to 120 feet apart on average.

Pre-construction activities include geotechnical investigations, identification and creation of staging areas, site preparation and demolition, relocation of utilities and other infrastructure (i.e., electric wiring, water canals, natural gas lines, petroleum pipelines), and implementation of temporary, long-term, or permanent road closures. Major construction activities are likely to include earthwork, excavation, construction support systems (trestles), bridge and aerial segment construction, and railroad systems construction (track work, traction electrification, signaling, and communication infrastructure placement). During peak construction, work may be underway at several locations along the route, with overlap between various elements. Working hours and personnel presence onsite will vary depending on the type of work being performed. According to BA Figure 2-2, page 2-7 (Authority and FRA 2018), construction site mobilization may begin in Year 1 of the schedule and aerial track laying would not be complete until Year 5 after start. The Authority intends to build the proposed action using sustainable methods that 1) minimize the use of nonrenewable resources, 2) minimize the effects on the natural environment, 3) protect environmental diversity, and 4) emphasize the use of renewable resources in a sustainable manner.

Proposed Conservation Measures

The Authority proposes to employ a variety of BMPs and AMMs, also known as conservation measures (CMs), to reduce or avoid adverse impacts to a variety of listed species and the habitats upon which they depend. The following CMs directly apply to listed species under NMFS jurisdiction (CCV steelhead and spring-run Chinook salmon) though other CMs will also be employed. A full description of all CMs proposed by the Authority is available in the BA, Chapter 2.6.1 General Conservation Measures (Authority and FRA 2018).

1. The following CMs apply to the design of the HSR crossings (CM-FISH-1). The Authority will implement general habitat protection measures to protect and minimize project effects on salmonid habitat:

    a. The design of the SJR and Eastside Bypass viaduct crossings will consider the increase in river flows planned by the SJRRP, and to maintain or effectively minimize any appreciable changes in scour, sediment transport, deposition, or changes in geomorphic processes that could alter habitat conditions in a manner that would impede the re-establishment of CV spring-run Chinook salmon in the SJR.

    b. The design-build team will work with NMFS to establish design hydrology and demonstrate minimal hydraulic effects from design.

    c. The Authority, along with the design-build team, will provide final SJR and Eastside Bypass crossing plans to NMFS prior to any site preparation or mobilization of construction work. If the design would affect salmonids in a manner or to an extent not previously considered, ESA Section 7 consultation would be reinitiated.

2. The following CMs apply to general construction activities (CM-FISH-1). The Authority will implement general habitat protection measures to protect and minimize effects on salmonid habitat during construction:

   a. Minimize clearing, grading, and cut-and-fill activities to the extent possible through design.

   b. Design night lighting of overwater structures (if required) such that illumination of the surrounding water is avoided.

   c. Locate temporary construction areas (e.g., staging, storage, parking, and stockpiling areas) outside of channels and riparian areas wherever feasible.

3. The following CMs apply to bank stabilization activities (CM-FISH-1). The following measures will be implemented during design and construction to minimize habitat disturbance from bank stabilization activities:

   a. Temporarily fence areas of natural riparian vegetation with high visibility environmentally sensitive area fence to protect it from work activities.

   b. Use "soft" approaches to bank erosion control to the extent possible (i.e., vegetative plantings and placement of large woody debris). Avoid hard bank protection methods (e.g., revetment) wherever feasible.

   c. Avoid the use of wood treated with creosote or copper-based chemicals in bank stabilization efforts.

   d. 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 would 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 described under CM-GEN-6.

   e. Revegetate temporarily disturbed areas with native plants to resemble the existing vegetation.

4. The following CM applies to weed control: Avoid the use of pesticides within the SJR and Eastside Bypass (i.e., the wetted channel and associated floodplain between the crests of the bordering levees).

5. The following CMs are designed to limit impacts to CCV steelhead and CV spring-run Chinook use of the project areas (CM-FISH-2). 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 time periods when effects on migrating juvenile and adult CCV steelhead and CV spring-run Chinook salmon would be minimal. Additionally, in-water work will be allowed when salmonid use is temperature limited (defined at one week of average water temperature of 75 degrees Fahrenheit (°F) or more), and work will be allowed in the channel and on the floodplain when channels are dry and ponded.

a. Near-water work is defined as construction activities other than impact pile driving occurring within the floodplain but not in the wetted channel (i.e., located between the wetted channel and the landside toe of the bordering levee).

b. In-water work is defined as all in-water work within the wetted channel and impact pile driving within the floodplain.

c. For in-water work at the SJR Reach 1A viaduct crossing north of Fresno, by SR-99, the construction work window will be **June 15 – October 31**.

d. For in-water work at the Reach 4A crossing of the SJR and the Eastside Bypass, the construction work window will be **June 1 – December 1** (Authority and FRA 2018), Table 4).

e. For near-water work at the Reach 4A crossing of the SJR and the Eastside Bypass, the construction work window will be **April 30 – December 1**.

f. If channels are dry or ponded (lacking continuous flow and connectivity), or water temperatures average 75°F or more for seven consecutive days, in-water and near-water work may proceed outside of the work windows stated above. NMFS will be consulted with to verify work can proceed if these conditions are present during construction.

6. The following CMs apply to pile driving (CM-FISH-1). If pile driving is necessary, the following measures will be implemented during design and construction to minimize its impacts on fish habitat and use:

    a. Select piles that are made of alternate materials and that produce less-harmful sounds, if feasible.

    b. Drive piles as far as possible with vibratory or other methods that produce lower levels of sound before using an impact hammer.

    c. Restrict pile driving to daylight hours from one hour after sunrise to one hour before sunset.

    d. During construction, a qualified fisheries biologist experienced with salmonid identifications will conduct snorkel surveys to confirm fish presence immediately prior to any in-water work. Surveys will be conducted again if there are multi-day pauses in in-water construction activities.

    e. Monitor piles daily for accumulated debris and remove debris to minimize hydraulic impacts.

7. The following CMs apply to managing underwater pressures caused by pile driving (CM-FISH-3).

  a. If in-water pile driving occurs in the wetted channel during the in-water work window, one of the following means of attenuating underwater sound will be implemented: 1) A cofferdam will be established around the pile driving area to keep it dewatered during impact pile driving, 2) a pipe with a larger diameter than the driven pile will be set to keep the area between the pile and the pipe completely dewatered with an air barrier, or 3) a bubble curtain will be maintained around the driven pile.

  b. NMFS will be consulted regarding the measure(s) to install piles and notified of the selected measure(s).

  c. During implementation of any of these measures and installation of driven piles, underwater sound monitoring will be conducted. If underwater sound monitoring indicates that underwater sound exceeds 205 peak strike decibels (dB) (estimated at 10 meters from the driven pile), or that the daily accumulated SEL is calculated to have exceeded 187 dB (estimated at 10 meters from the driven pile), NMFS will be notified within 24 hours and construction will cease until corrections are made to the attenuation apparatus/protocol so that the thresholds are not exceeded.

8. The following CMs apply to water diversion (CM-FISH-4). Construction within waterways may require temporary dewatering to minimize potential impacts on fisheries through pile driving, minimize potential erosion, sediment loss, scour, or increases in turbidity, and allow in-the-dry construction.

    a. If deemed necessary by NMFS, the contractor will construct cofferdams around the proposed work area or areas. Cofferdams will be kept to the minimum footprint necessary.

    b. The cofferdams will be constructed of sheet piles, gravel-filled sandbags, or comparable material. The temporary fill used to construct the cofferdam will be kept to the minimum footprint necessary.

    c. The cofferdams will be constructed over Visqueen or similar material to facilitate clean-up and removal of materials.

    d. Upon completion of construction, all temporary fills associated with the dewatering including sandbags and/or rock will be removed and the area restored to preconstruction contours.

9. The following CMs apply to fish rescue (CM-FISH-5), associated with temporary dewatering efforts.

    a. If construction requires the installation of cofferdams or dewatering, a fish rescue plan will be developed by the Authority in coordination with NMFS. The fish rescue plan will be approved by NMFS prior to starting work that may result in fish stranding. The plan will include the following content:

i. Fish rescue and relocation will be conducted by a qualified fisheries biologist with a current CDFW Scientific Collecting Permit.

ii. The fish rescue plan will also contain methods for minimizing the risk of stress and mortality from capture and handling of fish removed from the construction sites and returned to adjacent waterways.

b. Implementation of the fish rescue plan will include measures to minimize potential adverse effects on listed fish species (if present) associated with fish stranding during dewatering activities.

i. The fish rescue effort will be implemented during the dewatering of the areas behind the cofferdam(s) and will involve capture and return of those fish to suitable habitat within the adjacent waterways.

ii. A fisheries biologist will be on-site during initial pumping (dewatering) to confirm compliance with the fish rescue plan.

iii. The area will first be seined, followed by electrofishing to remove fish that are behind the cofferdam.

iv. The progress of dewatering will be monitored and allow for the fish rescue to occur prior to completely closing the cofferdam and again when water depths reach approximately 2 feet.

v. NMFS will be notified at least 48 hours prior to the start of fish rescue efforts.

vi. Information on the species, number, and sizes of fish collected will be recorded during the fish rescue and provided in a letter report to be submitted to NMFS within 30 days of the fish rescue.

Compensatory Mitigation

The Authority commits to balancing project objectives with minimizing impacts on waters of the United States (WOUS) and other sensitive environmental resources, and has selected the preliminary Preferred Alternative route based on assessing the environmental impact of each proposed route. The Authority has also created a preliminary compensatory mitigation plan that identifies potential mitigation options to offset anticipated impacts on regulated WOUS, special-status species listed as threatened or endangered under the ESA, the California Endangered Species Act, and certain non-listed special status species identified in the Draft Supplemental Environmental Impact Report/Environmental Impact Statement (EIR/EIS) as requiring compensatory mitigation for the CV Wye of the California HSR system. The preliminary compensatory mitigation plan identifies options that would offset permanent, unavoidable losses of regulated waters and achieve a “no net loss” of wetlands as: 1) mitigation banks, 2) in-lieu fee (ILF) programs, 3) conservation banks, and 4) permittee-responsible mitigation.

While the compensatory mitigation plan identified potential mitigation bank sites for other listed species, no mitigation banks approved by NMFS to offer salmonid restoration or conservation credits have service areas that serve the action area. Therefore, the Authority's compensatory mitigation plan identifies that participation in an ILF program will serve as an option to offset unavoidable impacts to habitats used by CCV steelhead and CV spring-run Chinook salmon in this action area. The National Fish and Wildlife Foundation (NFWF) provides a mitigation option that can be used by permittees to compensate for authorized impacts to aquatic resources over the geographic area under the jurisdiction of U. S. Army Corps of Engineers (USACE) Sacramento District (NFWF 2019), the ILF program. NMFS has also approved of the ILF program to offset authorized impacts to anadromous resources listed under the ESA. Therefore, the Authority has committed to meet their compensatory mitigation obligations to NMFS through participating in the NFWF ILF fee program instead of buying from, or establishing, a mitigation bank.

Specifically, the Authority's participation in the ILF program has earmarked to go towards the Mendota Wetland Restoration Project (NFWF and WRA Environmental Consultants 2019), at this time. The project site is 130 acres total, with 26.10 acres of aquatic resources being offered by re-establishing the seasonal floodplain/wetland habitat. The site is situated on the south bank of a meander bend of the SJR immediately downstream of the Chowchilla Bifurcation Structure. The site is bound to the north and west by the active channel of the SJR, Reach 2A.

Table 1. Project impact acreage estimates and in-lieu fee restored acreage compensatory mitigation targets for the HSR Merced to Fresno plus CV Wye section.

Site	**Project Impact Type**	**Impact Acreage**	**Ratio (*X*:1)**	**Mitigation Acreage**
SJR Reach 1A (Fresno, CP1)	Permanent	1.66	3	4.98
SJR Reach 1A (Fresno, CP1)	Temporary	1.62	3	4.86
Eastside Bypass (CV Wye)[1]	Permanent	1.36	1	1.36
Eastside Bypass (CV Wye)[1]	Temporary	2.72	0	0
SJR Reach 4A (CV Wye)	Permanent	0.36	3	1.08
SJR Reach 4A (CV Wye)	Temporary	0.71	3	2.13
Total	**—**	**8.43**	**—**	**14.41**

Long-term HSR operations and maintenance after construction

The Authority will regularly perform maintenance along the track and railroad right-of-way, as well as on the power systems, train control, signalizing, communications, and other vital systems required for the safe operation of the HSR system. The Authority expects maintenance methods to be comparable to those of existing European and Asian HSR systems, adapted to the specifics of the California HSR system, with inspection and maintenance for some project elements occurring several times per week (e.g. track and overhead power system) and some inspection occurring only a few times a year (e.g. structural inspection, vegetation control within the ROW). The FRA will specify standards of maintenance, inspection, and other items in a set of regulations to be issued in the next several years.

Periodic maintenance of the support piers in all crossings is required to ensure their integrity over time. The Authority proposes to perform underwater inspections on a 60-month cycle. Inspections will be performed by personnel that have appropriate certifications for diving.
For EINU components, no changes to existing operation and maintenance activities are anticipated with CV Wye implementation. Electrical lines are inspected yearly, or as needed when driven by an event or incident, such as an emergency. A detailed ground inspection is required every other year, with a subsequent aerial patrol between those years. The routine annual inspections, detailed ground inspections, and aerial patrols would not change from existing conditions with project implementation. As maintenance needs arise, repairs and preventative maintenance would continue to be fulfilled by the Pacific Gas & Electric (PG&E) transmission line crew (approximately five trained employees). Potential take of protected species by PG&E during operations and maintenance would continue to be covered under the existing PG&E San Joaquin Valley Operation & Maintenance Habitat Conservation Plan (PG&E 2007).

Interrelated and Interdependent Actions

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). The *Endangered Species Act Consultation Handbook* (USFWS and NMFS 1998) provides NMFS and USFWS with applicable guidance on how to analyze whether an activity is interrelated to or interdependent with the proposed action:

> As a practical matter, the analysis of whether other activities are interrelated to, or interdependent with, the proposed action under consultation should be conducted by applying a "but for" test. The biologist should ask whether another activity in question would occur "but for" the proposed action under consultation. If the answer is "no," that the activity in question would not occur but for the proposed action, then the activity is interrelated or interdependent and should be analyzed with the effects of the action.

The other HSR section would not be built but for the proposed action currently under consideration; thus, they should be considered interrelated to, or interdependent with, the proposed action: the Merced to Fresno plus CV Wye section.

The purpose of building a HSR system verses another type of transportation system was to connect major metropolitan hubs to the larger cities of the CCV, which currently have limited interconnectivity, with an additional goal to deliver passengers within approximately two hours of departure despite the vast distances. Currently, members of the public typically use highways to travel between these hubs, and the roads are usually clogged by automotive traffic. While each of the ten sections would theoretically be able to function independently between its own station hubs, an infrastructure project of this size would not have been undertaken simply to connect the cities of each section for such a limited distance. For passengers wishing to travel from downtown San Francisco to residences in Fresno, or vice versa, multiple sections must be completed and connected to make a daily trip feasible. Since the functionality of a state-wide high speed transportation system would not be possible without each section, the concept of the HSR system as a whole operating system will also be analyzed for adverse effects to the CCV steelhead ESU and CV spring-run Chinook salmon NEP, though at later dates when each section is submitted for ESA review prior to completing the NEPA process and awarding construction contracts.

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 adversely modify or destroy their designated critical habitat. Per the requirements of the ESA and its implementing regulations, Federal action agencies consult with NMFS on their actions that may affect listed species, and ESA Section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides 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 non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The effects analysis of the proposed action for NEP CV spring-run Chinook salmon is only included in this BO because it was requested by the Authority for conferencing purposes. There will be no take issued for CV spring-run Chinook salmon as part of this BO, and take of the NEP of CV spring-run Chinook salmon is not addressed in the ITS. The analysis on NEP CV spring-run Chinook salmon is for informational purposes only.

2.1 Analytical Approach

This 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 opinion also relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (50 CFR 402.02).

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species.
- Reach a conclusion about whether species are jeopardized.
- If necessary, suggest a Reasonable and Prudent Alternative to the proposed action.

Designated critical habitat for CCV steelhead or CV spring-run Chinook salmon does not occur within the action area of the proposed project, therefore there will not be analyses of impacts to their critical habitats.

2.1.1 Conservation Banking and ILF Participation in the Context of the ESA Environmental Baseline

Conservation or mitigation banks, or participation in the NFWF's ILF program, present a unique situation in terms of how they are used in the context of the Effects Analysis (Section 2.5) and the Environmental Baseline (Section 2.4) in ESA Section 7 consultations. When NMFS is consulting on a proposed action that includes conservation bank credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that a Section 7 consultation occurred at the time of bank establishment. When ILF payments are made, the payments are used as funding for physical restoration work at a site selected to benefit all species identified as impacted by fee-payees, and Section 7 consultation will be forthcoming but before the selected site is restored.

For these reasons, it is appropriate to treat the beneficial effects of the bank as accruing in connection with and at the time of specific credit purchases, not at the time of bank establishment or at the time of restoration work. This means that, in formal consultations on projects within the service area of a conservation bank, the beneficial effects of a conservation bank should be accounted for in the Environmental Baseline after a credit transaction has occurred. More specifically, the Environmental Baseline section should mention the bank establishment (and any consultation thereon) but, in terms of describing beneficial effects, it should discuss only the benefits attributable to credits already sold. In addition, in consultations that include credit purchases as part of the proposed action, the proportional benefits attributable to those credit purchases should be treated as effects of the action. Conversely, where a proposed action does not include credit purchases, it will not receive any direct offset associated with the bank. This approach preserves the value of the bank for its intended purposes, both for the value of the credits to the bank proponent and the conservation value of the bank to listed species and their critical habitat.

A traditional interpretation might suggest that the overall ecological benefits of the conservation bank or ILF program actions belong in the Environmental Baseline. Under this interpretation, where proposed actions include credit purchases or fee payments, it would not be possible to attribute their benefits to the proposed action, without double-counting. Such an interpretation does not reflect the unique circumstances that conservation banks and the ILF program serve.

Specifically, conservation banks are established based on the expectation of future credit purchases. Conservation banks areas would not be created and their beneficial effects would not occur in the absence of this expectation. Similarly, sites purchased, restored, and maintained by NFWF's ILF program may not have offered benefits to certain species unless earmarked to target those specific offsets during the restoration site selection and the ecological design stage, all of which may not have been put into motion without the action agency making ILF fee payments.

This opinion will analyze the beneficial effects of the credit or fee transactions associated with the proposed action. The beneficial effects associated with the remainder of the credits at the bank that have not been subject to a transaction or restoration sites under consideration but not yet implemented by NFWF's ILF program (and their associated potential ecological benefits) will not be considered in the Environmental Baseline nor in the effects of the 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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02.

The descriptions of the status of species in this opinion are a synopsis of the detailed information available on NMFS's West Coast Regional website (http://www.westcoast.fisheries.noaa.gov/). Table 2 below identifies the federally listed species with the potential to occur in the action area and the species' associated DPS or ESU listing. The website links listed below Table 2 lead to websites that provide more detailed information regarding species life history and geographical distribution, as well as the Federal Register (FR) Notices for species listing and critical habitat designation.

Table 2. ESA Listing History.

Species	**ESU or DPS**	**Original Final FR Listing**	**Current Final Listing Status**
Steelhead (*O. mykiss*)	California Central Valley DPS	3/19/1998 63 FR 13347 Threatened	1/5/2006 71 FR 834 Threatened
Spring-run Chinook salmon (*Oncorhynchus tshawytscha*)*	Central Valley ESU	9/16/1999 64 FR 50394 Threatened	6/28/2005 70 FR 37160 Threatened

* NEP spring-run Chinook salmon reintroduced to the San Joaquin River 10(j) designated 12/31/2013 (78 FR 79622)

More detailed CCV steelhead DPS and critical habitat listing information can be found at NOAA Fisheries West Coast Region's protected species CCV steelhead page, and more detailed information concerning CV spring-run Chinook salmon ESU and their critical habitat listing information can be found at NOAA Fisheries West Coast Region's protected species CV spring-run Chinook salmon page.

2.2.1 CCV steelhead DPS status

Individuals of the federally listed DPS of CCV steelhead may occur in the action area and may be affected by the proposed action, though its critical habitat does not occur within the action area. Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and viable salmonid population (VSP) parameters can be found in the 2015 5-year status review (NMFS 2016a).

Historical CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually. By the early 1960s, the CCV steelhead run size had declined to about 40,000 adults (McEwan 2001). Current abundance data for CCV steelhead are limited to reports of returns to hatcheries (Coleman National Fish Hatchery, Feather River Fish Hatchery) and redd surveys conducted on a few rivers such as American River and Clear Creek. The hatchery data are the most reliable because redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period.

CCV steelhead returns to Coleman National Fish Hatchery increased from 2011 to 2014 (see the 2015 5-year status review (NMFS 2016a) for further information). After hitting a low of only 790 fish in 2010, 2013 and 2014 averaged 2,895 fish in returns. Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200 to 300 fish each year. Numbers of wild adults returning each year ranged from 252 to 610 from 2010 to 2014.

The returns of CCV steelhead to the Feather River Fish Hatchery experienced a sharp decrease from 2003 to 2010, with only 679, 312, and 86 fish returning in 2008, 2009 and 2010, respectively. In recent years, however, returns have experienced an increase, with 830, 1,797, and 1,505 fish returning in 2012, 2013, and 2014, respectively. Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2015 that no clear trend is present.

An average of 143 redds have been counted on the American River from 2002 to 2015 (Hannon 2005, Chase 2010). An average of 178 redds have been counted in Clear Creek from 2001 to 2015 following the removal of Saeltzer Dam, which allowed steelhead access to additional spawning habitat. The Clear Creek redd count data range from less than 50 to just over 400 observed redds, and indicate a slight upward trend in abundance since 2006 (Schaefer *et al.* 2019).

Occasional catches in trawl surveys provide further information on juvenile steelhead abundance. An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the CV annually, based on rough calculations from sporadic catches in trawl gear (Good *et al.* 2005). Nobriga and Cadrett (2001) used the ratio of adipose fin-clipped (hatchery) to unclipped (wild) steelhead smolt catch ratios in the USFWS Chipps Island trawl from 1998 through 2000 to estimate that about 400,000 to 700,000 steelhead smolts are produced naturally each year in the CV. Trawl data indicate that the level of natural production of steelhead has remained very low since the 2011 status review, suggesting a decline in natural production assuming consistent hatchery releases. Catches of steelhead at the fish collection facilities in the southern Sacramento-San Joaquin River Delta (Delta) are another source of information on the production of wild steelhead relative to hatchery steelhead (CDFW 2019). The overall catch of steelhead has declined dramatically since the early 2000s, with an overall average of 2,705 in the last 10 years. The percentage of wild (unclipped) fish in salvage has fluctuated, but has leveled off to an average of 36 percent since a high of 93 percent in 1999.

Large portions of many historic populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS since they are unable to reach the ocean. Steelhead below major rim dams are well-distributed throughout the CV (Good *et al.* 2005, NMFS 2016c), however about 80 percent of the historical spawning and rearing habitat once used by CCV steelhead is now upstream of impassible dams (Lindley *et al.* 2006), which has greatly contribtued to the population's decline in abundance. Also, most populations of CCV steelhead DPS have a high hatchery component, including Battle Creek (adults intercepted at the Coleman National Fish Hatchery weir), the American River, Feather River, and Mokelumne River populations.

