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 PCTS # WCR-2018-8824

June 12, 2018

Ann Lubas-Williams
Program Manager
San Joaquin River Restoration Program
U.S. Bureau of Reclamation
2800 Cottage Way, W-1727
Sacramento, California 95825

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Eastside Bypass Improvements Project in Merced County, California

Dear Ms. Lubas-Williams:

Thank you for your letter of January 26, 2018, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Eastside Bypass Improvements Project in Merced County, California. 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 proposed action.

Enclosed is NMFS's biological opinion based on our review of the proposed Eastside Bypass Improvements Project associated with the San Joaquin River Restoration Program (SJRRP), and its effects on the Federally listed as threatened California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*) distinct population segment and the Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) evolutionarily significant unit (ESU) being reintroduced by the SJRRP in accordance with section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). This segment of the CV spring-run Chinook salmon population has been designated by NMFS as a non-essential experimental population in accordance with section 10(j) 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 listed species under our jurisdiction. NMFS has also 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. These measures would also minimize impacts to CV spring-run Chinook salmon. This opinion is based on information provided in the final biological assessment, the information discussed in NMFS's opinion on the effects of the proposed action, and numerous scientific articles and reports from both the peer reviewed literature and agency "gray literature."

This opinion contains "conferencing" for CV spring-run Chinook salmon because it was requested by the United States Bureau of Reclamation (Reclamation). A formal conferencing opinion is only required if the analysis of the proposed action results in a jeopardy determination, and we concluded the proposed action will not jeopardize the continued existence of the CV spring-run Chinook salmon ESU, therefore a formal conferencing opinion is not included in this opinion.

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 includes conservation recommendations. As required by section 305(b)(4)(B) of the MSA, Reclamation must provide a detailed response in writing to NMFS within 30 days after receiving EFH conservation recommendations. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS's EFH conservation recommendations unless NMFS and Reclamation 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 conservation recommendations, Reclamation 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 in the California Central Valley Office 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

for Barry A. Thom
Regional Administrator

Enclosure

cc: To the file: 151422-WCR2018-SA00411

UNITED STATES DEPARTMENT OF COMMERCE
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Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Eastside Bypass Improvements Project in Merced County, California

National Marine Fisheries Service (NMFS) Consultation Number: WCR-2018-8824

Action Agency: United States Bureau of Reclamation

Affected Species and NMFS's Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?ǂ	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*)	Threatened	Yes	No	NA	NA
Central Valley spring-run Chinook salmon, non-essential experimental population (*O. tshawytscha*)	Threatened*	Yes	No	NA	NA
Southern DPS of North American green sturgeon (*Acipenser medirostris*)ǂ	Threatened	No	NA	NA	NA

ǂPlease refer to section 2.12 for analyses of species or critical habitats that are not likely to be adversely affected.
*Treated as an ESA proposed threatened species per 10(j) non-essential experimental population treatment rules.

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

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

Issued By: Maria Rea

for Barry A. Thom
Regional Administrator

Date: June 12, 2018

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LIST OF ACRONYMS AND ABBREVIATIONS

AMMs – avoidance and minimization measures
BA – biological assessment
BMPs – best management practices
°C – degrees Celsius
CCV – California Central Valley
CVP – Central Valley Project
CDFW – California Department of Fish and Wildlife
CFR – Code of Federal Regulations
cfs – cubic-feet-per-second
CV – Central Valley
cy – cubic yards
Delta – Sacramento-San Joaquin River Delta
DPS – distinct population segment
DQA – Data Quality Act
DWR – California State Department of Water Resources
EFH – essential fish habitat
ESA – Endangered Species Act
ESM – engineered streambed material
ESU – evolutionarily significant unit
°F – degrees Fahrenheit
FMP – Fishery Management Plan
FR – Federal Register
gpm – gallons per minute
HAPCs – Habitat Areas of Particular Concern
H:V– horizontal to vertical
ITS – incidental take statement
LSJLD – Lower San Joaquin Levee District
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NEP – nonessential experimental population
NMFS – National Marine Fisheries Service
NTU – nephelometric turbidity unit
NWR – National Wildlife Refuge
opinion – biological opinion
PBF – physical or biological feature
PCE – primary constituent element
PCTS – Public Consultation Tracking System
PVA – population viability analysis
Reclamation – United States Bureau of Reclamation
RM – river mile
RMPs– reasonable and prudent measures
RMS – root mean square
ROW – right-of-way
sDPS – southern distinct population segment
SJR – San Joaquin River

SJRRP – San Joaquin River Restoration Program
SR – state route
SWE – snow water equivalent
SWP – State Water Project
SWPPP – Stormwater Pollution Prevention Plan
SWRCB – State Water Resources Control Board
USACE – United States Army Corps of Engineers
USC – United States Code
USFWS – United States Fish and Wildlife Service
VSP – viable salmonid population

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.