The observed reductions in population size are further reinforced by genetic analysis (Nielsen *et al.* 2003). Garza and Pearse (2008) also analyzed the genetic relationships among CCV steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the CV were often more closely related to below barrier fish from other watersheds than to *O. mykiss* above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers. The genetic diversity of CCV steelhead is also compromised by hatchery origin fish, placing the natural population at a high risk of extinction (Lindley *et al.* 2007).

In summary, the 2016 status of the CCV steelhead DPS appears to have remained unchanged since the 2011 status review, and the DPS is likely to become endangered in the near future throughout all or a significant portion of its range (NMFS 2014, 2016a). Indications suggest CCV steelhead have continued to decrease in overall abundance and in the proportion of natural fish over the past 25 years (Busby *et al.* 1996, Good *et al.* 2005, McClure 2011, NMFS 2014, 2016a), with a projected negative long-term trend unless recovery actions are taken. Most wild CCV populations are very small and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. Additionally, the genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild fish, but in some cases the historical genetic diversity persists in resident or adfluvial *O. mykiss* populations above major dams (Pearse and Campbell 2018). Further details regarding this DPS can be found in the 2015 5-year status review (NMFS 2016a).

2.2.2 NEP CV spring-run Chinook salmon status

Since 2014, the SJRRP has incrementally released groups of spring-run Chinook salmon back into the SJR in reintroduction efforts (SJRRP 2017a). These actions are to meet a settlement goal that also fulfills a NMFS's recovery requirement regarding the CV spring-run Chinook salmon ESU. According to a final rule under ESA Section 10(j), the CV spring-run Chinook salmon released as part of SJRRP's reintroduction efforts are designated as a NEP population inside of the experimental population area, which is defined as the SJR from its confluence with the Merced River upstream to the base of Friant Dam. All released NEP spring-run Chinook salmon juveniles are marked externally but released broodstock adults have successfully spawned in-river, producing unmarked NEP juveniles that are able to leave the NEP/SJRRP area (marked juveniles released into SJR Reach 1A were recovered downstream of the SJR/Merced River confluence, indicating juveniles are able to leave the area unassisted (NMFS 2019)).

Since the action area for this proposed action occurs inside the experimental population area of the NEP/SJRRP's Restoration area, and the project interacts with several of the migration corridors the NEP spring-run Chinook salmon must take to reach the ocean or return to the holding, spawning, and rearing areas in Reach 1A, the Authority has agreed to consider NEP CV spring-run Chinook salmon in this opinion as a threatened species. Adult NEP spring run have returned to the SJR (Cahill 2019, Sheehan 2019), though in low initial numbers and adults must be captured downstream and transported around passage barriers to reach holding and spawning grounds in Reach 1A. The number of spring-run Chinook salmon returning to the SJR in the Restoration area is expected to increase over time, as experimental hatchery production of juveniles for release is scheduled to increase, and the number of juveniles produced naturally due to increased adult escapement and spawning in-river.

Information concerning the CV spring-run Chinook ESU from which the NEP population was sourced is pertinent to the conservation considerations made for this conferencing opinion, therefore the status of the wild population is included below. The independent, wild populations of CV spring-run Chinook salmon in Butte, Deer and Mill creeks are the best trend indicators for the viability of this ESU. NMFS evaluates their risk of extinction based on VSP parameters in these watersheds. Lindley *et al.* (2007) indicated that the spring-run Chinook salmon populations in the CV had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis model and other population viability criteria (*i.e.*, population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of CV spring-run Chinook salmon was at moderate extinction risk according to the population viability analysis model, but appeared to satisfy the other viability criteria for low-risk status. However, the CV spring-run Chinook salmon ESU failed to meet the "representation and redundancy rule" for the spatial structure parameter since these three populations are the only demonstrably viable populations from one diversity group (northern Sierra Nevada) out of the three diversity groups that historically supported the ESU, or out of the four diversity groups as described in the NMFS CV Salmon and Steelhead Recovery Plan (NMFS 2014), which stated a recovery criteria of nine viable populations. Over the long term, these three remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run Chinook salmon populations in these three watersheds due to their close proximity to each other. One large event could eliminate all three populations.

The most recent status review (NMFS 2016b) reported that CV spring-run Chinook salmon escapements had increased, through 2014, since the previous status review (2010/2011), which moved the Mill and Deer creek populations from the high extinction risk category to the moderate extinction risk category, and Butte Creek remained in the low risk of extinction category. However, since the 2016 status review was issued, CV spring-run Chinook escapement estimates declined sharply, in 2016, 2017, and 2018 (California Department of Fish and Wildlife (CDFW) 2018). In 2017, Butte Creek held the majority of the spawning adults, at over 500 individuals, keeping it above the trigger of high extinction risk, while all other creeks had less than 300 adults (some creeks held 30 or less), for an estimated total of 1,105 wild fish returns. In 2018, Mill and Deer Creeks were believed to be heading towards the local extirpation of the species, with less than 500 adults consistently returning to watersheds that were once strongholds. NMFS and CDFW began drafting a CV spring-run Chinook salmon emergency action plan with the purpose of preventing this ESU from becoming classified as endangered in the next status review (Duryea 2018). In November of 2018, the Camp Fire in the City of Paradise, California, was the most destructive fire in California's history (ABC 7 News 2018). The debris and ash resultant from this wildfire is expected to devastate any spring-run Chinook salmon eggs that were incubating in the Butte Creek stream complex since the fire occurred around and upstream of many important spawning gravel beds. The poor water conditions and debris flows expected to have been mobilized by the rain that followed the wildfire are expected to suffocate and smother the developing eggs and fry, and therefore a total run failure of the 2018 cohort from Butte Creek is likely.

In summary, the CV spring-run Chinook salmon ESU is still facing significant extinction risk from many persistent threats, and may face mounting threats in the future. Detailed information regarding the ESU's life history, and VSP parameters pertaining to the natural populations that occur in tributaries of the Sacramento River basin can be found in the 2015 5-year status review (NMFS 2016b).

2.2.3 Climate change

One major factor affecting the rangewide status of all the listed anadromous fishes and their aquatic habitats in the CV at large is climate change. Temperatures are projected to increase steadily during the century, with a general increase from about 1.6°F in the early 21st century up to almost 4.8°F in the Sierra Nevada Mountains by the late 21st century (Reclamation 2015). Increased temperatures influence the timing and magnitude patterns of the hydrograph. Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000). These changes are partly due to more precipitation falling as rain rather than snow (Dettinger *et al.* 2004, Stewart *et al.* 2004). Runoff is expected to increase during the fall and winter months, and peak runoff may shift by more than a month earlier in some watersheds (Reclamation 2015).

The magnitude of snowpack reductions is also subject to annual variability in total precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (VanRheenen *et al.* 2004). Factors modeled by VanRheenen *et al.* (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100% in shallow snowpack areas). Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen *et al.*, 2004). The decrease in spring

SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the CV, where snowpack is shallower than in the SJR watersheds to the south.

An analysis on CCV steelhead's response to climate change is not available, however one has been conducted considering Chinook salmon environmental requirements. Projected warming is expected to affect all runs of CV Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, it is questionable whether any CV Chinook salmon populations can persist (Williams 2006) if Northern California atmospheric temperatures warm by 5°C (9°F), as predicted by Dettinger (2005). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951 to 1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005).

Steelhead in the CV historically consisted of both summer-run and winter-run migratory forms. Only winter-run (ocean maturing) steelhead currently are found in CCV rivers and streams as summer-runs have been extirpated (McEwan and Jackson 1996, Moyle 2002). In recent history, the summer and fall in-stream temperatures of many waterways below rim dams regularly exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 57 to 66°F (14 to 19 degrees Celsius (°C)). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough *et al.* 2001). In fact, McCullough *et al.* (2001) recommended an optimal incubation temperature at or below 52 to 55°F (11 to 13°C). Successful smoltification in steelhead however, may be impaired by temperatures above 54°F (12°C), as reported by Richter and Kolmes (2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but these individual may also experience decreased survival due to the higher metabolic demands and greater presence of predators. Additionally, stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations according to current climate change projections.

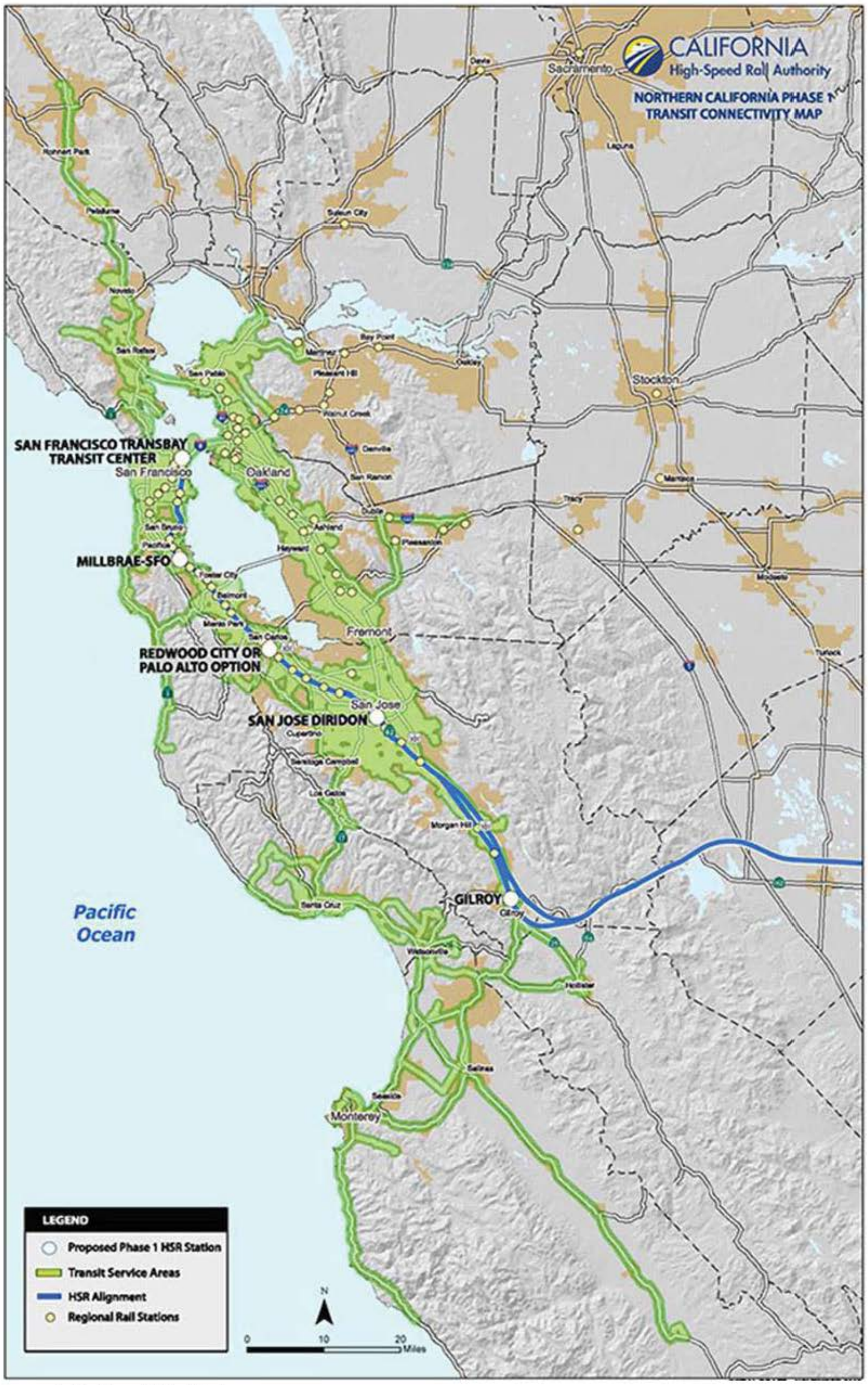
Besides simply facing temperature increases, and likely decreases in the overall availability of water at suitable temperatures during sensitive life stage periods on a region wide scale, there are additional effects expected to cascade through their freshwater ecosystems with severe consequences. Increases in the frequency, duration, and/or severity of droughts and heat stress caused by climate change are linked to wide-spread increases in tree mortality beyond what would be expected even in areas that are not normally-water limited (Allen *et al.* 2010). Widespread increases in dead trees in forested areas, as well as increases in other factors associated with climate change, greatly increase the risk for wildfires (Abatzoglou and Williams 2016). Wildfire activity in the Western U.S. has increased, with wildfires having longer durations and wildfire seasons lasting longer than they did before the mid-1980s (Westerling *et al.* 2006). Several watersheds critical to listed salmonids in the CCV have experienced large, intense forest fires recently, the Camp Fire being the most recent and most devastating example (ABC 7 News 2018). The increased risk of extinction elevated by wildfires has already been predicted in the NMFS Recovery Plan (NMFS 2014), especially for ESUs like that of the CV spring-run Chinook salmon, which is largely limited to a single geographic area and therefore extremely vulnerable to regional catastrophes.

In summary, observed and predicted climate change effects are generally detrimental to all anadromous species in the CCV as they rely on abundant cold water to successfully spawn and rear in freshwater habitats (McClure 2011, Wade *et al.* 2013). Unless offset by improvements in other factors, the statuses of these species are likely to decline over time due to the decreases in the functionality of their critical habitats to support cold-water breeding and rearing. The climate change projections referenced above cover the time period between the present and approximately 2100. While the uncertainty associated with climate change projections increases with time, the direction/trend of change is relatively certain (McClure *et al.* 2013) and is expected to exacerbate the extinction risk of the species covered here.

2.3 Action Area

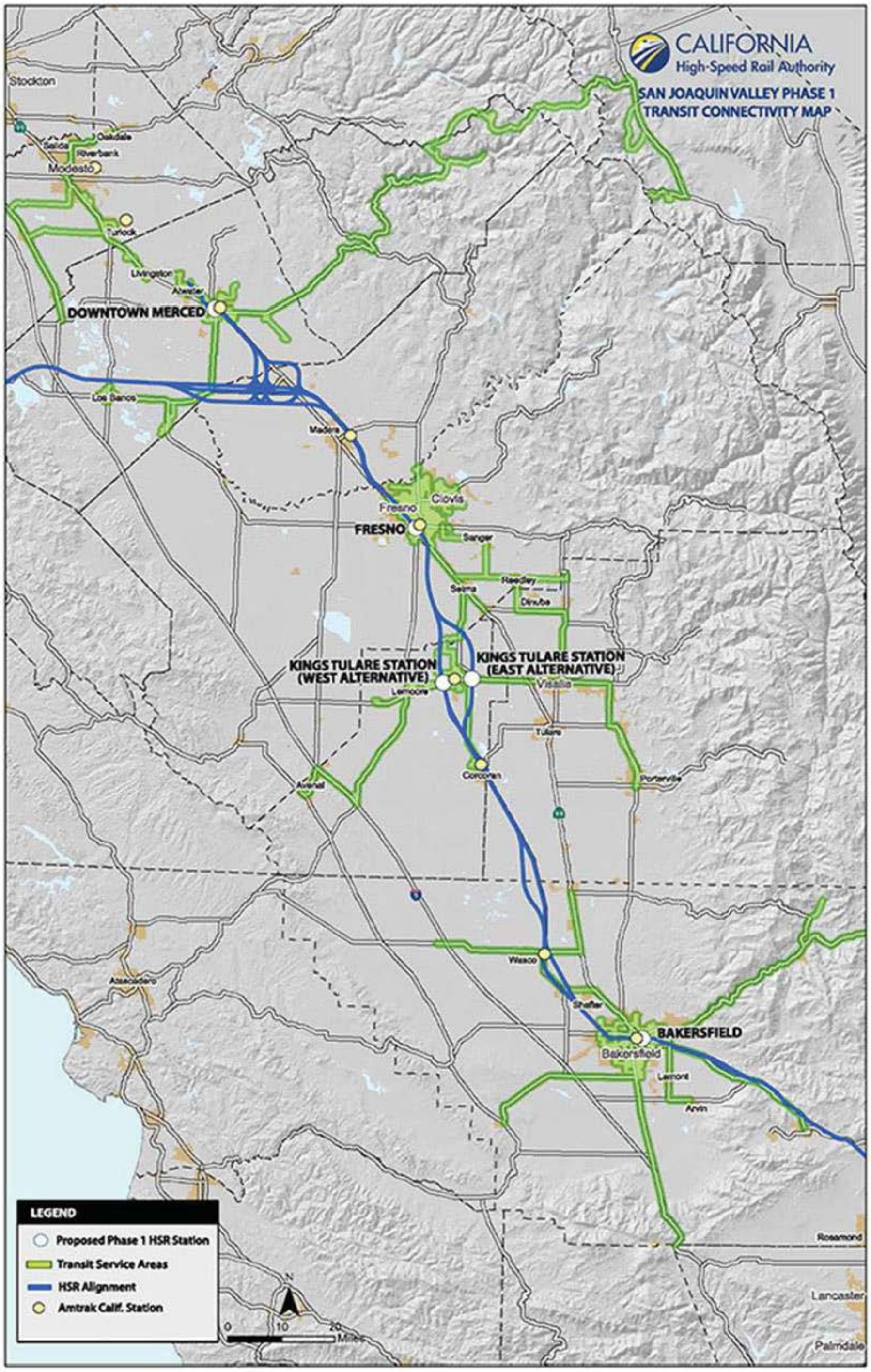
"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The immediate construction areas and where permanent structures remain that have interactions with species and habitats under NMFS jurisdiction that will be examined in this opinion include: 1) the HSR viaduct crossing over Reach 1A of the SJR north of Fresno, California (Latitude 36.844121, Longitude -119.932625); 2) the HSR viaduct crossing over the Eastside Bypass west of Chowchilla, California (Latitude 37.083793, Longitude -120.530783) ; and 3) the HSR viaduct crossing over Reach 4A of the SJR west of Chowchilla, California (Latitude 37.087718, Longitude -120.568113). Sections outside of the Merced to Fresno plus CV Wye section will be analyzed in their own biological opinions as those sections are submitted to NMFS for environmental review and will not be contained here (Figure 1, Figure 2, and Figure 3), though all sections must be completed for the HSR system to achieve its purpose in connecting the major metropolitan and urban areas of the state of California.

The action area also includes any conservation banks or restoration areas funded as part of the action. Since there are no NMFS-approved mitigation banks that offer shaded riparian or floodplain credits that include the action area of the project in their service areas, the Authority plans to participate in the NFWF's ILF program to offset long-term impacts to CCV steelhead and NEP CV spring-run Chinook within the action area. Therefore, the action area also includes the restoration site that will be funded by the fees paid by the Authority to the ILF program to offset impacts from the Fresno to Merced plus CV Wye section. Preliminary information exchanges indicate that these particular fee payments will fund the proposed Mendota Wetlands Restoration Project (Latitude 36.768224, Longitude -120.286208). The Mendota Wetlands Restoration Project is part of the Kings River Service Area approximately five miles east from the town of Mendota, California. It is a parcel along the SJR that can be converted back to floodplain habitat after a small levee is breached/set-back (NFWF and WRA Environmental Consultants 2019) that would produce 26.10 acres of aquatic habitat/credits at full realization (Figure 4).



Source: Authority and FRA, 2014b

Figure 1. HSR Northern California Phase 1 Transit Connectivity Map from the CCV to the San Francisco/San Jose Bay Area ((Authority and FRA 2018) Appendix A).

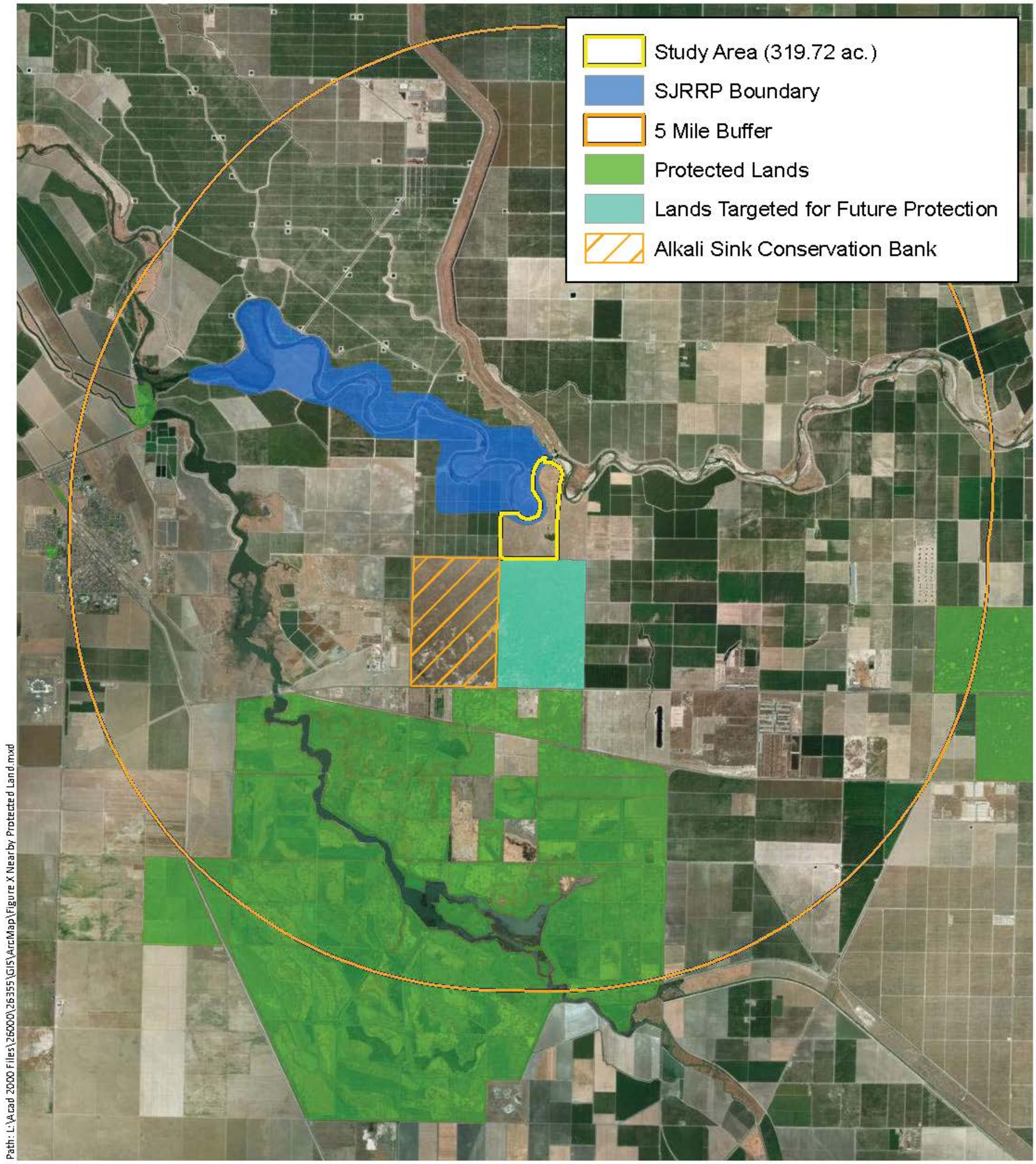


Source: Authority and FRA, 2014b

Figure 2. HSR San Joaquin Valley Phase 1 Transit Connectivity Map from Merced to Bakersfield, California, including the Merced to Fresno plus CV Wye section ((Authority and FRA 2018) Appendix A).

Source: Authority and FRA, 2014b

Figure 3. HSR Southern California Phase 1 Transit Connectivity Map from the CCV/Bakersfield to the Los Angeles/Anaheim Area ((Authority and FRA 2018) Appendix A).



Sources: National Geographic, CPAD, WRA | **Prepared By**: pkobylarz, 5/24/2018

Figure 4. Mendota Wetland Restoration Project site (yellow outline) in Fresno County, California, compared to other protected lands (green) and a portion of the SJRRP Restoration Area (blue) (NFWF and WRA Environmental Consultants 2019).

2.4 Environmental Baseline

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 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

2.4.1 Occurrence of listed species

The federally listed anadromous species that use and occupy the action area are adult and juvenile CCV steelhead and CV spring-run Chinook salmon. The SJR mainstem in the action area is the primary migration corridor for both adult and juvenile life stages spawned below Friant Dam to reach the Delta, which contains important rearing habitat for the juveniles. The Eastside Bypass has potential to act as an auxiliary pathway when water management decisions dictate its use, as juveniles may be pushed out through this pathway from Reach 1 and 2 during flood flow releases.

2.4.1.1 CCV steelhead

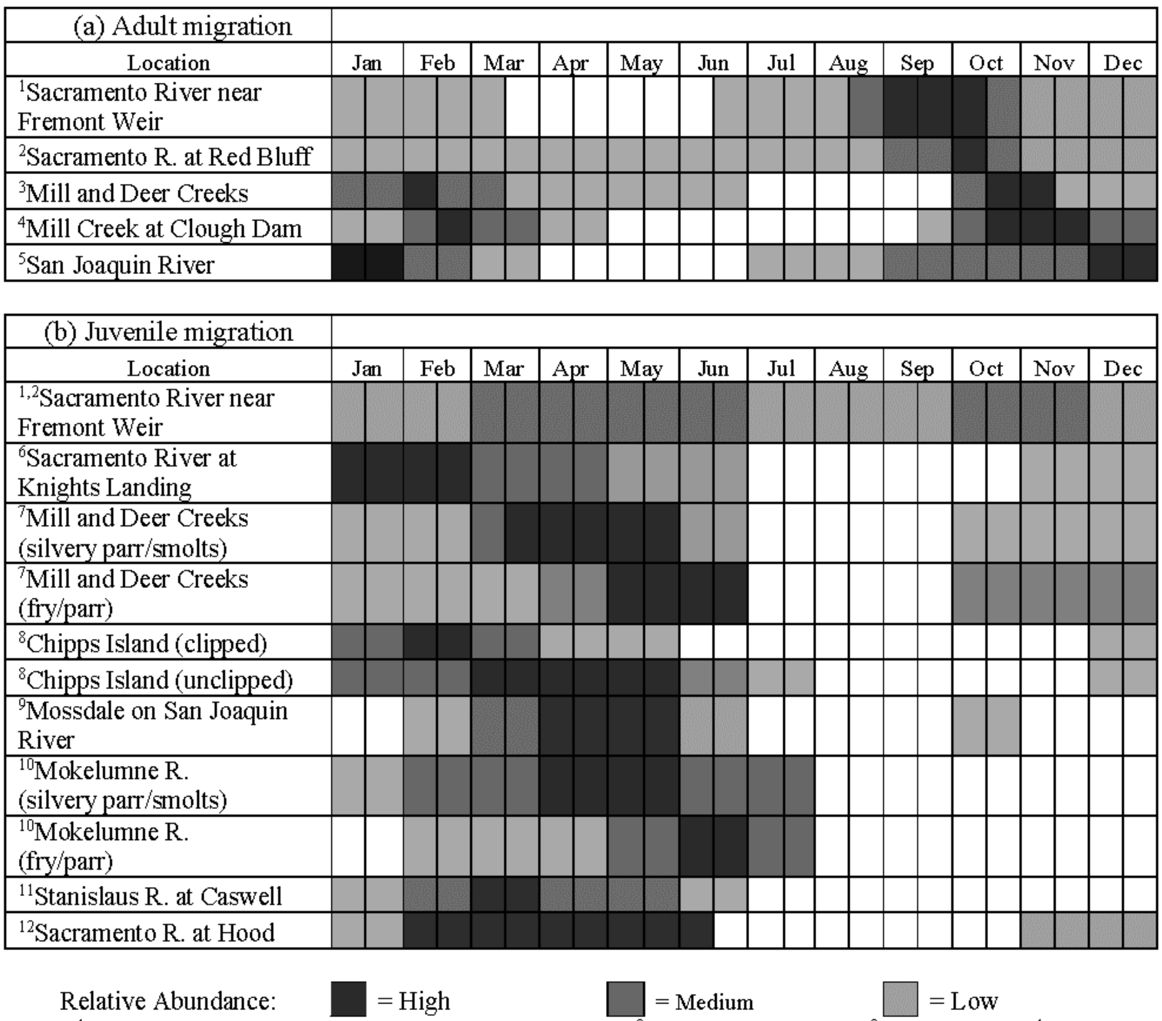
It is believed that all current stocks of CCV steelhead have a winter-run timing, meaning they may migrate up rivers in the winter starting with the first pulse of notable rain runoff (Moyle *et al.* 1995). The life history strategies of steelhead are extremely variable between individuals, and it is important to take into account that 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 Delta accounted for both upstream and downstream migrating adult steelhead (kelts).

Adult steelhead historically entered freshwater in August (Moyle 2002) and peak migration of adults moving upriver occurred August through September (Figure 5; Hallock, et al., 1957). Adult steelhead usually hold in large river mainstems until flows are high enough in the tributaries to complete their upstream, where they would spawn from December to April (Hallock *et al.* 1970). In the case of the SJR, many impassable barriers exist between the Delta, the SJR mainstem, and spawning areas in Reach 1A, until flows are over at least 5,000 cubic-feet-per-second (cfs), at which point the entire system would be in flood and fish barriers would be over-topped. This type of flooding is expected in 20% or less of all water year types (SJRRP 2017a), and could be expected to occur October (or later) through summer, depending on the year's precipitation pattern, snowpack availability, and melting rates and amounts compared to available storage capacity in Friant Dam. Additionally, the SJRRP monitors the confluence of the SJR and the Merced River for adult CCV steelhead (SJRRP 2015a), however none have been observed to date (though a large adult resident *O. mykiss* was captured in 2019 (Stuphin 2019a). Therefore an adult CCV steelhead migrating upstream could be expected to be present in the action area October through June, if the SJR were in major flood conditions at any point during that time period or if volitional passage was established through SJRRP efforts.

After spawning, any surviving steelhead kelts try to migrate back to the ocean starting in March (based on Sacramento River patterns), and have a relatively high presence in the Delta in May

(Figure 5). Therefore, kelt steelhead migrating downstream may be present in the action area from March through June, again depending on flow amounts and water temperatures.

Out-migrating juveniles in the Stanislaus River, the closest monitoring location to the construction areas, are observed January through June, with the core of their migration occurring February through the end of May (Figure 5). Larger juveniles in the process of smoltification (parr to smolt stage) have been captured until July on the Mokelumne River (Figure 5). Therefore, juveniles would be expected to be out-migrating from the upper SJR through the action area sometime between January through July, limited by suitable water temperature persistence.



Sources: [1](R. J. Hallock, D.H. Fry Jr., and Don A. LaFaunce, 1957); [2](D. R. McEwan, 2001); [3](Harvey, 1995); [4]CDFW unpublished data; [5]CDFG Steelhead Report Card Data 2007; [6]NMFS analysis of 1998-2011 CDFW data; [7](Johnson & Merrick, 2012); [8]NMFS analysis of 1998-2011 USFWS data; [9]NMFS analysis of 2003-2011 USFWS data; [10]unpublished EBMUD RST data for 2008-2013; [11]Oakdale RST data (collected by Fishbio) summarized by John Hannon (Reclamation); [12](Schaffter, 1980).

Figure 5. The temporal occurrence of (a) adult and (b) juvenile CCV steelhead at locations throughout the CV. Darker shades indicate months of greatest relative abundance.

2.4.1.2 NEP CV spring-run Chinook salmon

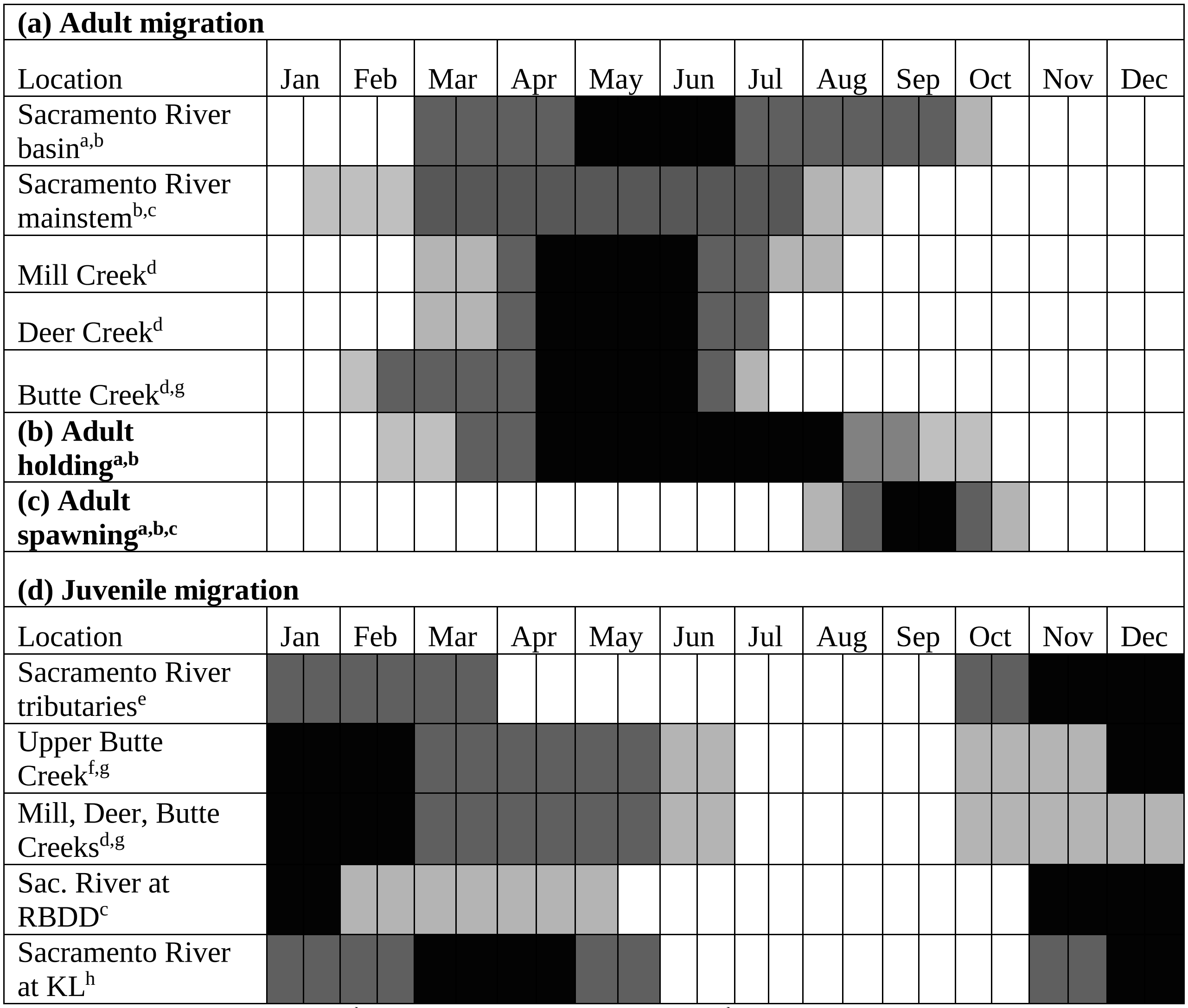
CV spring-run Chinook salmon are considered functionally extirpated from the Southern Sierra Nevada diversity group despite their historical abundance in the basin (NMFS 2016b). There have been observations of low numbers of spring time running fish returning to major SJR tributaries (the Stanislaus and Tuolumne Rivers) that exhibit some typical spring-run life history characteristics (Franks 2014). However, genetic evidence that these fish should be considered spring-run Chinook salmon is lacking (Garza 2019).

While the genetic disposition of fish from other rivers is still under scrutiny, the implementation of the reintroduction of the spring-run Chinook salmon into the upper SJR has begun and has resulted in over 800 wild-spawned NEP juvenile spring-run Chinook salmon (NMFS 2019), in addition to tens of thousands of juveniles released by SJRRP downstream of the Merced/SJR confluence for reintroduction purposes since 2014, and the return of 23 NEP adults to the SJR basin released by the SJRRP as juveniles in April 2019, likely from a 2017 release group (Glenn 2019b). Adult returns are expected to increase over time, especially as SJRRP proposed projects are completed (SJRRP 2017a, b) and river conditions become more suitable for Chinook use (NMFS 2016b).

The general CV spring-run Chinook salmon life history pattern is to return to freshwater as adults under spring floods/snowmelt flows to areas with deep holding pools high in the watersheds so that they can hold over summer and survive summer atmospheric temperatures while developing their gonads using energy reserves. Therefore adults typically return to freshwater basins starting in March (referencing the Sacramento River basin, Figure 6a), though the 23 returning NEP adults were captured April through May in the SJR basin, however high flows that persisted over March prevented adequate monitoring or fish capture that could detect earlier returns (Smith 2019). Therefore, as NEP adults begin returning in greater numbers, they may be expected to travel through the action area beginning sometime in March (Figure 6a). Several of the adults captured by SJRRP staff for transport to Reach 1A died in transit, likely due to water temperatures exceeding 75°F and in some cases 80°F, in the lower SJR near the capture location. While in-river temperatures have already receded, it is uncertain how many more adults may arrive, and at what point in the season water temperatures will completely dictate their survival by exceeding all lethality thresholds. However, if snow melt amounts and melt rates are able to drive in-river water temperatures down, adult returns could continue into July. Therefore, adult NEP returns may be expected to be present in the northern part of the action area from March through July, and in Reach 1A from the HSR viaduct crossing north of Fresno to the base of Friant Dam from March through September, however all use patterns are dictated by river flows and water temperatures.

The HSR construction areas are not adjacent to any holding habitat, though fish occasionally stray downstream during the summer. As summertime temperatures increase, adults are less and less likely to use the habitat by the HSR viaduct crossing north of the Fresno construction site. Interactions with spawning areas and activities are not expected as all known redds created by released adult NEP broodstock are located several miles upstream from the HSR viaduct crossing north of the Fresno construction site. Therefore, eggs and alevins are not anticipated to interact with the project.

NEP spring-run juveniles are expected in to be in the action area November through June (Figure 6b) as they emigrate through the action area, based on the known spring-run life history timing in the Sacramento River Basin and the limited information provided by SJRRP juvenile releases and monitoring. Rotary screw traps placed in the Restoration Area have captured fry and juveniles as early as December (Zachary Sutphin, preliminary 2018/2019 data, April 29, 2019, Fisheries Biologist, Reclamation), to mid-June in Reach 1A. Yearlings, which may stay in the system for an entire year, could be expected at the HSR viaduct crossing north of Fresno construction site at any time, depending on water temperatures. Again, exact timing of CV spring-run use of the action area is highly variable and these estimates of date ranges were made based on: 1) known volitional fish passage issues throughout the system; 2) observations of in-river water flows and temperatures; and 3) variations between life history stage timing differences between the better-known natural population in the Sacramento River basin and the information provided by the burgeoning success of the reintroduction of the NEP population in the SJR basin, as data becomes available.



Sources: [a]Yoshiyama et al. (1998); [b]Moyle (2002); [c]Myers et al. (1998); [d]S. T. Lindley et al. (2004); [e]CDFG (1998); [f]McReynolds, Garman, Ward, and Plemons (2007); [g]P. D. Ward, McReynolds, and Garman (2003); [h]Snider and Titus (2000)

Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after they hatch.

Relative Abundance: ■ = High ■ = Medium ■ = Low

Figure 6. The temporal occurrence of adult (a) and juvenile (b) Central Valley spring-run Chinook salmon in the Sacramento River (used for reference for the SJR until local information becomes available). Darker shades indicate months of greater relative abundance.

2.4.2 Factors affecting listed species

2.4.2.1 San Joaquin River Basin water resources

The SJR is the longest river in California, covering 366 miles, but is considered California's second largest river according to average total annual flow estimates. The SJR has an average flow of 6 million acre feet per year compared to the Sacramento River's 18 million acre feet (Reclamation 2015). It drains the central and southern portions of the CCV and joins the Sacramento River near the center of California to form the Delta, the largest estuary on the west coast of the United States. The SJR is primarily fed by the melting snowpack of the Sierra Nevada Mountains, receiving two thirds of its water in this way.

The primary water storage reservoir on the SJR is Millerton Lake, impounded by Friant Dam, which was completed in 1944. Millerton Lake/Reservoir can hold more than 500 thousand acre feet of water in storage. Friant Dam is then able to divert water into two canals, the Friant-Kern Canal and the Madera Canal, both of which primarily support the irrigation needs of agriculture as part of the Central Valley Project (CVP). See the existing Coordinated Long-term Operation of the CVP and State Water Project, and their effects on ESA-listed species and their critical habitats that have been analyzed in the 2009 NMFS CVP Operations opinion (NMFS 2009) for more information on the effects of federal and state water management on listed species under NMFS jurisdiction.

Since the completion of the Friant Dam/Millerton Reservoir, the entirety of SJR's flow was impounded and directed into the canals for southerly distribution by Friant Dam (except for releases into the SJR mainstem in an effort to manage flood flows and to fulfill a limited amount of riparian water rights holders downstream). These water management practices resulted in the river typically running dry for a 40 mile stretch annually and only achieving connection to the Delta during flood releases, until recently.

2.4.2.2 Flow patterns, flooding to summer lows, of the crossings

Since 2009, some forms of mandated river restoration flows have reconnected the SJR to the Delta on a semi-regular basis (see Section 2.4.3, Conservation and restoration efforts). A Settlement was reached between Natural Resources Defense Council (NRDC) et al. v. Rodgers et al (the Settling Parties) in 2006, including resolution to the finding that SJR flows were so regularly diverted out of the mainstem channel or stored in Millerton Lake to such a degree that historic water operations resulted in "significant portions of the main stem of the SJR between Friant Dam and Millerton Lake and the confluence of the Merced River being dry during significant portions of the year in most years,…" (2006) so that river flows must be released to restore the natural state of the SJR. The Settlement negotiations included, in part, a regular flow release schedule depending on water year type (Restoration Flows). Partial Restoration Flows, known as Interim Flows, began on October 1, 2009. Restoration Flows began January 1, 2014 but were curtailed in 2014 and 2015 due to extreme drought conditions. The SJR reconnected fully from Friant Dam to the Merced River confluence in August of 2016 and has been reconnected since (SJRRP 2018, 2019).

Restoration Flow and other water releases into the SJR main stem are currently implemented in a way that supports the re-introduction of spring-run Chinook salmon and their use of all reaches below Friant Dam for all life stages ((SJRRP 2017b) Appendix C, page 7). Though the total amount released each year as Restoration Flows from Millerton is dependent on the forecasted water year type, flow amounts and release periods were shaped to support the spring-run Chinook salmon spawning period, the spring-run Chinook salmon egg incubation period, fall-run Chinook salmon attraction period (fall-run Chinook salmon are also a focus species of SJRRP), the fall-run Chinook salmon spawning and egg incubation period, general winter base flows, spring rise and pulse flows (when regular increased snowmelt periods would occur naturally, as well as the spring-run Chinook salmon juvenile outmigration period and the spring-run adult attraction period), and summer base flows (including adult spring-run Chinook salmon holding period), until the cycle begins again. Critical water years still require some allocations to sustain the population, but the lower reaches are expected to receive little to no flows and may result in some lower reaches drying up again during the summers of very dry years.

In addition to Restoration Flows, the SJR basin is susceptible to flood flows since the capacity of Millerton Lake is limited to 520,500 acre feet of water (Reclamation 2016, 2019) but the annual mean flow is approximately 6 million acre feet, or more than 11 times Millerton's capacity. Flood conditions are usually in effect when SJR main stem flows are over 1,000 cfs, and have recently been recorded at over 5,000 cfs in 2016 at the Dos Palos gage in the SJR mainstem ((California Department of Water Resources 2018c, b) Figure 7). When extreme flood flows are expected, the Chowchilla and Eastside Bypasses are utilized to route excessive flows around areas vulnerable to flooding and avoid overtopping the levees and affecting adjacent properties.

The bypass system begins at the SJR 5 miles east of Mendota, California at the Chowchilla Canal Bypass Control Structure (a.k.a. the Chowchilla Bifurcation). The bypass system is designed for a capacity of 5,500 cfs however flows up to 12,000 cfs have been diverted through the bypasses when necessary (SWRCB 2010). Recent data from the California Data Exchange (CDEC) indicates that the bypass system has been utilized twice in recent years, in 2011 and 2017 (*Figure 8*). The Fresno River enters the bypass system at the downstream end of the Chowchilla Bypass, which is also where the Eastside Bypass begins, meaning the Eastside Bypass carries flows from both the Fresno River watershed and whatever flows were directed into the Chowchilla Bypass from SJR Reach 2. The Eastside Bypass's design capacity is 10,000 cfs at its entrance, but its channel capacity increases to 16,500 cfs by the time it joins the Mariposa Bypass. Flow in these bypasses are regulated by control structures downstream from the flow branching point and eventually enter the Delta.

a)

b)

Figure 7. Significant flow events (cfs) in the SJR from a) November 20, 2008 until October 20, 2018 date measured at the Donny Bridge Gage in Reach 1B, and b) since December 3, 2009 until October 20, 2018 at the Dos Palos Gage in Reach 3 (data from CDEC, (California Department of Water Resources 2018c, b)).

a)

b)

Figure 8. Recent use of the Chowchilla and Eastside Bypasses, flood event flows (cfs) from a) 2011 and b) 2017, as measured by the Chowchilla Bifurcation gage (California Department of Water Resources 2018a).

2.4.2.3 San Joaquin River water quality impairments

The Clean Water Act (CWA) gives the states the primary responsibility of protecting and restoring the quality of surface waters within state boundaries. Pursuant to CWA section 303(d), California is required to review and identify waterbodies within the state that do not meet water quality standards by identifying which parameter/standard not being met, the severity of the nonattainment, and the use of the waterbody curtailed because of its pollutants. CWA section 305(b) then requires California to report biennially the water quality conditions to the United States Environmental Protection Agency (EPA). These duties are carried out by the State Water Resources Control Board (SWRCB). The CWA section 305(b) Report and the CWA section 303(d) List was integrated into a single report for the state of California starting in 2012, (which satisfies the requirements of both CWA sections (SWRCB 2012, 2019b). Beyond the requirements, the 2012 California Integrated Report also includes SWRCB staff recommendations for additions or removals of waterbodies from the list, and input from stakeholder meetings and public comments from regional divisions. On October 3, 2017, the SWCRB issued the most recent report, the 2014 and 2016 California Integrated Report CWA Sections 303(d) and 305(b) (SWRCB 2019b) and it was approved by the EPA on April 6, 2018 (EPA 2018a).

The 2014/2016 California Integrated CWA Report assigns waterbodies to tiered categories according to the number of core beneficial uses supported by the waterway, whether a total maximum daily load (TMDL) or some other regulatory attainment framework has been implemented for the waterbody, and if enough data is available to evaluate the status of the water quality of a water body. Waterbodies may be assigned to categories 5A – 5C, 4A, or 4B, as either requiring the development of a TMDL, being addressed by a TMDL, or are being addressed by a regulatory action other than a TMDL. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a water body from known sources so that the waterbody will eventually attain and continue to meet required water quality standards to enable various water. On the 2014/2016 California CWA 303(d) list, the 70 miles stretch of the SJR from Friant Dam to the Mendota Pool is categorized as a 5A waterway, meaning that water quality standards are not met and a TMDL is still required (Table 3, (SWRCB 2016b)). The 88 mile stretch of the SJR from Mendota Pool to Bear Creek has impairments categorized as 5A and 5B, meaning that some water quality issues are being addressed with a TMDL, while others still require a TMDL (Table 3, SWRCB 2016b).

Regarding pesticides introduced from agricultural applications, in 2006 an amendment to the Basin Plan was approved by the EPA to address diazinon and chlorpyrifos discharges in the lower SJR only (EPA 2006). Currently, diazinon, chlorpyrifos, and pyrethroid pesticides are being addressed by TMDLs adopted as amendments that apply to the entire CV, including the SJR in the action area, to reduce the levels of these pesticides down to levels that are protective of both warm- and cold-water aquatic life (SWRCB 2014, 2017). A proposed TMDL amendment is in development to address organochlorine (SWRCB 2019a).

Regarding solutes that are found naturally in native soils but agriculturally concentrated through irrigation, TMDLs have been completed to address selenium inputs from Grasslands Marshes and Salt Slough, which are locations upstream and affect the action area (SWRCB 2000b, a), and salt and boron is being addressed by a phased agricultural discharge control program with a target to achieve compliance point at Vernalis, effective by 2020 (SWRCB 2019c).

Table 3. The impairments of the SJR in the action area, from Friant Dam to confluence with Bear Creek, as listed on the 2014/2016 California CWA section 303(d) list, the designated waterbody negatively affected uses, and the status of the TMDL status (SWRCB 2016b, c).

SJR	Cause of Impairment	Listing Category	State TMDL Development Status	Impaired Beneficial Use(s)
Friant Dam - Mendota Pool	Invasive Species	5A	TMDL still required	Warm freshwater habitat
Friant Dam - Mendota Pool	pH	5A	TMDL still required	Water contact recreation; municipal and domestic supply; cold freshwater habitat
Mendota Pool - Bear Creek	Boron	5A	TMDL still required	Agricultural Supply
Mendota Pool - Bear Creek	Chlorpyrifos	5B	TMDL completed	Warm freshwater habitat
Mendota Pool - Bear Creek	DDT	5A	TMDL still required	Commercial/recreation fish, shellfish, aquatic organisms
Mendota Pool - Bear Creek	Diazinon	5B	TMDL completed	Warm freshwater habitat
Mendota Pool - Bear Creek	Group A Pesticides	5A	TMDL still required	Commercial/recreation fish, shellfish, aquatic organisms
Mendota Pool - Bear Creek	Toxicity	5A	TMDL still required	Warm freshwater habitat

The SJRRP also monitors the water quality of the Restoration Area, including the action area, as water quality has a direct impact on the success of its reintroduction efforts (SJRRP 2010b). Regarding in-river temperatures, the SJRRP identifies 68°F as the upper water temperature threshold (i.e., lethal) during adult migration and holding, 62.6°F for spawning, 60°F for egg incubation, 75°F for in-river fry and juvenile growth, rearing, and out-migration for Chinook salmon, though the estimated optimal water temperatures are several degrees cooler (SJRRP 2010a). Warmer water temperatures promote bacterial activity that can compromise fish survival, and in other ways may limit the production of juvenile salmonids from the SJR and also decrease the availability of holding habitat for adult CV spring-run Chinook salmon if left uncontrolled.

Within the action area, water temperatures of the SJR normally exceed suitable temperatures for both juveniles and adults during the summer (Figure 9). Water temperatures begin exceeding 75°F at Donny Bridge (just downstream of the north of Fresno/Reach 1B) sometime between late April through early July and typical recede below 75°F early August through October (Figure

9a), depending on the water year type and atmospheric forcing of any particular year. This means this area often has temperatures that are suitable for fry and juvenile use, but not necessarily supportive of adult holding and spawning activities. In some years, however, like 2018, water temperatures remained below 75°F for the entire year, meaning adults had a much longer period in which they might use the habitat around HWY 99 and upstream, increasing the amount and availability of holding areas.

Water temperatures at the Dos Palos gage track similarly to the Donny Bridge temperatures during the same annual periods, despite being measured lower in the SJR (west of Chowchilla/Reach 4A, Figure 9b). One difference seems to be that water temperatures exceed 75°F more regularly and remain above 75°F over the summer consistently at this gage compared to the upstream gage. As returning adults would have to pass through this section of the SJR sometime from March through June, they would have to complete their migration before this area exceeded 68°F, which is also variable but occurs most often May through June.

a)

b)

Figure 9. Water temperature readings of the San Joaquin River at the a) Donny Bridge gage and the b) Dos Palos gage stations, from 2009 or 2008 until October 2018. The black line indicates a lethality threshold for all life stages of CV spring-run Chinook salmon at 75°F (California Department of Water Resources 2018c, b).

2.4.3 Conservation and restoration efforts

There are many efforts by federal and state agencies to restore aspects of the SJR basin back to its natural physical state and biological functionality. For example, the SWRCB is pursuing new narratives and revisions for the previously existing 2006 Bay-Delta plan (SWRCB 2006) that outline lower SJR flow requirements that would be necessary to support natural populations of native fishes in this system and maintain southern Delta salinities that would protect surface water quality for agricultural beneficial uses (SWRCB 2016a). These recent proposed changes to the existing Bay-Delta plan are an attempt to address the "ecological crisis" occurring in the Delta and CV while also protecting the beneficial uses the limited surface water provides to the communities of California. While ESA-listed salmonids needs are addressed in the Bay-Delta plan, these efforts focus more on restoring the functionality of the available existing habitat. Other agencies are implementing efforts that are directed more to restoring specific salmonid populations in the SJR basin.

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 in the CV is challenging due to California's large and expanding human population, the associated amount and extent of water use and manipulation, and the continuous development of natural areas for agricultural production and housing (NMFS 2014).

In the 2014 Recovery Plan, NMFS established delisting/recovery criteria for the ESU of spring-run Chinook salmon and the DPS of CCV steelhead, including that both have at least two robust populations in the Southern Sierra Diversity Group (i.e., the upper SJR tributaries) (NMFS 2014). Though there are many recovery actions that are directed to restoring the marine, estuarine, and freshwater systems that these species depend on, there are a series of actions/efforts that must be completed specific to the SJR basin for these populations to successfully establish and persist. These are identified in full in the 2014 Recovery Plan (NMFS 2014), and include: implementation of restoration flows in the SJR, re-introduction of spring-run Chinook salmon, channel modifications and reconstructions for improved passage, minimization of fish entrainment and fish loss to diversions, improved management of predation risks, improved wastewater and stormwater treatment and management, spawning gravel augmentation, reestablishment of populations above dams, and development and execution of long-term population monitoring plans, to highlight an important subset. Many of the major actions required for recovery in the SJR are scheduled to be completed by the SJRRP (SJRRP 2010a, 2012, 2017a, b, 2019), and habitat-improvement actions that are designed to benefit spring-run Chinook salmon are likely to also benefit CCV steelhead when access is restored. SJRRP-moderated restoration flows that benefit fish passage through, and use of, the SJR basin have already begun, and spring-run Chinook salmon re-introduction efforts are ongoing. Fish passage and levee improvement components are scheduled to begin in 2018 through 2020 (NMFS 2018), and the Department of Commerce is required to report to Congress on the progress made on reintroduction and plans for the future of the reintroduction by the end of 2024.

2.4.3.2 The San Joaquin River Restoration Program

As previously discussed, the SJRRP is the result of a settlement that was reached in 2006 on an 18-year lawsuit between federal agencies, the Natural Resources Defense Council, and the Friant Water Users Authority (SJRRP 2018). The settlement stipulates that sufficient fish habitat must be provided in the SJR below Friant Dam so that two primary goals are met: 1) Fish populations must be maintained and restored to "good conditions" in the mainstem of the SJR from Friant Dam to the confluence of the Merced River, including self-sustained populations of salmon; and 2) Water management must reduce or avoid adverse water supply impacts to all Friant Division long-term contractors that may result from interim and restoration flows provided for fish and wildlife restorations. Some critical recovery actions identified in the NMFS recovery plan are achieved through the implementation of the settlement goals. Though this settlement and the SJRRP actions are restricted to the recovery area, the SJR mainstem from Friant Dam to the Merced River, the achievement of volitional fish passage from the Delta to the base of Friant Dam would increase the use of the SJR mainstem within the action area of this project by both adult and juvenile salmonid migration. SJRRP restoration projects slated for near-term implementation include: 1) the Reach 2B and Mendota Pool Bypass (creates bypass around Mendota Dam and increases capacity of Reach 2B to 4,500 cfs); 2) the Reach 4A and Eastside Bypass Improvement Project (restores the flow capacity of the low-flow channel in the Eastside Bypass and removes fish barriers); the Arroyo Canal and Sack Dam fish screen and fish passage project (adds a fish screen to the Arroyo Canal and modifies Sack Dam for fish passage); and 4) the Gravel Pit Isolation Project (inventories gravel pits of the SJR and ranks priority to which pits most adversely affect reintroduction efforts so they can be addressed in order of impacts). Several of these project directly address recovery actions outlined in the NMFS recovery plan for the SJR (NMFS 2014). There are also several additional projects that target the second goal of the SJRRP, i.e., minimizing effects of water management to water users, but that will not be covered in this section as these actions are unlikely to benefit the conservation or restoration of these species directly (more information may be found here: http://www.restoresjr.net/projects/).

2.4.3.3 In-lieu fee program

Currently there are no mitigation banks that serve the action area *and* offer NMFS-approved salmonid credits, shaded riparian, or floodplain credits. Therefore, as previously identified, the Authority will pay into USACE/NFWF's in-lieu fee program, enabling the restoration of the Mendota Wetland Restoration Project since the fee payments will be earmarked to offset impacts to CCV steelhead and NEP CV spring-run Chinook salmon.

Considered part of the environmental baseline, there are four biological communities present onsite currently at the Mendota Wetland Restoration Project: ruderal alkali grassland, seasonal wetlands, open water, and mixed riparian woodland scrub (NFWF and WRA Environmental Consultants 2019). Historical SJR floodplain habitat has remained largely unaltered though kept from seasonal inundation due to levees. While no special status species have been observed on-site thus far, once the floodplain acres are reconnected via levee breaches, this area will be highly beneficial to rearing anadromous fishes, most likely to rearing NEP spring-run Chinook salmon reintroduced by the SJRRP. This restoration project augments a recovery action identified in the NMFS recovery plan to permanently protect and restore riparian and floodplain habitats along the SJR (NMFS 2014).

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. The analyses of effects on CCV steelhead and CV spring-run Chinook salmon will occur together for the consideration of the effects of operation of the California HSR system, due to the similarities in their life history patterns, timing and use of the action area, the limitations of their physiology, and their generally similar reactions to environmental perturbations.

Three viaducts proposed for the Merced to Fresno, including the CV Wye, HSR section crossing over with waterways containing listed salmonids considered in this opinion are: 1) the crossing over the SJR Reach 1A SR-99/North of Fresno (currently in construction), 2) the crossing over the SJR Reach 4A/West of Chowchilla, and 3) the crossing over the Eastside Bypass/West of Chowchilla. After construction of the Merced to Fresno plus CV Wye section is complete, construction site clean-up and habitat restoration will commence. As construction of the other HSR track sections, stations, and maintenance yards move towards completion, the Authority and its contractors will begin safety tests of rolling stock/high speed trains. The Phase I of the HSR system will be considered complete when all sections, stations, and associated utilities and infrastructure of the Northern California Section (San Francisco/San Jose/Gilroy), the San Joaquin Valley Section (Merced/Fresno/Bakersfield), and the Southern California Section (Palmdale/Los Angeles/Anaheim) are connected and passenger operations can begin.

This opinion will consider the direct and indirect effects of the construction of the three bridges in the Merced to Fresno section plus the CV Wye section, and the long-term effects of HSR structure permanence and operations in the action area, as described in the 2018 HSR BA (Authority and FRA 2018).

2.5.1 Direct and indirect effects to species

2.5.1.1 General construction activities

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, directly or indirectly. 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.

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 direct and indirect adverse effects could vary. An example of a direct adverse effect 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. In the context of construction at the viaduct crossings, the migratory and rearing behaviors of juvenile salmonids are expected to be affected by various construction-related effects.

To minimize the impacts of construction on listed salmonids, the Authority has proposed to adhere to specific work windows for in-water and near-water construction activities of the HSR system in the Merced to Fresno plus CV Wye section (pile-driving activities and adverse effects will be discussed in Section 2.5.1.4 Vibratory and impact pile driving, below).

Table 4. Proposed work windows by viaduct crossing and construction activities.

Site	Specified Activity	Work Window
Reach 1A/SR-99 North of Fresno	• In-water work • In-water impact and vibratory pile driving • Impact pile driving in floodplain outside of wetted channel	June 15th – October 31st
SJR Reach 4A Eastside Bypass West of Chowchilla	• In-water work • In-water impact and vibratory pile driving • Impact pile driving in floodplain outside of wetted channel	June 1st – December 1st
SJR Reach 4A Eastside Bypass West of Chowchilla	• All other near-water work in floodplain	April 30th – December 1st

These proposed in-water and near-water work windows align with work windows recommended by NMFS during early technical assistance meetings, and avoid the majority of the time periods CV spring-run Chinook salmon and CCV steelhead will use these areas. The BA also states that all construction in the Eastside Bypass channel will only occur when the channel is dry (i.e., not in use conveying water), therefore salmonid use of that immediate construction area would be extremely unlikely and listed fishes would not be adversely affected by work activities in that situation.

However, because each of these species may utilize a yearling life history strategy (i.e., juveniles rearing in freshwater habitats for longer than a year since hatching), a yearling could be present in any work area near a connected waterway at any point of the year, given suitable water temperatures. Also, steelhead adults occupy or migrate through freshwater habitats from July to December, but suitable water temperatures and adequate passage conditions would restrict their use of the action area. Due to the complexity of considering two species, and multiple life stages, locations, and work activities, Table 5,Table *6*, and Table *7* below summarize the assessed exposure of each subgroup to the proposed construction work windows.

Table 5. Evaluation of listed fish exposure by life stage and likelihood of habitat occupation to in-water construction (not including impact pile driving in the floodplain, see above work window) occurring at the SJR Reach1A/north of Fresno from June 15th – October 31st.

Species, life stage	Risk associated with the **June 15th – October 31st** work window at the SJR Reach 1A/north of Fresno site
NEP CV spring-run Chinook juveniles	Spring-run Chinook salmon juveniles may be finishing their out-migration from rearing areas in Reach 1A beyond June 15th, exemplified by rotary screw trap (RST) captures of spring-run juveniles until June 23, 2018 (NMFS 2019, Stuphin 2019b). Therefore, NEP CV spring-run juvenile may be present while in-water construction begins, though the extent downstream and duration of their occupation is dependent on seasonal water temperatures. If they are present during in-water impact pile driving, they are likely to be injured. Impact risk: Moderate
NEP CV spring-run Chinook yearlings	Spring-run Chinook salmon juveniles that persist in Reach 1A past the downstream migration period will become yearlings. Their use of the habitat near the construction area through the in-water work window is dependent on local water temperature, which may remain suitable until mid-to-late July in the summer. Water temperatures may again lower to below 68°F as soon as mid-September, and yearlings would be expected to migrate downstream in December through January. Therefore, in-water work may also overlap with yearling presence during the in-water window, depending on water temperatures and annual variation. If they are present during in-water impact pile driving, they are likely to be injured. Impact risk: Moderate
NEP CV spring-run Chinook adults	Adult NEP CV spring-run Chinook salmon, whether an adult return trapped, hauled past passage barriers, and released into Reach 1A, or a brood stock adult released for in-river spawning purposes, may be in Reach 1A at the beginning of the in-water work window (June 15th). Trapped and hauled returning adults are released at Camp Pashayan (the same river access locale as the SJR Reach1A/north of Fresno construction site) for water temperature acclimation purposes (Glenn 2019a). However, most fish quickly

	swim upstream to holding pool much further up Reach 1A and past acoustic tracking data of released adult brood stock has shown that while released adults display movement, none have strayed as far downstream as the SR-99/north of Fresno crossing construction area. Preliminary data of their movements and a seeming preference to stay higher up in Reach 1A does not preclude their use of the action area, if water temperatures were suitable, as redd surveys have marked fall-run Chinook redds directly below the crossing footprint (SJRRP 2016). Therefore, there is a small probability that an adult may be present in the habitat in the construction area, but it would be highly atypical, based upon available data, especially during the work window. <u>Impact risk: Low</u>
CCV steelhead juveniles	CCV steelhead juvenile outmigration should be on a similar time frame as CV spring-run juveniles, and they would be similarly limited by water temperature thresholds, though steelhead juveniles have higher water temperature tolerances compared to Chinook salmon juveniles (McEwan 2001). An adult rainbow trout has been captured upstream of the Merced River/SJR confluence (Stuphin 2019a) and rainbow trout parents are capable of producing anadromous offspring (NMFS 2014), though not included under ESA protections themselves. This adult was captured and moved back downstream according to the SJRRP's steelhead monitoring program guidelines. However, CCV steelhead have not been identified in the SJR upstream of its confluence with the Merced since the river's reconnection in 2012 (SJRRP 2015a). Without adults spawning upstream to produce a CCV steelhead juvenile, the overall probability of a juvenile occurring in the construction zone is low, even when suitable water temperatures persist throughout the area. <u>Impact risk: Low</u>
CCV steelhead adults	As above, adult CCV steelhead have not been observed in the SJR since their extirpation, however improvements in river health associated with flow amounts and aquatic/riparian/floodplain habitat conditions increase the probability of their recolonization of the Restoration Area each year as restoration efforts continue. Steelhead adults are more capable swimmers and jumpers than Chinook salmon, and are able to pass barriers that block Chinook salmon adults, given sufficient flow. If steelhead adults were to

	occur the action area, they would be arriving with the initial portion of substantial fall/winter rain runoff (September through December) to spawn sometime in winter (December through January). Additionally, adults may survive spawning and go back downstream as kelts, meaning adult CCV steelhead may be traveling through the construction area any time between January through May, if present and water temps/conditions are suitable, and therefore may overlap with in-water construction at this location. Due to their life history strategies, an adult CCV steelhead has a very low probability of occurring within the construction zone from approximately September through October 31st, when they are migrating upstream and may be injured during in-water impact pile-driving. However they would be very few in number, only those that were not captured and relocated by the SJRRP steelhead monitoring program. <u>Impact risk: Very Low</u>

Table 6. Evaluation of listed fish exposure by life stage and likelihood of habitat occupation to in-water construction (including in-water impact and vibratory pile driving and impact pile driving in floodplain but outside of wetted channel) occurring at the SJR Reach 4A/west of Chowchilla from June 1st – December 1st.

Species, life stage	Risk associated with using the **June 1st – December 1st** work window at the SJR Reach 4A/west of Chowchilla site
NEP CV spring-run Chinook juveniles	NEP CV spring-run Chinook juveniles are unlikely to be present in the SJR Reach 4A or the Eastside bypass during the work window according to the outmigration timing data currently available (NMFS 2019), coupled with the average water temperatures during the work window being suitable to host the juveniles. Juveniles are usually past this area and in the Delta by the end of April. Therefore, it is unlikely that juveniles would be present in the waterways near the construction area during the work window and would not overlap with in-water activities or pile-driving. Impact risk: Low
NEP CV spring-run Chinook yearlings	Chinook yearlings are unlikely to be present in Reach 4A or the Eastside Bypass during the majority of the work window. They may be present when water temperatures and flow are suitable in the fall and winter (SJRRP tagged yearling releases show fish traveling to the Delta within 3 months of release (NMFS 2019)), and it is possible yearlings could be forced out of superior rearing habitat in Reach 1A if heavy early rains occur October through December or spring/early summer snowmelts cause flood flows that require the use of the Eastside Bypass, as seen in May of 2019. However a majority of their natural movement is expected to occur December through March. There is a very low probability that a yearling spring-run Chinook would occur in the Reach 4A during the latter part of the work window. Impact risk: Low
NEP CV spring-run Chinook adults	Adult NEP spring-run Chinook are expected to migrate through the middle reaches of the SJR/Eastside Bypass before May to begin holding in Reach 1A before water temperatures exceed 68°F, which is reflected in water temperature readings from the Dos Palos gage (California Department of Water Resources 2018c).

	Also, multiple migration barriers still exist downstream and would likely prevent adult upstream passage to this construction site in normal water years, until all SJRRP passage projects are complete. Therefore, neither naturally returning CV spring-run Chinook salmon nor released reintroduction adult brood stock would be expected to be using this river reach during the work window, so no interaction is expected. <u>Impact risk: Very Low to None</u>
CCV steelhead juveniles	Juvenile steelhead outmigration should be on a similar time frame as CV spring-run juveniles, since they are also adversely affected by high water temperatures though their upper lethal limit is slightly above that of Chinook salmon. Therefore, juvenile steelhead should have left the area for the Delta by April or May, but certainly by June. Combined with the previous discussion that CCV steelhead have not been positively identified or captured in the SJR upstream of its confluence with the Merced River since their extirpation, the overall probability of juvenile presence in SJR Reach 4A during the work window is low. <u>Impact risk: Low</u>
CCV steelhead adults	Improvements in flow amounts and habitat conditions annually increase probability of adult CCV steelhead occurrence as the SJRRP continues with their restoration efforts. Steelhead are more capable swimmers and jumpers than Chinook salmon, and are able to pass barriers that block Chinook salmon adults, given sufficient water flow. If an adult were to occur in the area, it could be traveling through the construction area any time between October through May, if storm runoff and other water conditions were suitable, and if it avoided capture by the steelhead monitoring program. Even so, the total number of adults would be expected to be very low overall, until most river restoration and connectivity issues are addressed by SJRRP actions. <u>Impact risk: Very Low</u>

Table 7. Evaluation of exposure of listed fish by life stage and likelihood of habitat occupation to near-water construction (but not impact pile driving in the floodplain, see above in Table 6) occurring at the SJR Reach 4A and Eastside Bypass/west of Chowchilla from April 30th –December 1st.

Species, life stage	Risk associated with using the **April 30th –December 1st** work window at the SJR Reach 4A/west of Chowchilla site
NEP CV spring-run Chinook juveniles	NEP CV spring-run Chinook juveniles may be at the tail end of their out-migration period through the middle reaches of the SJR, depending on water temperatures. They may also be in the Eastside Bypass if used for flood control purposes, which may persist until July. Therefore, juveniles may be present in the waterway during near-water construction, and their movement patterns could be disturbed. Impact risk: Low to Moderate
NEP CV spring-run Chinook yearlings	Juveniles may stay in Reach 1A for more than a year and migrate out of the region December through early spring and use this location when water temperatures and flows are suitable. However, available data indicates that yearly fish generally leave the Restoration Area and arrive in the Delta within 3 months of release (NMFS 2019). Potential overlap of yearling Chinook use and near-water work activities is expected to occur only at either end of the work window, and yearlings would not be expected to be greatly harmed by the near-water work. Impact risk: Low
NEP CV spring-run Chinook adults	NEP adults are expected to migrate through the middle reaches of the SJR and the Eastside Bypass April through June, and therefore their occurrence in the action area is expected to overlap with construction for a short period with the beginning of the near-water work window at these locations. SJRRP counted over 20 adult returns as of May 21, 2019 (Glenn 2019b), and more are expected but they require capture and transport around passage barriers to reach the upper SJR. The number of returning adults

	is expected to stay relatively low until passage barriers downstream are addressed through SJRRP restoration actions. Impact risk: Low
CCV steelhead juveniles	Juvenile CCV steelhead outmigration should be on a similar time frame as CV spring-run juveniles, since they are also adversely affected by high water temperatures, although their upper lethal limit is slightly above that of Chinook salmon. While juvenile steelhead should have left Reach 4A area for the Delta by April or May, there may be some overlap of work activities and CCV steelhead use of the water way during the work window. Combined with the previous discussions that CCV steelhead have not been positively identified or captured in the SJR upstream of its confluence with the Merced River since their extirpation, the overall probability of juvenile presence is small. Impact risk: Low
CCV steelhead adults	Improvements in flow amounts and habitat conditions annually increase the probability of adult CCV steelhead occurrence as the SJRRP continues with their restoration efforts. Steelhead are more capable swimmers and jumpers than Chinook salmon, and are able to pass barriers that block Chinook salmon adults, given sufficient water flow. If an adult did manage to spawn upstream in the SJR and survive, it would be migrating through Reach 4A as a kelt sometime between January through March, before the start of this work window. If an adult migrated upstream through Reach 4A, it could be traveling through the construction area any time between October through December, if storm runoff and other water conditions were suitable and if it avoided capture by SJRRP's steelhead monitoring program. Even so, the total number of adults would be expected to be very low overall, until most river restoration and connectivity issues were address by SJRRP actions. Impact risk: Very Low

In addition to the seasonal work windows, active work hours conducted near waterways would be limited to daylight hours from one hour after sunrise to one hour before sunset. These daily work hour restrictions are likely to minimize project effects on fish migration and passage behaviors during crepuscular periods and at night. Recent studies suggests that adult steelhead show the greatest amount of upstream movement in river mainstems from early dawn until approximately 0800 hours and show somewhat more movement nocturnally compared to mid-morning and evening hours (Keefer *et al.* 2012). Steelhead juveniles are known to change diel movement tactics as they leave their natal streams; however, in this section of the SJR/Delta, they are expected to move mostly at night or have no preference between night or day movement (Chapman *et al.* 2012).

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. 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 great amount of acute physiological stress.

Because salmonid use of the middle SJR/Reach 4A is limited by warm temperatures and adequate water flows, the Authority has 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. If water temperatures exceed Chinook temperature tolerances (SJRRP 2010a) for a week or more, salmonids are likely to have vacated the area to seek thermal refugia elsewhere and would no longer be present in the Reach 4A construction site effects boundaries. Seven consecutive days is ample time for individuals to move to other areas upstream closer proximity to the Friant Dam spillway where water temperatures are kept suitable, or complete their outmigration to the Delta. In such cases, there is no cause for construction to adhere to the work windows designed to avoid salmonid use if construction impacts to individual salmonids 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 propose to contact NMFS to confirm with staff that local water temperatures measured 75°F or more for at least seven consecutive days, that salmonid presence is not expected in the area, and that construction may commence outside of the stated work windows. 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 salmonids in the action area.

Viaduct 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 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 juvenile CCV steelhead present in the action area during the proposed in-water construction window. For salmonids specifically, high sedimentation and turbidity levels has 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., clear waters). Coupled with information presented by Gregory (1993) which found that juvenile Chinook salmon decrease predator avoidance behaviors at increased turbidities, juvenile salmonids may avoid clear waters where they are easily visible to predators but since they experience negative physiological effects in muddy waters, they may be most successfully overall in slightly cloudy waters. Given the proposed development of a stormwater pollution prevention plan (SWPPP) and the other erosion control BMPs included in the project description and general Authority construction guidelines, it is unlikely that construction activities will alter the natural range of in-river turbidities to a degree that would adversely affect the salmonids using the action area, therefore adverse effects are expected to be minimal.

In summary, harm and harassment of listed salmonids due to general construction activities is expected to occur through disruption of normal fish behaviors and their use of the aquatic habitats near construction zones. Equipment operation, construction noise, soil disturbance, and general human presence in and near waterways is expected to elicit these responses. Though the adoption of seasonal (Table 4) and daily work windows (one hour after sunrise to one hour before sunset) substantially diminishes the impacts to NEP spring-run Chinook salmon and CCV steelhead caused by general construction, the possibility remains that these fishes may occupy the SJR mainstem and the Eastside Bypass channel while HSR construction is occurring due to natural seasonal variability of fish use of these waterways. Specifically, adult CCV steelhead and NEP spring-run Chinook salmon may be deterred from using the area and may delay their migration during active construction. Juveniles CCV steelhead and NEP spring-run Chinook salmon may also be deterred from using the area for migration or rearing purposes. Direct injury or mortality from general construction activity is not anticipated to be an adverse effect because it would require an extreme event to occur (e.g., overwater support failure resulting in debris and construction materials violently crashing down into a waterway containing listed species). Artificial lighting from construction is not expected to occur, as nighttime work is not proposed. Overall, adhering to the work windows will substantially decrease the probability that listed fish will be present in the waterways affected by construction, and will decrease the overlap between fish use and construction activities, therefore decreasing the extent of harm to these populations.

2.5.1.2 Site preparation, relocation of utilities, and vegetation removal

Site preparation is required and will likely occur early in the work window periods (before July) and will include pre-construction surveys, sensitive habitat identification, the 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 of utilities. In the process of preparing the site for major construction, riparian vegetation and trees may be trimmed or removed for construction access and permanent structure placement.

As examined above in Section 2.5.1.1, general human presence and general construction activities near waterways have the potential to disturb fishes and disrupt their normal behavior patterns when the timing of the activities and fish occurrence overlap. Concerning preparatory work during the beginning of the work windows, juvenile and yearling CCV steelhead and NEP

CV spring-run Chinook salmon would be expected to be out-migrating past the construction locations from January through June, again depending on the availability of suitable water temperatures and flows. Adult CV spring-run Chinook salmon may be migrating past these locations to reach holding areas far upstream in Reach 1A (Figure 6) between February through May, while CCV steelhead kelts may migrate downstream past the construction locations sometime between January through March. Overlap between site preparation, vegetation removal, and utility relocation during spring is expected to overlap with juvenile salmonid rearing and migration use, including behaviors highly susceptible to disturbance such as foraging, resting, and sheltering. Adult CCV steelhead and CV spring-run Chinook are not expected to forage during their migrations and therefore would only be adversely affected via temporary disruption of resting and migration patterns. Given the daily work hours, sunset, sunrise, and nighttime periods will be available to listed fishes to move undisturbed daily.

For all activities, preparing the construction footprints and staging areas is expected to create fugitive dust that may settle into nearby waterways. Turbidity increases caused by dust input may have a minimal impact to any fish occupying affected waters. These effects are expected to persist only as long as clearing, grubbing, and grading activities are occurring and are therefore temporary. Due to BMPs and AMMs to control erosion incorporated into the project description, increased turbidity from soil entering the SJR are not expected.

Beyond disruption of normal rearing behavior in waterways adjacent to vegetation removal and site preparation activities, the decreases in riparian vegetation will create physical changes in the environment, which cumulatively decrease the survivorship of juvenile salmonids (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 salmonid growth (Meehan *et al.* 1977). Removal of riverine vegetation prior to construction will reduce the natural cover that was previously available on site and reduce the general habitat complexity that would otherwise be beneficial to CCV steelhead and spring-run Chinook salmon freshwater rearing and juvenile freshwater migration. Particularly at the Reach 4A crossing, these removals decrease habitat complexity in a stretch of the SJR main stem that is relatively sparse in riparian vegetation due to long-term anthropogenic management and removal.

In addition, overhanging or in-channel vegetation that provides shade is an important habitat component capable of mitigating solar radiation and offsetting the associated increases in water temperatures to some degree. While water temperature increases caused by vegetation removal is a concern, at a certain point soon after the work window opens, summer atmospheric temperatures will cause water in the channel to readily exceed lethal thresholds, regardless of the cooling capabilities of the local vegetation. Therefore, while existing vegetation in or near the channel may somewhat delay the time at which local water temperatures exceed lethality, the amount of delay attributable to currently available vegetation is likely insignificant relative to typical timing, which is determined by largescale atmospheric forcing.

The Authority proposes to replace any removed vegetation in-kind on-site locally of at least a 3:1 ratio. Though the Authority has committed to replant the disturbed areas with native riparian species at a higher ratio than what was removed, there will be temporary reductions of vegetative cover at all viaduct construction locations until the plantings establish and flourish. The period of reduced riverine vegetation will begin when construction commences and persist for several years while construction is ongoing (the Reach 1A/SR-99 north of Fresno SJR viaduct crossing construction began in 2016, still under construction in 2019), until replanting occurs. The replanting will likely take at least one year to execute, and then take several additional years until the vegetation matures. During this lengthy interim, juvenile CCV steelhead and NEP CV spring-run Chinook salmon are expected to experience reductions to their individual fitness to a small degree.

2.5.1.3 Potential contamination of waterways from equipment operations, staging, and maintenance

Construction staging areas will be established in the areas that will ultimately serve as permanent HSR facilities when possible, to further reduce impacts to natural habitats (CM-GEN-13). Additional staging and material storage areas may occur seasonally in the floodplain of waterways, restricted to the period of April 15th through October 31st (CM-GEN-14), and only when areas are dry. At all other times, equipment may enter the river channel area for daily use but will be removed and stored outside areas subject to possible flooding at the end of each work day.

Operation of construction equipment/heavy machinery is 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 contain polyaromatic 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). Studies have shown that increased exposure of salmonids to PAHs results in reduced immunosuppression and therefore increases their susceptibility to pathogens Arkoosh (Arkoosh *et al.* 1998, Arkoosh and Collier 2010). Though these substances can kill fish or illicit sub-lethal effects when introduced into waterways in sufficient concentrations, adverse effects from hazardous materials is not expected due to the numerous AMMs and BMPs integrated into the proposed action to control such pollutants and the implementation of an appropriate spill prevention control and countermeasures plan (SPCCP) and SWPPP.

Fuels, maintenance fluids, and other necessary chemicals will be stored at least 200 feet from the OHWM, preferably on paved roads or area, within double containment, and all fueling, cleaning, and equipment maintenance will be performed on vehicles and equipment in designated refueling/staging areas on existing paved surfaces with secondary containment at least 200 feet from the OHWM. 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. Hazardous materials stored in floodplain areas will be properly stored in catch basins and any spills will be immediately cleaned up (including any contaminated soil). Due to adherence to these pollution prevention BMPs, adverse effects resulting from these activities are not expected.

2.5.1.4 Vibratory and impact pile driving

Construction of the three viaduct crossings will require the use of both vibratory and impact pile driving to install cofferdams, the temporary construction support decks and platforms, and to place the permanent CIDH columns that will support the aerial HSR tracks. Temporary support piles and sheet piles for cofferdams will be placed via pile driving into the wetted channel, and the permanent CIDH piles will be placed near wetted channels. When construction is complete, vibratory pile driving will be used to remove the temporary support piles and cofferdam sheet piles.

Pile driving near or in water has the potential to kill, injure, and cause death 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, Popper *et al.* 2006). Sensory cells and other internal organ tissue may also be damaged by pressure waves generated during pile driving activities as sound reverberates through a fish’s viscera (Caltrans 2015). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings and Popper 2005). Smaller fish with lower mass are more susceptible to the impacts of elevated sound fields than larger fish, so acute 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 and adults) of the same species. Beyond immediate injury, multiple studies have also shown responses in the form of behavioral changes in fish due to human-produced noises (Wardle *et al.* 2001, Slotte *et al.* 2004, Popper and Hastings 2009).

Based on recommendations from the Fisheries Hydroacoustic Working Group (FHWG), NMFS uses an interim dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (NMFS 2008a, 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 changes/noises from pile driving is likely to cause flight/startle responses, hiding, feeding interruption, area avoidance, and movement blockage. For a single strike, the peak exposure level (peak) above which injury is expected to occur is 206 dB (reference to 1 micro-pascal [1µpa] squared per second). However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB. Therefore, the accumulated SEL level 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 these thresholds for injury. NMFS uses a 150 dB root-mean-square

(RMS) threshold for behavioral responses in salmonids. Though the dB value is the same, the 150 dB RMS threshold for behavioral effects is unrelated to the 150 dB effective quiet threshold.

At the viaduct crossing of the SJR in Reach 4A, the proposed action includes up to 120 temporary support piles will be placed in the wetted channel and in the nearby riparian corridor. These piles will be a mix of 24-inch and 30-inch diameter steel pipe piles, similar to those used in the construction of the north of Fresno viaduct construction. The Authority estimates that pile installation would take between 20 to 25 days of one in-water work season. For the Eastside Bypass viaduct, temporary trestles and support piles would not be needed because work would only be complete if the Eastside Bypass channel was dry, removing the need of a temporary work platform during permanent column installation. The north of Fresno viaduct crossing location has already installed their temporary piles, 119 in total, though installation took approximately 35 days to complete over two work seasons (though all in-water piles were placed during one work season in 2016). In addition, some piles placed were 36-inches in diameter or I-Beams.

On-site data were recorded during in-water installation of piles at the north of Fresno/Reach 1A construction location. Though some of the underwater sound monitoring was executed incorrectly, some of the maximum estimates were somewhat informative to this analysis. Often the cumulative SEL exceeded the 187 dB threshold, as multiple piles required a high number of strikes per day to be set, and underwater sound attenuation tactics were not effectively or consistently used. The peak dB threshold was not exceeded as often as the cumulative SEL dB threshold, but at its highest was estimated at 211 dB (back calculated to estimate sound exposure at adjusted back to 10 meters from the driven pile). Vibratory pile driving was generally less harmful, but the 150 dB RMS threshold was also exceeded regularly, according to the self-reported monitoring data (Environmental Science Associates 2017).

According to the Caltrans 2012 pile driving compendium of field data (Caltrans 2012), in-water impact pile driving of the 36-inch diameter steel pipe piles for this project could generate unattenuated underwater sound waves of up to 210 dB peak, 190 dB SEL, and 190 dB RMS, as measured at 10 meters from the strikes, in approximately 5 meters of water depth or less (Table 8). These estimates are calculated from field data gathered from pile driving activities at other locations and are considered informative only, not the definite levels that will be generated by impact pile driving in the SJR in Reach 4A during the course of this project. This is because each pile driving situation is unique and variations in the substrate, channel shape, depth, and even water temperature are expected to alter how the pressure waves will propagate and the amount of transmission loss that will dampen the underwater sounds as they travel. These numbers are similar to some of the underwater sound data collected by the Authority during installation of piles at the north of Fresno viaduct crossing.

Table 8. Empirical data from various pile driving activities offered by the 2012 FHWG pile driving compendium Caltrans for various types and sizes of piles, driving types, distance at which underwater sound was recorded, in reference to the proposed pile driving activities of the project (Caltrans 2012).

Pile Type	**Driver Type**	**Pile Location**	**Reference Distance**	**Peak (dB)**	**SEL (dB)**	**RMS (dB)**
20-inch diameter steel pipe piles	Impact	In water, >5 meters depth	10 meters	208	176	187
20-inch diameter steel pipe piles	Impact	In water, >5 meters depth	20 meters	201	173	184
20-inch diameter steel pipe piles	Impact	On land	10 meters	198	171	183
20-inch diameter steel pipe piles	Impact	On land	20 meters	188	NA	172
24-inch diameter steel pipe piles	Impact	In water, ~ 5 meters depth	10 meters	203	177	190
30-inch diameter steel pipe piles	Impact	In water, +/- 3 meters depth	10 meters	210	190	177
36-inch diameter steel pipe piles	Impact	In water, <5 meters depth	10 meters	208	180	190
36-inch diameter steel pipe piles	Impact	On land	10 meters	201	174	186
36-inch diameter steel pipe piles	Impact	On land	20 meters	198	171	183
36-inch diameter steel pipe pile	Vibratory	In water, ~ 5 meters	10 meters	180-185	170-175	170
24-inch AZ steel sheet pile	Vibratory	In water, ~15 meters	10 meters	175-182	160-165	160-165

For 1,000 impact strikes a day, the NMFS Pile Driving Calculator (NMFS 2008a) indicates (using the above underwater pressure estimates for maximum sound levels) that the distance that instantaneous mortality due to underwater pressures above the 206 dB peak threshold would be expected to occur is within 18 meters from the driven pile. For fish above 2 grams (as would be expected at the SJR Reach 4A location), the distance at which injury is expected to occur due to cumulative SEL exposure above 187 dB is within 1585 meters from the driven pile (*Table 9*). The distance within which behavior changes are expected is 4,642 meters from the driven pile, where the RMS sound will be above 150 dB RMS. SELs below 150 dB are assumed to not accumulate and cause fish injury, or be significantly different from ambient conditions, (i.e., effective quiet). If the number of strikes per day is increased to 5,000, the distances affected by injurious cumulative SELs is increased to almost the entirety of the affected area, out to 4,634 meters from the driven pile.

Pressure levels in excess of 150 dB_{RMS} are expected to cause temporary behavioral changes (startle and stress) that could decrease a fish's ability to avoid predators. The background RMS sound pressure levels, or effective quiet, is assumed to be 150 dB_{RMS} and the acoustic impact area is the area where the predicted RMS sound pressure level generated by pile driving exceeds this threshold. Once the pressure waves attenuate below this level, fish are assumed to no longer be adversely affected by pile driving sounds. Under the concept of effective quiet being equal to 150 dB_{RMS}, the distance fish are expected to be adversely affected during pile driving is out to 4,642 meters (*Table 9*) from the location of the pile being driven, assuming a transmission loss constant of 15 (NMFS 2008a).

Table 9. Estimated threshold distances to in-water adverse effects using maximum dBs (210 dB peak, 190 dB SEL, 190 dB RMS), modulated by strikes per day, for fish weighing >2 grams, calculated by the NMFS pile driving calculator (NMFS 2008a).

Strikes per Day	**Peak (dB) ≥ 206**	**Cumulative SEL (dB) ≥187**	**RMS (dB) ≥150**
1,000	18 meters	1585 meters	4642 meters
5,000	18 meters	4634 meters	4642 meters

Based on past performance (data from the 2016 construction season at the SR-99/SJR Reach 1A/north of Fresno viaduct crossing (Environmental Science Associates 2017)), the Authority and its contractors are likely to be unable to effectively control the underwater pressure waves created by pile driving, mostly due to inconsistent use and improper application of standard attenuation devices. Additionally, field observations of the underwater sound monitoring protocols and hydrophone apparatus installation in-river call into question the integrity of the underwater sound monitoring data gathered. And based on the number of strikes per day actually taken on site in past performance, the construction crew is likely to exceed the typical expected 1,000 strikes per day, so a great amount of underwater habitat will experience cumulative SEL pressures that exceed the injury threshold, up to approximately 2.87 miles away from the pile driving site in both directions (Table 9). In the SJR Reach 4A, this would mean an approximately 5.74 miles of river would be hazardous to CCV steelhead and NEP spring-run Chinook salmon during active impact pile driving, from south of HWY 152 to north of the Eastside Bypass connection with the SJR (Table 9). The elevated underwater sounds would be expected to cause behavioral disturbances and harass fish out to this same distance.

Though the underwater pressure waves are expected to affect a large area of the water channels, the number of individual fish affected by pile driving is expected to be small due to the life history patterns of the fishes (Tables Table *5*,Table *6*, &Table *7*), the in-water/pile driving work windows, and environmental factors that limit fish use of a waterway, such as high seasonal water temperatures and low flow patterns.

- Reach 1A/SR-99/SJR crossing north of Fresno: No additional impact pile driving is expected at the Reach 1A/SR-99 crossing north of Fresno, as all pile installation was completed in the 2016 construction season. Temporary piles and cofferdams may be removed in a subsequent construction season using vibratory pile driving, but the underwater sound levels created should not reach peak or cumulative SEL thresholds for injury or death, though fish may be disturbed. The most at risk group is juvenile and yearling CV spring-run Chinook salmon, and they are expected to have mostly completed their outmigration by the start of the in-water work window (Table 5).

- Eastside Bypass/west of Chowchilla: The BA states all channel work within the Eastside Bypass will be completed in one season while the bypass is completely dry. Without a wetted, connected channel, salmonid presence in the work area is impossible.
- Reach 4A/west of Chowchilla SJR viaduct crossing: All in-water work including impact and vibratory pile driving, and impact pile driving in the nearby floodplain outside of the wetted channel is scheduled to occur between June 1st through December 1st.
    - Adult NEP spring-run Chinook salmon are expected to complete the majority of their upstream migration by June 1st (TableTable *6* &Table *7*)
    - The downstream migration of juvenile NEP spring-run Chinook salmon should be completed by the start of the work window at this location (TableTable *6* &Table *7*).
    - If sufficient, early winter storms occur, there is a chance yearling NEP spring-run Chinook salmon may pass through the area in early December, however, in such a situation, the Authority's contractors would cease working during significant rain events due to erosion concerns and on-site personnel safety requirements.
    - CCV steelhead adults could be passing by this area on their upstream migration in early summer if flows are available, however barriers to migration downstream of the project site usually prevent volitional passage. Also, SJRRP steelhead monitoring efforts would likely capture any adults downstream, preventing them from entering the action area in SJR Reach 4A or upstream (TableTable *6* &Table *7*).

The possibility of a CCV steelhead juvenile being present in the work area during impact pile driving is also very low, because although *O. mykiss* adults may have spawned upstream, a juvenile steelhead has not been confirmed in SJRRP steelhead monitoring efforts (Table 6, *Table 7*). In summary, any NEP CV spring-run Chinook salmon adults and juveniles, and CCV steelhead juveniles present, are expected to be adversely affected by pile driving during some portions of the in-water work windows during which pile driving occurs. Listed salmonids are expected to experience temporary disturbance of normal behaviors and migratory patterns from both impact and vibratory pile driving in-water and on land near waterways, and in a few instances, underwater pressure waves created by impact pile driving may cause injury and direct or indirect mortalities. Because of the timing of the work windows and fish use of the waterway, and what is known about the current abundance of these species in the action area, the overall number of individuals to be adversely affected is expected to be very low.

2.5.1.5 Cofferdam installation and dewatering

During the in-water work windows, cofferdams will be installed on the river bank or near the water line to isolate and de-water areas before the construction of permanent HSR aerial supports. Cofferdams may also be used as an underwater sound mitigation measure. Cofferdams will be made of sheet piles, gravel-filled sandbags, or comparable materials. Sheet piling will be installed around the work area to form a cofferdam via vibratory hammer pile driving (effects of vibratory pile driving examined above, Section 2.5.1.4). Any contained or ponded water will need to be pumped out so that the soils below the OHWM may be accessed. Pumped out water will be directed or trucked to nearby infiltration pits/basins that will allow the water to return to the SJR water table without affecting in-river water quality. After construction is complete, the sheet piles will be removed via a vibratory hammer and the areas will be restored to pre-construction condition.

If water temperatures remain suitable during the in-water work windows, there is a small possibility that juvenile salmonids may become entrapped or stranded during cofferdam installation and be adversely affected by dewatering activities. Entrapped fish will require capture and release, AKA “fish rescue,” before the area is pumped dry to ensure their survival and minimize take of listed fishes. A fish rescue plan will be drafted and approved by NMFS before dewatering activities that may involve fish commence, and will include methods for minimizing stress and the risk of mortality from capture and handling of fish (see CM-FISH-5,(Authority and FRA 2018)).

Prior to any fish rescue, fish handling, or dewatering, the Authority or its contractors will contact NMFS so that such activities can be coordinated and ensure minimal adverse effects to fish through capture and handling procedures. It is expected that the number of juvenile salmonids to require fish rescue and handling will be very low, due to the seasonal in-water work windows, expected species abundances, and dewatering and pumping should only be required during cofferdam establishment.

Stranded juvenile CCV steelhead and NEP CV spring-run Chinook salmon would likely experience increased stress levels, shock, and suffer mild injuries during capture and handling, even if seasoned fisheries biologists perform the fish rescue. Some juveniles may be killed during capture, handling, or transport, while others may be disoriented at release, leaving them more susceptible to predation. Furthermore, handled fish are more likely to develop serious infections from small wounds inflicted during handling compared to unhandled fish. The expected rate of immediate juvenile salmonid mortality due to capture and handling is expected to be low (i.e., no more than 3% of the total number of juveniles relocated). These adverse effects would be expected to occur at the Reach 1A and Reach 4A construction sites. In the Eastside Bypass, construction will not commence until the channel is dry, however some juveniles may become entrapped in any ponded water within the construction zone as the floodway is ramped down following a flood flow release. Though individual juveniles will experience increased stress and harm, it is preferable to capture and relocate them into connected aquatic habitat compared to the eventual mortality these individual would otherwise experience. Adults are not expected to become entrapped and therefore would not be adversely affected by dewatering activities.

2.5.1.6 Curing of new concrete

The pouring of new concrete may negatively affect water quality by increasing the pH of water in contact with uncured surfaces. The amount the curing cement will increase pH in water decreases over time as the concrete cures, but during the curing period these pH changes can harm 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 reduced. New concrete is expected to mature and be practically inert within six months after casting, but it is possible that raised river heights caused by rain and snow melt in the months following project completion may cause SJR water to be in contact with the concrete before curing is complete. The large amount of river volume expected when the maturing concrete is in contact with raised river water is expected to dampen any potential changes in pH of river water from contact down to immeasurable differences due to volumetric dilution, even if listed fishes are present while the cement is still precipitating alkali. Therefore, adverse effects to listed fishes from chemical changes from new concrete are not expected to occur.

2.5.1.7 Placement of riprap and bank stabilization measures

Riprap/revetment will be placed on some SJR banks to protect and stabilize the permanent HSR column footings placed on in-river channel or floodplain areas. Otherwise, "soft" approaches such as vegetative plants and placement of large woody debris, to control bank erosion will be used to the extent possible. A combination of both tactics may be used at a single site to maintain a natural riparian corridor (CM-GEN-6, CM-FISH-1) and ensure bank stability.

While "soft" erosion control approaches would generally benefit listed fish over the long term by promoting a more natural riparian corridor (FEMA 2009), the construction of these areas will harass fish in the same way general construction effects might, as described in Section 2.5.1.1. When hard revetment or riprap is placed on stream banks, it removes the marginal shallow water habitat at the water/bank interface that provides refugia for rearing salmonids, reduces the total amount of riparian vegetation that can be established in the future, changes the prey base through alteration of the benthic substrate type and localized water dynamics, and often provides ambush habitat for non-native piscivorous fishes (Tiffan *et al.* 2016). In addition, the act of bank stabilization is expected to prevent normal stream processes from occurring, like natural braiding and erosion, which would otherwise create the habitat complexity that supports rearing salmonids. Instead, the placement of any riprap or revetment will perpetuate the channelization of the SJR into the future. Therefore, the habitat changes that follow placement of the riprap is expected to have a negative impact on juvenile CCV steelhead and NEP spring-run Chinook salmon survivorship and growth in the area (Knudsen and Dilley 1987, Fischenich 2003), though there is potential to offset these adverse effects, if the "soft" approaches are utilized to their fullest extent. These adverse effects will persist as long as hard riprap/revetment remains and serves as bank stabilization.

Adult CCV steelhead and CV spring-run Chinook salmon are not expected to be directly affected by the placement of riprap as they are not reliant on margin habitat for foraging or refuge like juveniles.

2.5.1.8 Placement of permanent HSR structures and associated shading

The three HSR viaducts to be constructed as part of the proposed action are new structures that will span the SJR and Eastside Bypass river channels in perpetuity. The viaduct crossings are approximately 360 feet in length and 100 feet in width, indicating the structure would cover 36,000 square feet, or 0.826 acres of riparian corridor including the river channel itself, at each crossing location. This will decrease the amount of light the aquatic vegetation and river ecosystem below the viaducts receives compared to current conditions, which is expected to adversely affect juvenile salmonids using these areas.

Overwater structures affect the amount of light that reaches the water column and the bottom of a riverbed, which limits or prevents riparian and aquatic plant growth underneath and around the structure due to shading. Introduced shade has cascading effects on the benthic ecosystem immediately underneath the structure. This changes the type and amount of prey available to rearing juvenile CCV steelhead and NEP spring-run Chinook salmon. 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, verse 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 brightly light areas with greater success compared to those not hiding in stark shadows (Helfman 1981). Therefore, the localized shading increases are expected to reduce the fitness and increase the risk of mortality of juvenile salmonids. 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 salmonids in the recovery plans for the SJR basin (NMFS 2014).

The footings of the support columns of the HSR viaduct crossings will permanently and physically occupy riparian and floodplain habitat due to their placement in these natural areas, though the Authority has designed the viaduct crossings to avoid the active water channels to the extent practicable.

- At the SJR Reach 1A/SR-99 north of Fresno crossing, the footings of the two support columns are located just outside of the summer-time water level of this portion of Reach 1A.

- At the SJR Reach 4A/west of Chowchilla crossing, the footings of three support columns will be located in the floodplain habitat while one will be completely outside the wetted channel.

- At the Eastside Bypass/west of Chowchilla crossing, the footings of the nine supporting columns will be located within the bypass channel itself.

While most of the support columns and footings will not be in water during normal flow conditions, as the SJRRP moves forward with channel capacity and seepage easement actions, and the restoration flow release amounts increase over time, and during periods of flood flows, the column footings are increasingly likely to interact with the river flow as river levels rise. These structures will create a new source of water turbulence as they interact with the flows, and affect the water velocities listed salmonids will experience while using the areas under the viaduct crossings. In addition, the change in hydrodynamics has the potential to create abnormal erosion and sediment deposition rates around and downstream from the supports and footings (Oregon Water Resources Research Institute 1995). At the SJR Reach 4A and Eastside Bypass crossing, there is no potential to affect spawning habitat, however appropriate amounts of gravel are important to provide prey for rearing salmonids (Merz 2001, Merz and Ochikubo Chan 2005). Scour around these footings may remove local gravel deposits, decreasing the available food for rearing salmonids.

The Authority has committed to offsetting the occupational footprint of the viaducts over riparian habitat used by salmonids through participation in NFWF's ILF program, as discussed below in Section 2.5.1.7. To address potential scour and sedimentation impacts, proposed CM-FISH-1 also identifies that:

- The designs of the SJR Reach 4A and Eastside Bypass crossings will incorporate the flow increases planned by the SJRRP and minimize any appreciable changes in scour, sediment transport, deposition, or changes in geomorphic processes that could alter habitat conditions in ways that may impede the re-establishment of NEP CV spring-run Chinook salmon;

- The design-build team will work with NMFS to design hydrology and demonstrate minimal hydraulic effects from crossing designs, and;

- The Authority with the design-build team will provide final SJR Reach 4A/Eastside Bypass crossing plans to NMFS prior to any site preparation or mobilization of work. If design is determined to affect listed salmonids in a manner or to an extent not considered in this opinion, ESA Section 7 consultation with NMFS would be reinitiated.

There is also a possibility that over-river HSR crossing structures may require nighttime lighting for operational safety reasons. CM-FISH-1 also states that if night lighting is required for these structures, then the design will ensure that direct illumination of the surrounding waters is avoided. It is likely that both juvenile salmonids and piscivorous predators will be attracted to night lighting, increasing the risk of mortality to individual juveniles.

Due to the incorporation of CM-FISH-1 to the Authority's proposed plan for the Merced to Fresno plus CV Wye HSR section, a majority of the possible adverse effects to fish from the permanent structures are addressed to the extent practicable at this time. While adverse effects to CCV steelhead and NEP CV spring-run Chinook salmon, especially to juveniles, are still expected to occur, the Authority has committed to minimize these long-term effects through a commitment of continued coordination with NMFS.

2.5.1.9 Mitigation credit purchase or in-lieu fee program participation

To offset the expected reductions in juvenile salmonid fitness and survival anticipated over the extended construction period and to acknowledge that the occupation of riverine habitat by permanent HSR structures that, even after on-site restoration, will degrade habitat used by salmonids, the Authority is purchasing 14.41 acres of aquatic habitat credits that will benefit CV salmonids from NFWF's Sacramento District California ILF program. From the Authority's ILF payment, a restoration project will be implemented that will result in increases to the juvenile salmonid rearing and floodplain habitat close to the location of impact in the long-term, and will sufficiently offset the loss and indirect adverse effects to habitat important to rearing salmonids, resultant from the HSR project Merced to Fresno plus CV Wye section.

The Mendota Wetland Restoration Project has been identified as the site that will be restored and preserved with these funds. While the site is still under design and has a draft prospectus, early contact between the site leads, NMFS staff, and SJRRP representatives indicate that restoring this area and reconnecting the potential floodplain habitat it contains via strategic levee breaches has great potential to benefit the CCV steelhead and NEP spring-run Chinook salmon populations impacted by the project. It is expected to increase the functionality of the rearing habitat in the upper SJR reaches, and may eventually help to increase the outmigration survival and success of reintroduced/recolonizing salmonid juveniles in the future. NMFS expects to be continuously involved in the project so that salmonid benefits will result from restoration of the selected site. The Authority has elected not to provide compensatory mitigation for its temporary impacts to riparian habitat offered by the Eastside Bypass but will offset for permanent impacts there at a 1:1 ratio.

NMFS expects that both reintroduced NEP of spring-run Chinook salmon and individuals from the CCV steelhead DPS will eventually directly benefit from the restoration and reconnection of the Mendota Wetlands as juvenile salmonids of both species should be able to use the floodplain habitat created by the restoration, once complete. The benefits this restoration site will offer are expected to be provided in perpetuity. As part of the area served by NFWF's Sacramento District California ILF Program, the Mendota Wetland Restoration Project is governed by an enabling instrument (NFWF 2018, 2019, NFWF and WRA Environmental Consultants 2019). The enabling instrument, originally approved by NMFS leadership on October 3, 2014, and most recently with amendments on February 12, 2018, ensures that the funds generated by each credit sale will be tracked comprehensively and allocated to the appropriate credit type. Additionally, there is a program account separate from any long-term management and maintenance funds of ILF project sites, established by the program sponsor, according to stipulations in the enabling instrument.

2.5.2 Interrelated and interdependent action effects to species

After the construction of the viaduct crossings and the associated construction clean-up is complete, the Authority will be responsible for the HSR's management, operations, and maintenance as a whole running transit system. Effects associated with the operation of the HSR are considered effects of an interrelated/interdependent action, as described in section 1.3, *Proposed Federal Action*.

2.5.2.1 Effects of vibration and noise from HSR train operations

Once the CA HSR system is completely constructed and regular ridership commences complete with regular schedules, it is assumed that the trains running over SJR/Eastside Bypass on the viaducts may harass fish 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 13 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 CA HSR system will eventually run as many trains as the Shinkansen system over the SJR/Eastside Bypass waterways per hour, 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 traffic over bridges permeating into the aquatic environment (Hawkins and Popper 2016, Pavlock McAuliffe 2016)), and that HSR systems currently cause disturbance to human residents that live in close proximity to tracks in operation (Yokoshima *et al.* 2017) and disturbance to fish utilizing habitat under viaducts crossing is similarly expected. Studying fish responses to varying levels and types of transportation/disturbance sounds have produced unclear results (Federal Highway Administration 2017), however, it can be assumed that due to the speed, wind shear, and vibrations that will be associated with the HSR operations (Hunt and Hussein 2007), fish will be startled as engines and passenger cars pass overhead throughout a 24 hour period.

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. Adult salmonids that are temporarily startled are expected to leave the immediate area, moving either upstream or downstream. This would alter their migration and use patterns, and at the SJR Reach 1A crossing, train operations could interrupt resting periods. Juvenile salmonids are also expected to be startled and alter their migration patterns, and their foraging and resting behaviors. An unwarranted startle response would make juveniles susceptible to attack from piscivorous predators and increase their risk of mortality. 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.

2.5.2.2 Effects of pollution from HSR system over time

General HSR Operations

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 and FRA 2018). 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 2019a). 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 was 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 be further linked to the decline of salmonids in California's CV as high rim dams continue to block salmonids from a majority of their spawning habitats in the Sierra Nevada (NMFS 2014), as well as adversely controlling and altering water flow and river temperatures downstream. Since hydropower is not cited as a possible renewable energy source, it is not expected that the creation of the electricity used to power the HSR system will cause indirect adverse effects to listed salmonids.

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), 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 breaking as the breaking pad materials are worn down and degraded by use (Brooks 2004, Burkhardt *et al.* 2008, Bobryk 2015, Levengood *et al.* 2015). In general, train operations are expected to contribute low-levels of heavy metals such as zinc, copper, lead, nickel, manganese, chromium, and iron to the environment immediately near tracks, and most studies indicate that the concentration of these metals and PAHs increases drastically at station platforms and at maintenance yards (Bukowiecki *et al.* 2007, Wilkomirski *et al.* 2011, Wilkomirski *et al.* 2012).

At this time the Authority is committed to capturing all stormwater runoff (Authority and FRA 2018). 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. The Authority and the FRA are 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, vegetated swales (bioswales), in accordance with the Phase II Small Municipal Separate Stormwater Permit (State Water Board Order 2013-0001-DWQ). There are even 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 are still forthcoming, but due to the high degree of stormwater management attention, in addition to (Authority 2019b) public stormwater outreach efforts and LID stormwater control design plans in past documents (Authority 2012), it is anticipated the Authority will adequately control and treat all transportation pollution created by operation of the HSR system. Therefore it is not expected that listed salmonids will be adversely affected through the introduction of heavy metals, PAHs, and other general transportation pollution created by the project. In addition, it is expected that the HSR system will decrease the amount of passenger vehicles driving between the cities in the CCV serviced by the system, therefore overall transportation pollution that stormwater carries into adjacent waterways may decrease over time and as HSR ridership increases, potentially improving water quality.

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 when draft safety check protocols are available so that a determination can be made regarding listed salmonid interactions with Authority staff and actions at that time.

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 drafted, but these activities would likely include manual removals, such as trimming and "weed whacking", and also some forms of herbicide application. If vegetation control is required in the riparian corridor, in floodplain habitat, or near waterways containing listed fish, NMFS again assumes that the Authority will approach NMFS for additional ESA Section 7 consultation to ensure adverse effects to salmonids are minimized and incidental take coverage is obtained prior to the commencement of such activities.

Catastrophic Accidents

Finally, a catastrophic derailment of the system while running is possible and a crash from a viaduct would certainly affect the riparian environment and adversely affect salmonids 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 (Sim 2017), despite some lapses in inspection protocols and material vetting before an oil leak was discovered and resolved on December 11, 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 number of lines, trips, and total number of HSR systems in operation for comparison and their overall safety record, the occurrence of a derailment would be so rare that it is unlikely to reasonably adversely affect listed salmonids.

2.5.3 Interrelated and interdependent action effects to designated critical habitat

As previously stated, there is no designated critical habitat for CCV steelhead or CV spring-run Chinook salmon within the action area (CCV steelhead critical habitat ends at the confluence of the Merced and San Joaquin Rivers, substantially north of both viaduct crossing locations discussed in this opinion). While the proposed action under examination is not expected to cause direct or indirect effects to their designated critical habitats, local suitable habitat for each species' life history stage is important to maintain so fish may successfully migrate through and rear throughout the action areas. These potential impacts were identified previously as direct impacts to individuals of each species. Impacts to the quality and functionality of aquatic habitats important to the growth, maturation, and production of Chinook salmon are also discussed in *Section 3: The Magnusson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation*.

2.6 Cumulative Effects

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

The CCV cities in general, but especially Merced, Chowchilla, Madera, and Fresno, anticipate increases in human population growth and urban development (Fresno Council of Governments 2012), especially near HSR stations and in association with increased connection to larger employment centers like the Bay Area/Silicon Valley or the Los Angeles metropolitan area. The Authority acknowledges the link between the service the HSR system will provide and increased urban development, and has committed to coordinating with sprawl-reducing and best environmental practices land use development tactics ((Authority and FRA 2018) page A-21). Even with the best intentions, it is expected that private development associated with the HSR system will increase the percent of impervious surfaces, the freshwater demand, and the overall degree of environmental degradation and pollution from non-Federal sources over the long term once the HSR system is operational.

A primary concern is that the stormwater volume and contaminant load is likely to increase in the CV as the amount of impervious cover increases with HSR build-out and associated urban development, despite the Authority planning on treating all of its stormwater prior to discharge. Pollutants become more concentrated on impervious surfaces until either they degrade in place, or are transported via wind, precipitation, or active site management to another location. Stormwater runoff delivers a wide variety of pollutants to aquatic ecosystems, many of which are not listed by the EPA or SWRCB, so discharge of such pollutants often goes unregulated and uncontrolled. Increased urbanization of streams generally leads to decreases in the health and abundance of aquatic species (Hecht *et al.* 2007, Scholz 2011, McIntyre *et al.* 2012, McIntyre *et al.* 2015, Closs *et al.* 2016, Feist *et al.* 2017), including the abundance and health of salmonids of various species.

Post-construction stormwater runoff often picks up a variety of pollutants from both diffuse (nonpoint) and point sources before depositing them into receiving water bodies (EPA 1993). Constituents may include, but are not limited to: fertilizers, herbicides, insecticides, and sediments (landscaping/agriculture); oil, grease, PAHs, and other toxic compounds from motor vehicle operations (roads and parking lots); pathogens, bacteria, and nutrients (pet/dairy wastes, faulty septic systems); toxic metals and metalloid like aluminum, arsenic, copper, chromium, lead, mercury, nickel, and zinc (from building decay, manufacturing or industry byproducts); and the atmospheric deposition onto impervious surfaces from other surrounding land uses (manufacturing industry, freight and trucking exhaust, agriculture field treatments). Therefore, stormwater pollution created by local urban development associated with HSR station placement may be more likely to have a greater impact on aquatic life in receiving waterbodies than the stormwater output of the HSR project itself, since stormwater impacts directly associated with the HSR project will be more carefully planned and monitored.

Fish exposure to these ubiquitous pollutants in the freshwater and estuarine habitats is likely to cause multiple adverse effects to steelhead and salmon, even at pre-project, ambient levels (Spromberg and Meador 2005, Hecht *et al.* 2007, Sandahl *et al.* 2007, Macneale *et al.* 2010, Feist *et al.* 2017). For instance, stormwater contaminants accumulate in the tissues of juvenile salmonids, acquired from contaminant accumulation in the tissues of their prey (bio-accumulation). Depending on the level of concentration, those contaminants can cause a variety of lethal and sub-lethal effects on salmon and steelhead, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Hecht *et al.* 2007). Predators of salmonids, like killer whales (*Orcinus orca*), harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californicus*), are in turn at risk of ingesting toxins that have bio-accumulated in their salmonid prey or are adversely affected in other ways by stormwater toxins, even when far removed from the area of exposure (Grant and Ross 2002, Mos *et al.* 2006, NMFS 2008b).

Even at very low levels, chronic exposures to those contaminants have a wide range of adverse effects on the ESA-listed species considered in this opinion, including:

- Increases in early development issues in gastrulation, organogenesis (exposure of adults, sub-lethal effects passed to resulting offspring) which lowers hatching success.
- Decreases in juvenile survival through reduction in foraging efficiency, reduced growth rates and condition index.
- Increased delay in, or issues occurring during smoltification (only in salmonids) rooted in anion exchange, thyroxin blood hormone, and salinity tolerance.
- Increases in mortality due to increased susceptibility to diseases and pathogens, and depressed immunocompetence.
- Decreased survivorship due to increased predation, reduced predator detection, less shelter use, and less use of schooling behaviors.
- Changes or delays to migration patterns, use of rearing habitats, ability of adults to home to natal streams, and spawning site selection.
- Changes to reproductive behaviors that affect production, including altered courtship behavior, reduced number of eggs produced, and decreased fertilization success (NMFS, 2016b).

Data that quantify the exact sublethal effects of urban stormwater on steelhead and Chinook salmon are limited, which makes analyzing the effects of new or additional sources of non-point stormwater discharge on these populations difficult. It is reasonable, however, to conclude that stormwater that is not sufficiently treated coming from sources outside of the Authority's jurisdiction will cause persistent adverse effects to listed salmonids that are realized at a watershed/basin level.

Finally, 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 part of the environmental baseline versus 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 posed to species and critical habitat as a result of implementing the proposed action. 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 for the conservation of the species.

CCV steelhead is listed as threatened under the ESA and the most recent 5-year status review for the DPS concluded that its threatened status is still applicable (NMFS, 2015; 2016b). CCV steelhead remain threatened despite recovery efforts in large part because of widespread degradation, destruction, and blockage of their natural freshwater habitats. The CV spring-run Chinook salmon ESU is also listed as threatened under the ESA but is considered extirpated from the SJR basin as a wild population (NMFS, 2016a). Through recovery plan implementation and SJRRP experimental reintroduction efforts (SJRRP, 2018), NEP CV spring-run Chinook salmon are expected to use the action area, which is also a priority recovery action in the recovery plan for the CV spring-run Chinook ESU (NMFS 2014).

One of the primary reasons both of these species were listed under the ESA is the ubiquitous artificial modifications to, and destruction of, the freshwater habitats upon which these species depend. Also, these populations have been tremendously negatively affected by high rim dams, which have blocked them from a majority of their spawning and rearing habitat high in Sierra Nevada for decades, altering water flow patterns and river temperatures downstream. These primary threats are expected to persist and to grow as human populations, land development, and freshwater demands also increase throughout California. Such trends are likely to suppress the recovery potential of these populations, especially comparing the effective scale of past and continuing adverse habitat changes to restorative recovery actions.

The adverse effects to CCV steelhead and NEP CV spring-run Chinook salmon through HSR system construction are short-term disturbance, decreased survivorship probabilities, disruption of normal behaviors and habitat use, and may result in injury, or in the death of, a small number of fish of each population at each crossing over several years once construction commences. The placement of permanent artificial structure (the viaduct overcrossing structures and their footings) over the waterways and riprap in the floodplain is expected to remove small amounts of habitat through spatial occupation, change the aquatic ecosystem structure below the structure due to shading, and slightly degrade freshwater habitat locally through the placement of riprap. These adverse effects will slightly reduce the functionality of the habitat available to listed salmonids in the action area. This project will also prevent these riparian areas from being returned to a completely natural state despite Authority restoration and replanting plans, in part due to the HSR system's reliance on existing river levees and other bank armoring tactics to maintain bank stability and reliance on the status quo of the flood protection systems of the SJR basin.

Because the placement of the HSR system will effectively remove a small amount of functional acreage from riparian habitats in perpetuity and to offset temporary adverse habitat changes, the Authority plans to offset these impacts by participating in the NFWF's ILF program and purchasing aquatic habitat credits. Through the Authority's participation and payment of fees, the Mendota Wetlands Restoration Project will commence, including the local restoration and re-connection of historical floodplain habitat. This restored habitat will be maintained in perpetuity, making this tactic an effective offset to long-term adverse salmonid habitat impacts associated with building and operating the Merced to Fresno section of the HSR system, because the same populations of salmonids negatively affected by Authority actions will also have access to the floodplain habitat this restoration project will provide upon completion. The Mendota Wetlands Restoration Project is expected to restore and preserve up to 26.1 acres of floodplain habitat that will be accessible to listed salmonids that use the SJR in the SJRRP's Restoration Area. The amount of floodplain acreage restored by the Mendota Wetlands Restoration Project is greater than the acreage total of the HSR aerial structure and riprap footprints over riparian habitat (3:1 offset ratio over the SJR, 1:1 in the Eastside Bypass) to ensure that the intended benefits will compensate for the adverse effects of habitat destruction and degradation caused by constructing the HSR.

Once the HSR system is operational, low-level railway pollution is expected to be generated and may be transported into waterways through stormwater runoff from the tracks. At stations, passenger parking lots, and rolling stock maintenance facilities, the Authority plans to incorporate a high degree of LID designs and effective stormwater treatment and control devices, which are expected to minimize the introduction of transportation contamination into waters containing listed fishes to the extent practicable. However, increased development around HSR stations is expected in the CV as commuters begin having reliable, fast access to the San Francisco/San Jose Bay Areas and the Los Angeles Area for employment but enjoy the lower costs-of-living in the CV. As the human population in the CV increases, freshwater water quality impacts are also expected to increase, through increased urbanization effects, increases in stormwater runoff and contaminate loads, increases discharges from wastewater treatment plants, and increases in the demand for drinking water.

The expectations of climate change in California is that precipitation and snowpack patterns will begin to fluctuate rapidly between extreme highs and lows, and that dry year types may become more frequent, in addition to becoming more severe. Since the SJR is historically a snowmelt-fed system, if snowpack becomes unavailable, surface water in the SJR basin will also become more limited. Thus, because the ability of the SJR and Sierra Nevada supply of freshwater may be diminished at a time when human demands on the freshwater supply is increasing, it is likely that the water quality in the SJR basin will become severely degraded. Better water quality control and adequate treatment of new sources of urban stormwater discharges throughout the CV are needed to ensure that the water quality of aquatic habitats will be maintained at sufficient levels into the future to sustain listed salmonids through all water year types.

Overall, the total numbers of fish taken directly and indirectly as a result of the proposed action is anticipated to be small compared to the total population, especially over the long-term. Combining the adverse and beneficial effects associated with this proposed action, effects of the interrelated/interdependent actions, the environmental baseline and the cumulative effects, and taking into account the status of the species affected by the project, the construction and operation of the Merced to Fresno plus CV Wye section of the HSR system is not expected to appreciably reduce the likelihood of survival or recovery of the listed species examined in the opinion.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of CCV steelhead, or CV spring-run Chinook salmon, or jeopardize the reintroduction of the NEP spring-run Chinook salmon to the SJR below Friant Dam.

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). "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. Adult and juvenile CCV steelhead are expected to be incidentally harassed, harmed, injured, or killed as a result of the proposed action. Incidental take will not be issued for NEP CV spring-run Chinook salmon though they will also be affected, because the 10(j) designations means otherwise lawful activities are excepted from take prohibitions of Section 9 within the boundaries of the experimental population area, though recommendations on how to minimize the harm to this 10(j) population will be included for conferencing purposes. Specifically:

1. General construction activities in and near waterways are expected to harass adult and juvenile fish by causing them to alter their normal behaviors and their migration patterns, and inducing stress, even during the proposed in-water work window, due to disturbance (noise, vibration, and equipment operation).

2. Site preparation, relocation of utilities, and vegetation removal in and near waterways are expected to harass adult and juvenile fish by causing them to alter their normal behaviors and their migration patterns, and inducing stress, due to disturbance. Reducing habitat quality (vegetation removal, temporary and permanent land disturbance and alteration, shading) is expected to reduce the growth and survival of salmonids in the action area, decreasing their overall fitness.

3. Vibratory and impact pile driving in and near waterways are expected to harass, injure, or kill adult and juvenile salmonids by introducing underwater pressure waves into the aquatic environment during the installation and removal of temporary steel pipe and cofferdams sheet piles, and the installation of permanent CIDH piles.

    a. The underwater pressure waves from vibratory pile driving is not expected to reach injurious or mortalities levels (<206 dB_{PEAK}, <150 dB_{RMS}) but will harass and disturb fish up to 4,642 meters in both directions from the pile driving location.

    b. The underwater pressure waves from impact pile driving are expected to exceed injurious and mortality levels (≥206 dB_{PEAK}, ≥ 187 dB_{SEL} cumulative, and ≥150 dB_{RMS}). Instantaneous mortality is expected within an 18 meter radius from the driven pile, and injury leading to death is expected out to a 4,634 meter radius from the driven pile without the use of underwater sound control measures.

    c. The density of CCV steelhead in the areas affected by pile driving underwater sound within the estimated distances during the seasonal work windows are expected to be very low, with adult returns expected to be rare before volitional passage is achieved and because the SJRRP steelhead monitoring program is likely to encounter, capture, and relocate steelhead adults before they enter the action area, *therefore* it is estimated that no more than 1 adult CCV steelhead will be injured or killed per year due to pile driving activities. Juvenile steelhead presence is expected to be somewhat more probable as resident *O. mykiss* parents may produce anadromous steelhead offspring (McEwan 2001, Courter *et al.* 2013, Pearse and Campbell 2018) and adult resident *O. mykiss* have been confirmed in SJR Reach 1A. One successful *O. mykiss* redd would be capable of producing multiple ocean-type/steelhead offspring that would use the action area, but due to the timing of the work windows, juvenile use and pile driving overlap would be limited. Therefore, it is expected that no more than 2 juvenile CCV steelhead will be injured or killed per year due to pile driving activities.

4. Cofferdam dewatering is expected to harass, injure, or kill juvenile salmonids by entrapping them, necessitating their capture, handling, and relocation, which is likely to stress, shock, and injure them, resulting in immediate or delayed death, or susceptibility

to predation. The number of juveniles salmonids entrapped by cofferdams, requiring capture and relocation is expected to be low, no more than 10 individual juveniles per year or 33 individuals over the course of construction of the Merced to Fresno plus CV Wye Section. It is also estimated that no more than 3% of the total number of juveniles should die due to capture, handling, and relocation by the Authority or its contractors.

5. In-water activities that contact the channel bottom, such as in-water pile driving for both pile installation and removal, are expected to cause turbidity plumes locally and downstream of the construction locations, and will harass adult and juvenile salmonids by causing them to alter their normal behaviors, their migration patterns, and induce respiratory stress, as long as the turbidity plumes persist.

6. Placement of riprap and bank stabilization measures is expected to harm juvenile salmonids because the use of "hard" stabilization methods (i.e., riprap/revetment) will reduce the amount of feeding and resting areas locally. A reduction in the amount of feeding and resting areas is expected to reduce the fitness of fishes that would have otherwise used this area, in perpetuity.

7. Placement of permanent artificial structures and associated shading is expected to harm juvenile salmonids because the permanent structure occupation of habitat effectively reduces the amount of feeding and resting areas locally, and the shading of the viaduct over the river channel will change the local aquatic ecosystem composition/available salmonid prey base, and create ambush habitat for predators of juvenile salmonids, in perpetuity. Additionally, juvenile salmonids are likely to be startled by vibrations and noise created when high speed trains pass over the viaducts, causing them to flee when they otherwise may be resting or foraging, potentially creating situations in which they are more likely to be predated upon in these areas over the long term.

For incidental take avenues 1, 2, 3a, 5, 6, and 7, 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 of 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 measureable, and the Authority or its contractors can monitor them to determine whether the level of anticipated incidental take described in this ITS is exceeded over the course of project implementation.

2.9.1.1 Incidental take associated with general disturbance, vibration, and noise

The most appropriate threshold for incidental take consisting of temporary fish displacement, behavior modification and slight increases in stress levels associated with general construction activities (#1), site preparation and relocation of utilities (#2), and vibratory pile driving and impact pile driving underwater sound greater than 150 dB_{RMS} but less than cumulatively injurious SEL (187 dB) (#3a) is an ecological surrogate of the amount of habitat disturbance due to these activities within a certain distance from the construction site.

Vibratory pile driving is expected to produce underwater pressure levels over 150 dB_{RMS} out to 4,642 meters from the location of the pile driving sites. Though these elevated 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 and adult salmonids, leading to harm as described in Section 2.5.1.4. 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 fitness is expected to decrease slightly when area avoidance delays their upstream migration.

Elevated noise disturbance is also expected to elevate fish stress levels. Beyond 4,642 meters, underwater sound is expected to attenuate down to effective quiet underwater sound levels, or 150 dB_{RMS} or less, and therefore this distance is considered the limit of this ecological surrogate. All other activities that cause noise and vibration disturbance, such as general construction activities, heavy equipment operation, site preparation, and relocation of utilities, would also be contained within the vibratory pile driving distance threshold of exceeding effective quiet. Therefore, for simplicity, this surrogate will apply to incidental take forms #1, 2, and 3a and require that all disturbance from these activities be limited from the boundary of the location of the disruptive activity out to 4,642 meters upstream and downstream of the location. All other types of temporary disturbance effects related to noise or vibrations created by equipment operation, construction noise, and human presence is expected to also be contained within this boundary of anticipated incidental take, during the proposed work windows in Table 4. Exceeding 150 dB_{RMS} beyond 4,642 meters from the construction site will be considered exceeding expected incidental take levels for this surrogate.

2.9.1.2 Incidental take associated with elevated in-river turbidity plumes

The most appropriate threshold for incidental take consisting of fish disturbance and sub-lethal effects associated with elevated in-river turbidity plumes is an ecological surrogate of the amount of increase in downstream in-river turbidity generated by in-water pile driving activities (incidental take form #5). In-river pile driving and in-river pile removal are expected to mobilize sediment and increase water turbidity above natural levels. Increased turbidity is expected to cause harm to adult and juvenile CCV steelhead through elevated stress levels and disruption of normal habitat use locally. These temporary responses are linked to decreased growth, survivorship, and overall reduced fitness as described for underwater noise avoidance.

The surrogate for turbidity increases will be based on juvenile salmonid sensitivity to raised turbidity levels. According to CDEC Dos Palos (SDP) station, while NTUs can range over a 1,000 NTU in winter flood condition, typical turbidity in the SJR during the in-water work season is usually less than 50 NTU (California Department of Water Resources 2018c). 50 NTU is already above the range at which steelhead experience reduced growth rates (25 NTU) but below the range steelhead would be expected to actively avoid the area. Therefore, within the already established disturbance surrogate for pile driving, SJR river water cannot be more than 50 NTU above the turbidity level in upstream measurements. Downstream of the construction underwater noise/pile driving disturbance surrogate boundary, turbidity immediately downstream cannot measure more than 25 NTU above the ambient turbidity level in SJR water measured immediately upstream of project activities. Since in-river values change daily, the upstream comparison value must therefore be taken daily, in association with the downstream readings, during in-water pile driving. Exceeding these tiered turbidity thresholds will be considered as exceeding the expected incidental take levels.

2.9.1.3 Incidental take associated with placement of riprap, bank stabilization, permanent structure, habitat occupation by artificial material, and shading

The most appropriate measurement of harm to salmonids associated with placement of permanent riprap and bank stabilization (#6), and permanent structure, habitat occupation by artificial material, and shading (#7) is a surrogate of the amount of degradation of habitat function in the immediate area associated with artificial structure placement and material occupation. The artificial hard structure and materials would occupy benthic substrates that support benthic prey of juvenile salmonids, reducing feeding opportunities and negatively affecting their potential growth rates. The hard structures and the new water velocities created around them also reduce the possibility of natural processes from otherwise occurring in the area, like aquatic vegetation or large woody material establishment, preventing juveniles from resting or sheltering in the immediate project area. Any shading is related and proportional to the amount and degree of artificial structures overhanging the wetted channels and riparian corridor, and will change the local ecosystem structure and increase the amount of water column ambush predator habitat. While habitat functionality will not be lost completely, the artificial structures and associated habitat changes will be maintained in perpetuity; therefore, the adverse effects associated with these structures will also remain as long as the artificial structure and riprap remain. While the Authority is proposing restoration and compensatory mitigation to offset some of these impacts, these adverse effects will remain locally.

On the bank, the Authority estimates that the permanent structures will occupy a total of 2.02 acres of riparian habitat in Reach 1A and Reach 4A of the SJR and 1.36 acres on the leveed bank of the Eastside Bypass (Table 1). Oblique shading over a greater distance around the aerial structures caused by differing sunlight angles throughout the day are omitted from this total for simplicity and because the area directly under the structure will experience the greatest reduction in surface lighting. The temporary adverse effects associated with these sites are estimated to impact 5.05 acres of riparian habitat. Exceeding these total acreages stated above as surrogate amounts for incidental take forms #6 and #7 will be considered as exceeding the expected incidental take levels. Also, the amount of compensatory mitigation purchased is directly related to the estimated areas of temporary and permanent habitat disturbance, therefore any increases to the amount of area disturbed or permanently covered by HSR permanent structures will not be adequately offset by current in-lieu fee payments.

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.

2.9.3 Reasonable and prudent measures

"Reasonable and prudent measures" (RPMs) are nondiscretionary 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 and harm to CCV steelhead caused by construction activities and equipment operation in the action area, related to both direct and indirect effects, as discussed in this opinion.

2. Measures shall be taken by the Authority and its contractors to reduce the extent of degradation and alteration to the habitats used by CCV steelhead in the action area, related to both direct and indirect effects of this project as discussed in this opinion, because further degradation of such habitats would decrease the survival and success of this species in the action area.

3. The Authority or its contractors shall prepare and provide NMFS with updates, reports, and monitoring plans pertinent to incidental take under NMFS jurisdiction.

The following terms and conditions will also minimize the amount of harm to the NEP CV spring-run Chinook salmon being reintroduced in the action area.

2.9.4 Terms and conditions

The terms and conditions described below are non-discretionary, and the Authority and its contractors must comply with them in order to implement the RPMs stated above (50 CFR 402.14). The Authority and its contractors have a continuing duty to monitor the impacts of incidental take and therefore must report the progress of the action and its impact on the species as specified in the 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 RPM 1:

   a. Measures shall be taken to maintain, monitor, and adaptively manage all conservation measures, AMMs, and BMPs throughout the life of the project to ensure their effectiveness.

   b. The Authority and its contractors shall work in coordination with NMFS and SJRRP fisheries representatives throughout HSR project active construction phases 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 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 and incorporate comments on drafts of HSR safety check protocols when possibility of interaction with listed salmonids or their habitats is likely, prior to establishing said safety protocols.

ii. The Authority shall request NMFS review and incorporate comments on draft plans for vegetation removal activities and herbicide use as regular maintenance near waterways containing listed salmonids, prior to undertaking said activities.

d. In the course of monitoring the construction portion of the project, the Authority or its contractors shall contact and coordinate with NMFS within 24 hours after direct incidental take of a listed fish or of its ecological surrogate is observed, or is suspected of being exceeded, so that both agencies can work to reduce take back below applicable levels. Construction shall cease until coordination can take place and an adaptive management plan is put in place.

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 take of listed anadromous fishes;

ii. Explicit assignment of the responsibilities of implementation of the environmental AMMs/BMPs related to NMFS resources required to meet the terms and conditions as part of the award package, and;

iii. Explicit assignment of responsibilities of the monitoring of NMFS resources and associated ecological surrogates to ensure the performance of the AMMs/BMPs associated with the terms and conditions stated below, as part of project award packages.

f. The schedule of the construction activities shall be modified to avoid or limit interacting with CCV steelhead. The schedule of the construction activities necessary to limit the impacts of construction on CCV steelhead at each overwater construction location, depending on whether SJRRP fish passage projects have been completed and volitional anadromy is achieved in the system relative to the start of construction, as follows:

i. <u>At the SJR crossing Reach 1A/SR-99 Construction Package-1 north of Fresno site</u>: the seasonal work window shall be limited to **June 15th – October 31st**, irrespective of volitional passage because this location is already high-value/high-use area. Activities inclusive to this work window at this location include: all in-water work, in-water impact and vibratory pile driving, and all near-water work, including impact and vibratory pile driving in the floodplain outside of the wetted channel.

ii. At the SJR crossing Reach 4A, CV Wye west of Chowchilla site:

1. If volitional passage is not yet achieved:

    a. the seasonal work window for in-water work, including in-water impact and vibratory pile driving, and impact pile driving in the floodplain near water but outside of the wetted channel shall be limited to **June 1st – December 1st**.

    b. the seasonal work window for all other types of near-water work outside of the wetted channel, in the floodplain/on channel banks, including vibratory pile driving, shall be limited to **April 30th – December 1st**.

2. If volitional passage has been achieved:

    a. the seasonal work window for in-water work, including in-water impact and vibratory pile driving, and impact pile driving in the floodplain near water but outside of the wetted channel shall be limited to **July 1st – October 15th**.

    b. the seasonal work window for all other types of near-water work outside of the wetted channel, in the floodplain/on channel banks, including vibratory pile driving, shall be limited to **June 15th – October 15th**.

iii. At the Eastside Bypass crossing, CV Wye west of Chowchilla site:

1. No work shall occur in the channel of the Eastside Bypass until flows cease (the BA states no work will occur at this location until the channel is dry or water is at least ponded in disconnected pools, therefore avoiding most fish interactions).

2. The seasonal work window for in-water/in-channel work, including in-water impact and vibratory pile driving and impact pile driving in the floodplain near water is **June 1st – December 1st**.

3. All other types of near-water work that may occur in the floodplain/on the banks when the wetted channel is connected, including vibratory pile driving, shall occur **April 30th – December 1st**.

iv. During all seasonal work windows stated above, the daily work hours for all SJR/Eastside Bypass crossing construction sites shall be limited to one hour after sunrise to one hour before sunset when wetted channels are connected, to avoid nighttime, dawn, and dusk hours, when peak salmonid movement and feeding activities occur.

v. If water temperatures exceed 75°F or more, on average, for seven consecutive days in the wetted channel affected by the construction work, the Authority and its contractors shall contact NMFS staff to obtain approval to proceed with in-water work and impact pile driving (in water or in the floodplain) outside of the work windows stated above. NMFS staff must concur with the Authority's conclusion that no salmonids are likely to be present in the wetted channels near the work site due to high water temperatures before the Authority and its contractors may proceed with construction activities, until such time that water temperatures drop below 75°F once again or the original work window ends.

vi. High water years with suitable water temperatures may necessitate additional consideration of salmonid presence at different construction sites, and shall require additional coordination between all involved agencies to reduce interactions with salmonids.

g. During construction activities, but especially pertaining to impact and vibratory pile driving periods:

i. If any salmonid is 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.

ii. If dead, the fish shall be recovered and placed on ice or frozen until transfer to NMFS or SJRRP offices can occur. If injured, the fish shall be 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.

iii. Construction activities shall not resume until NMFS can analyze the situation and determine if the take could have been avoided.

h. During in-water pile driving for installation and removal of cofferdams and permanent structures:

i. Piles shall be driven as far as possible with vibratory hammering before using an impact hammer.

ii. Piles shall be inspected daily for accumulated debris and debris shall be removed.

iii. A qualified biologist shall use a held-hand turbidity monitor to conduct water quality monitoring upstream and downstream of the location of construction activities to ensure in-river turbidity plumes created by construction do not exceed 50 NTUs beyond the underwater noise surrogate boundary. If an in-river turbidity plume is created and conditions within the plume exceed this threshold beyond the underwater noise surrogate boundary, construction will cease and turbidity/sedimentation control AMMs/BMPS shall be adjusted until increases to turbidity readings downstream relative to upstream readings cease.

i. During the in-water work windows, if cofferdams require dewatering, the enclosed area shall be checked for listed salmonids, according to the best recommendations of the assigned, on-site fish biologist, but considering the following:

   i. NMFS staff shall be notified of any planned "fish rescue" or salvage activities at least two business days before fish capture and relocation activities begin, so that staff can advise these efforts or make a field visit to observe, if deemed necessary.

   ii. Juvenile salmonids entrapped shall be captured using nets (seines) or electrofishing of enclosed areas, water temperature permitting (less than 18°C). Fishing equipment used shall be in good condition and decontaminated if used outside of the SJR watershed prior to the fish salvage event.

   iii. Persons performing salmonid captures shall be experienced juvenile salmonid handlers and be familiar with the fishing equipment in use.

   iv. If electrofishing is selected to be used, the operator of the equipment shall have at least 100 hours of practical experience using such equipment in the field.

   v. Clean relocation equipment and containers shall be available and ready to receive fish on site during all fishing/fish salvage activities, preferably under shade.

   vi. Captured juvenile salmonids shall be identified to species (*O. mykiss* and *O. tshawytscha* shall be sufficient), counted, and assessed visually for immediate health condition. <u>Total immediate mortality from fish salvage/rescue and relocation activities shall be less than 3% of the total captured and relocated.</u> Therefore, fish salvage operations shall take measures to minimize the number of juveniles injured or killed.

   vii. If a listed fish dies, see retaining and reporting a mortality procedures above (Term and Condition 1f).

   viii. The water quality of the transport water shall be monitored to ensure sufficient oxygen and temperature levels are maintained. Transport water shall be within 2°C of the river water to minimize shock and transport stress, and less than 18°C overall.

ix. Captured juvenile salmonids shall be held in transport containers for no more than 30 minutes before release. Release locations shall be nearby, be the same water body from which they were removed, and the selected release area shall have complex shaded habitat so juveniles may rest or hide after release.

x. Water pumps shall be screened and checked periodically to ensure they are working properly and that any fish missed in capture efforts are not being entrained and injured by the pumps.

xi. A report on fish rescue and 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.

xii. If the Authority or its contractors observe salmonids entrapped in naturally ponded or disconnected waterways within the action area, they shall notify NMFS as soon as possible in case a separate fish salvage effort must ensue. The Authority and its contractors shall facilitate site and area access through the ROW/construction zone until the fish salvage efforts conclude.

j. In-stream woody material refugia shall be designed and placed near the viaduct footings in the SJR to minimize predation of juveniles expected from the regular disturbance of HSR trains running over the river channel on the viaducts and the artificial structures attracting more piscivorous predators to the area than would be expected without the overwater structures and ongoing HSR operations. The Authority shall contact NMFS and SJRRP staff to advise placement and amount to provide optimal refuge for juveniles to hide in and avoid predation.

k. The Authority and its contractors shall prepare and adhere to a SPCCP and SWPPP for each construction site discussed in this opinion, to minimize the probability of introducing pollution into waterways and to reduce the amount discharged should an accidental or uncontrolled discharge occur.

i. Stormwater and erosion AMMs and BMPs shall be established prior to the start of construction and earthwork, and be maintained 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 time, to ensure rapid response to events. Materials 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 the SJR or Eastside Bypass occur, NMFS staff 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.

2. The following terms and conditions implement RPM 2:

a. The Authority and its design-build team shall work with NMFS staff to ensure viaduct footings will demonstrate minimal hydraulic effects and not alter the hydrology of the SJR in a way that may impede the migration of listed salmonids or cause changes in geomorphic processes that could alter habitat, taking into account increases in Restoration Flow planned by SJRRP.

b. The Authority and its design-build team shall provide final SJR Reach 4A and Eastside Bypass crossing plans of the CV Wye to NMFS at least one year prior to construction mobilization and site preparation start dates for consultation and coordination purposes, in case new information or project design changes warrant consultation re-initiation or opinion amendments.

i. If consultation reinitiation or opinion amendments 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.

c. Decreases to the riparian vegetation available locally shall be minimized.

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 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.

d. Trees to be removed for the project shall be surveyed for species and number. The Authority or its contractors shall replant onsite at least a 3:1 ratio in-kind for the number of individual trees removed once construction is complete. Plantings shall be monitored and cared for at least three years after planting to ensure survival.

e. Temporary construction materials and BMPs shall consist of natural biodegradable materials and the use of plastic (such as monofilament and Visqueen) shall be minimized to the extent practicable. All materials intended for temporary use onsite shall be removed within 60 days post construction/project completion to reduce pollution and trash entering the waterways.

f. Temporary construction areas shall be utilized for staging, storage, parking, and stockpiling outside of the water channels, floodplains, and riparian areas whenever practicable.

g. Disturbed areas that were graded will be re-contoured and stabilized at the end of the construction year to ensure erosion and sediment mobilization into the SJR will be avoided. Once construction is complete, all disturbed areas shall be naturalized to the extent practicable.

h. The placement of artificial structures in the riparian corridor and on the river banks shall be limited to the extent practicable, both above and below the OHWM.

i. The placement of riprap on the river bank shall be limited to the extent described in the 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 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.

iv. Temporarily disturbed areas shall be revegetated with native plants that resembles or improves 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.

i. The use of pesticides and herbicides shall be avoided within the SJR and Eastside Bypass wetted channels, floodplains, and uplands during weed control activities.

j. Temporary piles shall be completely removed rather than cutting or breaking them off below the water/ riverbed surface to avoid creating predator habitat.

k. Sediment suspension created by removing temporary piles shall be controlled by encircling the in-water work area with a silt curtain, pulling the piles out slowly, and filling any holes with clean, native sediment or appropriately sized spawning gravel following pile removal.

3. The following terms and conditions implement RPM 3:

a. The Authority and its contractors shall coordinate with SJRRP fisheries staff and NMFS, when necessary, to allow safe and reliable access through HSR ROW and construction sites when in-river SJRRP monitoring or fish salvage operations are required.

i. NMFS and SJRRP shall submit requests for access to particular locations at least 48 hours before the date of the required access.

ii. 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 and SJRRP of their contact information regularly.

b. Annual updates and reports required by these terms and conditions shall be submitted by December 31st of each year of construction.

c. Monitoring reports related to RPM 3 shall include record of adherence to project schedules, project milestone completion dates, and details regarding AMM/BMP implementation and performance, as well as any take, incidents, or encounters relating to NMFS resources or their ecological surrogates.

d. Updates and reports required by these terms and conditions shall be sent to:

San Joaquin River Branch Chief – Erin Strange
California Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814
Erin.strange@noaa.gov

2.10 Conservation recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

- When local water temperatures of the SJR are less than 65°F during impact pile driving activities during the aforementioned seasonal in-water work windows (in Reach 1A or Reach 4A), listed salmonids may still be present in the wetted channel areas. NMFS recommends that the Authority or its contractors control their underwater sound from pile driving activities to the FHWG interim threshold levels (Caltrans 2015, 2019) and adjusting pile driving activities appropriately (NMFS 2008a) and/or implementing underwater sound control measures correctly.

- The Authority and its contractors should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis, monitoring, and funding to otherwise support salmonid restoration projects and reintroduction actions projects in the CV, particularly efforts associated with the SJRRP, regarding the Merced to Fresno plus CV Wye section. Doing so would aid restoration of the functionality of existing critical habitats in general, and improve the resiliency and probability of recovery of CCV steelhead and NEP spring-run Chinook salmon 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 CCV steelhead and NEP spring-run Chinook salmon.

2.11 Reinitiation of consultation

This concludes formal consultation for the California HSR Merced to Fresno plus CV Wye Section.

As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (Section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” 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) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Authority and descriptions of EFH for Pacific Coast Salmon contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce (PFMC 2014, 2016).

3.1 Essential Fish Habitat affected by the project

The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by PFMC-managed salmon within the USGS 4th field hydrologic units identified by the fishery management plan (PFMC 2014). This designation includes the 18040001 – Middle San Joaquin-Lower Chowchilla hydrologic unit for all runs of Chinook salmon that historically and currently use these watersheds (spring-run and fall-run). The fishery management plan also identifies Habitat Areas of Particular Concern (HAPCs) for Pacific Coast Salmon as: complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation.

The action area occurs within Pacific Coast Salmon EFH, specifically watersheds utilized by Chinook salmon (*O. tshawtyscha)*, including a fall-run and a NEP of re-introduced spring-run, though the spring-run historically dominated this watershed. The SJR is historical habitat for these two runs and contains the southernmost populations of Chinook salmon, though anthropogenic changes in the environment have severely adversely impacted their ability to use this basin over the last century. The combined Sacramento – San Joaquin Rivers system once supported Chinook salmon runs comparable to those of the Columbia and Fraser rivers. The freshwater Pacific Coast Salmon EFH components affected by this project include spawning and egg incubation habitat (for fall-run Chinook, discussed below), juvenile rearing habitat, and the juvenile and adult migration corridors, but does not include adult holding habitat. Any habitat used for spawning is considered a HAPC, however HAPCs have not been officially designated in this area.

In 2010, the SJRRP began trap and haul activities to move adult fall-run Chinook salmon around dry stretches of the river as an interim action to restore anadromy until full river connectivity was achieved. In 2013 and 2014, translocated fall-run Chinook salmon were spawning in the SJR near the action area (SJRRP 2016), and in 2015, more than 20 redds were observed near the span of the HWY 99/North of Fresno site in Reach 1A, under to slightly downstream of the direct in-water footprint of the project (Portz 2016). Therefore the Merced to Fresno section of the HSR project affects the spawning HAPC of fall-run Chinook salmon.

Starting in 2016, the SJRRP began releasing excess adult NEP spring-run broodstock into Reach 1A to monitor and gather data about adult holding behaviors, use areas, and redd creation locations (NMFS 2019). Over the last three years (2016, 2017, and 2018) no spring-run redds have been observed as far downstream as the HWY 99 bridge/HSR viaduct construction site though spawning had occurred in Reach 1A upstream of these sites, despite the 319 fish having sufficient flows and free access to the area (majority of released NEP spring-run broodstock were acoustically tagged and tracked throughout the holding and spawning periods). Reach 1A is suspected as being spawning habitat/gravel limited and issues may eventually arise where fall-run pairs dig up or superimpose over spring-run redds (SJRRP 2017a). Observations of fall-run/spring-run redd superimposition have not yet occurred and may not be a pressing issue until both runs simultaneously occupy SJR Reach 1A in greater numbers.

3.2 Adverse effects on Essential Fish Habitat

Proposed projects that occur in or along waterways often cause significant long-term or permanent negative impacts to aquatic habitat, and the HSR system is no different as the route crosses the SJR and other waterways multiple times in this section. Additionally, improved transportation infrastructure is associated with increased human population growth and urbanization effects that combine to cumulatively decrease the functionality of aquatic ecosystems over large landscapes via individually smaller but pervasive public and private actions (i.e., land development from rural/agriculture to housing and commercial lots, increased water demands, increases in impervious surfaces, point and non-point source pollution increases, increases in aquatic recreation, increases in bank protections to protect new land development, etc.). Therefore, direct and immediate impacts to Pacific Coast Salmon EFH will be considered, as well as indirect and long-term effects of the existence and operation of the HSR system as its implementation affects the quality and quantity of Pacific Coast Salmon EFH into the future.

3.2.1 HSR Construction and Permanent Structure (Pacific Coast Salmon EFH, Complex Channel & Floodplain HAPC, Spawning Gravel HAPC)

The construction of the HSR system in and over the riparian corridor (e.g., building permanent structures, utility installation, temporary or permanent road building, earthwork, etc.) will significantly alter the land surface, soil, vegetation, and hydrology characteristics of the local areas and therefore adversely impacts salmon EFH directly through habitat loss or modification. The HSR viaducts will permanently occupy a small portion of the wetted channel through support columns and footings, and also permanently shade under the viaducts structures, changing the aquatic ecosystem below its structure. A larger area of floodplains, the riparian corridor, and upland areas will be occupied by the HSR route and track placement, associated utilities, and Authority ROW. Construction activities can also have detrimental effects on salmon habitat through adverse water quality impacts via runoff of large quantities of sediment where topsoil is disturbed, as well as the potential for construction equipment lubricants, heavy metals, and pesticides to be introduced into the waterway.

The Authority is offsetting much of the permanent and temporary impacts to Pacific Coast Salmon EFH through on-site replanting of removed riparian vegetation at a 3:1 ratio by species removed (and agreeing to maintain and monitor for five years after construction is complete), stabilizing and reseeding disturbed topsoil as soon as possible after activities conclude, employing rigorous onsite SWPPP and SPCCP measures to avoid construction pollution impacts to water quality, and by payments into the NFWF/USACE's in-lieu fee program at a 3:1 ratio of the footprint of the viaducts of the SJR riparian corridor and at a 1:1 ratio of the footprint of the viaducts in the Eastside Bypass.

However, these restorative or offset measures do not address the hydrologic effects of the large number of temporary support piles placed into the SJR channel (>120 24 inch or greater diameter piles, arranged in rows of four-five piles each) over the course of the 2016 to 2018 water years, which saw some flood events. It is likely that the temporary piles changed the water flow dynamics of the area, increased the velocities between the pile rows and caused scour and artificial movement of the spawning gravel that was below the temporary support trestle at the HWY 99/Reach 1A North of Fresno viaduct crossing site. Because Friant Dam sequesters any new inputs of sediment and gravel behind the dam, any spawning gravel lost to scour will not be naturally replaced, further limiting and reducing the spawning habitat available to Chinook salmon.

Also, it is likely that during operations of the HSR system, rolling stock passing overhead will cause vibrations and noise to travel down the support columns into the water column, and periodically disturb fish. While it is difficult to determine to what extent Chinook salmon may be disturbed by HSR rolling stock operation, given that much underwater sound research is focused on high impact sounds that rise to the level of injuring or killing fish, such as impact pile driving or offshore drilling activities (Popper and Hastings 2009, Hawkins and Popper 2016), it is reasonable to expected that sudden vibration from trains running at 120 mph will elicit a startle response. While adults may be disturbed with little detriment beyond expending a few calories in movement, juveniles that are caused to flush or startle from resting or hiding spots become vulnerable to predators for a short time period. In combination with shading effects from the overhead bridge that obscure objects in the shaded portion when observed from sunlight water columns (Helfman 1981), it is likely that the HSR viaducts will become habitats that attract ambush predators (predation hotspots). Juvenile Chinook salmon must pass under the HSR viaducts to complete their migration to the Delta and the Pacific Ocean, so constructing and using HSR viaducts will degrade the quality of their migration corridor by occupying a relatively small portion of physical space, but also making it less likely that an individual juvenile will survive the journey.

To mitigate for some of these adverse effects to Pacific Coast Salmon EFH, the Authority is planning to purchase 14.41 acres of aquatic habitat credits from the NFWF's Sacramento District California in-lieu fee program (as discussed in Section 2.5.1.9 Mitigation credit purchase or in-lieu fee program participation).

3.2.2 Floodplain alteration through bank stabilization and protection (Pacific Coast Salmon EFH, Complex Channel & Floodplain HAPC)

Many river valleys in the west were once marshes and were well vegetated, filled with mazes of floodplain sloughs, beaver ponds, and wetlands. Salmon evolved within these systems. Juvenile salmon can spend large portions of their freshwater residence rearing and over-wintering in floodplain environments and riverine wetlands. Spring-run Chinook salmon also will spend up to a year rearing in freshwater and will rely on floodplains for refuge during flood conditions, and access to such floodplain refuge improves their overall growth and fitness (Sommer *et al.* 2001). Salmon survival and growth are often better in floodplain channels, oxbow lakes, and other river-adjacent waters than in mainstream systems (National Research Council 1996).

Now, much of the floodplain rearing habitat in the CCV is highly altered and its functionality has been greatly reduced. Within the action area, a large degree of the alterations to floodplain and wetlands are associated with levees and the flood protection system. The hard armoring and leveeing of mainstem shorelines simplifies habitats, reduces the amount of complex freshwater and intertidal habitats by design, and affects nearshore processes and the ecology of a myriad of species (Williams and Thom 2001). The physical, chemical and biological processes driving natural riverine ecosystem function are often not correctly considered in bank stabilization and shoreline protection project designs (Beechie *et al.* 2010) and frequently result in alterations of stream flows and temperatures and reduction of the heterogeneity of rearing habitat. As such, the preservation and enhancement of any remaining floodplain is important to maintain the ability of Pacific Coast Salmon to naturally rear in the CCV, however these physical changes can also decrease the effectiveness of salmon habitat restoration efforts that co-occur in the area (Beechie *et al.* 2005).

Therefore, the adverse effects from the HSR system infrastructure will be added on top of previous degradation to the floodplain and complex channel HAPC. Though the SJR mainstem and the Eastside Bypass Channel are already leveed, impacted, and artificially maintained to different degrees, the addition of hard stabilization measures and artificial structures make it unlikely that these areas will ever be set-back or restored to their natural states, and the quality and quantity of the Pacific Salmon EFH available locally to rearing juvenile Chinook salmon will remain low. However, the Authority has also committed to using 'soft armoring' techniques (FEMA 2009, Authority and FRA 2018) to the extent practicable and to participating in NFWF/USACE's in-lieu fee program. The Authority has specifically identified fee payment commitment to the Mendota Wetland Restoration Project due to this location's unique ability to increase the floodplain habitat available to salmonids in the upper SJR. This project proposes to purchase largely unaltered, SJR-adjacent land and strategically breach its levees to reconnect historical floodplain back to the SJR watershed (NFWF and WRA Environmental Consultants 2019). This will re-create and maintain floodplain habitat that can be used by rearing Chinook salmon juveniles affected by the proposed HSR action.

3.2.3 Urbanization and associated increases in stormwater pollution (Pacific Coast Salmon EFH, Complex Channel & Floodplain HAPC)

The degree of urbanization of the action area is expected to increase as the HSR system becomes operational, and therefore urbanization of Pacific Coast Salmon EFH is considered an indirect but important effect of the proposed project. The negative effects of urbanization on stream ecology are second only to agriculture, even though urban areas occupy significantly less land surface than farmlands (Paul and Meyer 2001). This is because the amount and pervasiveness of impervious surfaces associated with urbanization and development. Buildings, rooftops, sidewalks, parking lots, roads, gutters, storm drains, and drainage ditches, in combination, quickly divert rainwater and snow melt into receiving streams, resulting in an increased volume of runoff from each storm, increased peak discharges, decreased discharge time for runoff to reach the stream, and increased frequency and severity of flooding. Flooding reduces refuge space for fish, especially where accompanied by loss of instream structure, off-channel areas, and habitat complexity. Flooding can also scour eggs and young from the gravel in spawning HAPCs. Increases in streamflow disturbance frequencies and peak flows also compromises the ability of aquatic insects and fish to recover (May *et al.* 1997).

In addition, urbanization greatly impacts Pacific Coast Salmon EFH through decreasing local and downstream water quality via various urban/municipal sources. Water quality is essential to salmon, and the quality of their habitat can be altered when pollutants are introduced through surface runoff or through direct discharges of pollutants into the water. Direct input of pollutants include the wastewater discharges of municipal sewage or stormwater treatment plants, power generating stations, and industrial facilities (e.g., pulp mills, desalination plants, fish processing facilities). Indirect sources of water pollution in salmon habitat results from runoff from streets, yards, construction sites, gravel or rock crushing operations, or agricultural and forestry lands. Stormwater runoff from streets is the main indirect concern in this instance, and it may carry oil and other hydrocarbons, lead and other heavy metals, pesticides, herbicides, sediment, nutrients, bacteria, and pathogens into salmon habitat (Feist *et al.* 2017) without adequate treatment. The introduction of pollutants into EFH can create both lethal and sublethal habitat conditions to salmon and their prey (Scholz 2011, McIntyre *et al.* 2015).

Due to the intermittent nature of rainfall and runoff, the large variety of pollutant source types, and the variable nature of source loadings, urban runoff is difficult to control. The National Water Quality Inventory (EPA 2009) reports that runoff from urban areas is the leading source of impairment to surveyed estuaries and the third largest source of impairment to surveyed lakes. The amount of impervious surfaces also can influence stream temperatures. Summertime air and ground temperatures in impervious areas can be 5°C warmer than in agricultural and forested areas (Bounoua *et al.* 2015, Edmondson *et al.* 2016). In addition, the trees that could be providing shade to offset the effects of solar radiation are often missing in urban areas, and these temperatures can translate to increases in stream temperatures during storm events (Zeiger and Hubbart 2015). The lack of infiltration also results in lower stream flows during the summer by reducing the interception, storage, and release of groundwater into streams. This affects habitat availability and salmonid production, particularly for those species that have extended freshwater rearing requirements (e.g., spring-run Chinook salmon/Coho salmon). Generally, it has been found that instream functions and value seriously deteriorate if the levels of impervious surfaces reach 10% of the total land surface cover in a sub-basin.

Numerous Federal and State programs have been established to improve and protect water quality. One of the most important programs relating to salmon EFH is the CWA’s Section 319 program administered by the EPA. Under this section, states are required to submit to EPA for approval of an assessment of waters within the state that, without additional action to control nonpoint sources of pollution, cannot be expected to attain or maintain applicable water quality standards. In addition, states are to submit to EPA their management programs that identify measures to reduce pollutant loadings, including BMPs and monitoring programs. It is, therefore, critical that actions aimed at improving EFH water quality, especially in streams and rivers, are taken in concert with state agencies (e.g., California's SWRCB) responsible for water quality management.

The Authority has pursued and obtained the necessary SWRCB permits to enable HSR construction and operations, and plans to incorporate a high degree of stormwater control and treatment/LID designs into the project, including both along the systems routes and at stations, passenger parking lots, and service areas. Considering these steps, it is unlikely that the HSR system itself will directly negatively impact the water quality of the Pacific Coast Salmon EFH within the action area. However, the Authority has significantly less control over the stormwater and runoff management of the community areas outside of its properties and jurisdiction, though increased development is expected in association with the HSR route. This will further urbanize the action area, and reductions in SJR basin water quality are expected because the status quo stormwater control and treatment practices of the area are not sufficient to meet the water quality requirements of Pacific Coast Salmon in the SJR mainstem and tributaries (EPA 2018a, b, SWRCB 2019b).

Other adverse effects concerning habitat functionality and individual salmon impacts are discussed further in Section 2.5 of the biological opinion.

3.3 Essential Fish Habitat Conservation Recommendations

The species managed under the Pacific Coast salmon fishery management plan that may be affected by this project are: Chinook salmon (*O. tshawytscha)*, both the fall-run and spring-run. Fall-run Chinook are known to migrate and spawn in SJR tributaries, spring-run Chinook salmon are being to be re-introduced and re-establish in the project area, and juveniles from both runs are known to grow and rear in the action area. The EFH of Chinook salmon is adversely affected by the proposed project through the pathways identified above: HSR system construction and artificial structure placement in/over the riparian corridor, floodplain alteration and bank stabilization, and increased urbanization and associated stormwater inputs once the HSR system becomes operational.

Some Pacific Salmon EFH concerns are addressed through the ESA consultation RPM's 1-3 (Section 2.9.3) and the Authority's plan to purchase 14.41 acres of aquatic habitat credits that will benefit CV salmonids from NFWF's Sacramento District California ILF program, specifically opening up floodplain habitat previously disconnected from the SJR system. In addition, the following EFH Conservation Recommendations (CRs) are intended to address the adverse effects of temporary and permanent structures associated with the HSR system construction near the HWY 99 Reach 1A north of Fresno crossing, placed in and over the spawning HAPC used by Chinook salmon:

1. To address the alteration of sediment composition under and downstream of the temporary support piles/false work structures and permanent viaduct HSR structures through alterations of in-river flows through temporary and permanent

flow obstruction, NMFS recommends that the FRA, or the Authority on behalf of the FRA, restore the riverbed sediment to its original condition, including the placement of clean, native river gravel and/or cobble appropriately sized for the spawning and rearing habitat for Chinook salmon after the construction of the viaduct is complete and temporary support piles are removed. Sediment size-classes, origin, volumes, timing, and placement will be coordinated with NMFS and other agencies affiliated with SJRRP regarding specifics to fulfill the restorative intent of this CR (SJRRP 2015b). Augmenting the available local gravel is also expected to help address the alteration of benthic prey (benthic macro-invertebrate) abundance/composition and the quality of local foraging habitat for juvenile salmon due to sediment composition change and overwater structure shading under the viaduct crossings (Merz and Ochikubo Chan 2005), therefore execution of this CR may serve a dual purpose.

The following CRs are intended to address the adverse effects of temporary and permanent structures associated with the HSR system construction placed in and over juvenile Chinook rearing and migration EFH, and the floodplain and complex channel HAPC:

2. To address the creation of predator habitat through installation of permanent in-water structures (ambush locations, overwater shading), NMFS recommends also installing in-river large woody material (LWM) around or adjacent to the HSR viaduct crossing and footings so that juvenile Chinook may also have access to predator refuges nearby the impacted locations. Enhance in-stream fish habitat by providing root wads and deflector logs below the stabilized bank, and by planting shaded riverine aquatic cover vegetation, 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 and SJRRP staff to ensure LWM installations are placed in arrangements and in sufficient numbers so that maximal benefits and use of Chinook salmon juveniles are likely and expected (Dolloff and Warren 2003).

The following CRs are intended to address the adverse effects of floodplain alteration and bank stabilization associated with the HSR system installation in the riparian corridor and juvenile Chinook rearing and migration EFH, and the floodplain and complex channel HAPC:

3. To address the need to continue to stabilize the river banks upon which the HSR structures are placed, NMFS recommends utilizing alternatives to traditional riprap and hard armoring, such as designing compacted fill lifts and vegetation plantings to stabilize banks while also enhancing the limited rearing and foraging EFH locally available to juvenile Chinook. 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 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.

4. In areas where levees are under the jurisdiction of the USACE, apply for and obtain a vegetation variance which will allow for the Authority or its contractors to re-plant the area with native species as described above in CR #3, at least in the lower one-third of the waterside of the levee.

The following CRs are intended to address the increased urbanization and associated stormwater inputs once the HSR system becomes operational, and its impact on the floodplain and complex channel HAPC and general Pacific Salmon EFH for all life stages and uses:

5. To address general urbanization of natural areas, NMFS recommends the Authority re-examine its ROW and access road designs of the immediate project areas to designate more acreage near the riparian corridor as public green areas/open spaces that will allow access and enjoyment wherever feasible while also ensuring HSR operational safety and environmental continuity. Interpretative signage should be included in the public space to explain how the Authority places a high value on river health and preservation of aquatic/riverine ecosystems, including Pacific Salmon EFH, even with an increasing urban landscape. Such designs could also include incorporation of stormwater treatment/LID tactics that can help treat stormwater before discharge, further decreasing HSR indirect negative impacts on the SJR watershed.

6. To address expected decreases in EFH water quality due to increased urbanization and stormwater discharge associated with HSR system implementation, NMFS recommends that the Authority take efforts beyond its own properties to help the local communities (perhaps through permitting guidance or knowledge exchanges with the communities stations are located within):

    i. Install and monitor vegetated buffers along stormwater drains to streams or bioswales in a large percentage of upland areas with the goals of trapping sediment, removing nutrients and metals, and moderating water temperatures, as feasible.

    ii. Increase their stormwater quality monitoring following National Pollutant Discharge Elimination System and SWRCB requirements from all stormwater discharge points, and before and after pollution control BMPs to establish their performance over time, and adapt/replace/maintain stormwater quality BMPs, as necessary.

iii. Increase their access to knowledge about water quality issues and encourage local efforts to improve SJR watershed water quality in general, especially meeting the existing TMDLs that affect salmon EFH.

In total, fully implementing these six EFH CRs would protect, by avoiding or minimizing the adverse effects described in Section 3.2, at least 38.5 acres (approximately) of designated EFH for Pacific Coast Salmon in the Merced to Fresno plus CV Wye action area.

3.4 Statutory Response Requirement

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 CR. 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 CRs 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 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 CRs, 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 CRs 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 CRs 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 CRs (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The 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 Authority and the FRA. 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.

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