Since the proposed action would modify a stream or other body of water but with the intent of benefiting fish and wildlife resources, NMFS did not provide recommendations and comments for the purpose of conserving fish and wildlife resources, as would otherwise be required under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS's Public Consultation Tracking System (PCTS) [*https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts*]. A complete record of this consultation is on file at the California Central Valley Office in Sacramento, California.

1.2 Consultation History

On July 6, 2017, NMFS attended an early consultation meeting with the United States Bureau of Reclamation (Reclamation), about the proposed action as part of the San Joaquin River Restoration Program (SJRRP).

On December 15, 2017, Reclamation provided a draft biological assessment (BA) to NMFS for review and comments.

On January 4, 2018, NMFS provided Reclamation with draft BA comments.

On January 26, 2018, NMFS received a request for formal and informal consultation concerning the proposed Eastside Bypass Improvement Project with a BA of the project (Reclamation, 2018). In their initiation packet and assessment, Reclamation identified that the project may affect:

- California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS), threatened
- Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) non-essential experimental population, treated as threatened
- Pacific Coast Salmon EFH

On February 1, 2018, NMFS sent Reclamation a letter notifying them that the consultation had been initiated on January 26, 2018.

On April 5th, 2018, Reclamation conveyed via email a determination that the proposed project was "not likely to adversely affect" the southern distinct population segment (sDPS) of North American green sturgeon (*Acipenser medirostris*).

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). Reclamation and the California State Department of Water Resources (DWR) propose to design, permit, and then implement a Federal action composed of four project elements, with the intent to improve fish passage and increase channel flow capacity for fish benefit, in the Eastside Bypass (Reclamation, 2018). In this consultation, Reclamation is the lead Federal agency for this action while DWR is considered their applicant.

The proposed action elements:

1) Eastside Bypass Levee Reinforcement: Propose to reinforce approximately two miles of levee along the Eastside Bypass to improve levee stability and reduce seepage (Reach O Levee Improvements) so channel flow capacity can increase
2) Eastside Bypass Control Structure Modification: Propose to modify the existing Eastside Bypass Control Structure to improve fish passage
3) Dan McNamara Road Crossing Culvert Replacement: Propose to replace the existing culvert at the Dan McNamara Road crossing over the Eastside Bypass to improve fish passage
4) Merced National Wildlife Refuge (NWR) Weir Removal and Well Replacement: Propose to remove two weirs in the Eastside Bypass operated by the United States Fish and Wildlife Service (USFWS) that provided water to the Merced NWR to improve fish passage, and replacement of their water supply by reclaiming an abandoned well

Additional permits will be required to implement this action, such as a Section 404 Clean Water Act from the U. S. Army Corps of Engineers (USACE) or other public trust resource reviews like USFWS opinions, and the act of obtaining permits will be considered as part of the proposed action.

Reintroducing populations into historically occupied or other suitable areas is one of two primary goals of the recovery plan (NMFS, 2014). Restoring a population of spring-run Chinook salmon below Friant dam is a top priority for reintroduction concerning this evolutionarily significant unit (ESU) (NMFS, 2014)), so that their South Sierra Nevada diversity group may once again support the viability and abundance of the ESU. To accomplish this, volitional passage must be restored, and the proposed action involves the mediation of fish passage impediments and channel reinforcement to allow conveyance of increased river flows, both of which will improve accessibility of available holding, spawning, incubation, and rearing reaches in the San Joaquin River (SJR) below Friant. The recovery of CCV steelhead would also benefit from the proposed action, as restoring access to those same spawning areas below Friant dam could passively reintroduce the DPS and help support their DPS by having representation from the CCV steelhead South Sierra Nevada diversity group.

1.3.1 Proposed Action Element 1: Eastside Bypass Levee Reinforcement

The Middle Eastside Bypass and Lower Eastside Bypass are flood bypasses within the action area targeted for channel capacity improvement. Eastside Bypass levees were originally constructed as part of the Lower San Joaquin River Flood Control Plan (or the Lower San Joaquin River and Tributaries Project) in the early 1960s. The Operation and Maintenance Manual used at the time of original construction (Reclamation Board, 1967) provided guidelines for levee capacity. Channel design capacity was authorized based on the amount of water that can pass through a given reach, while maintaining a levee freeboard of four feet. The carrying capacities of the Middle and Lower sections of the Eastside Bypass for flood flows are 16,500 and 8,000 cubic-feet-per-section (cfs), respectively, though some flood damages still expected on adjacent land developments due to water seepage under the levees, through the levees, or because of backwater effects of local storm drains (USACE, 1993).

Because of the known issues of levee seepage and structural stability, the levees of the Eastside Bypass between Sand Slough and the Mariposa Bypass have been identified as the most limited channel reach when considering increasing flows through the channel up to full Restoration Flow allocations. In context of the SJRRP, “Restoration Flows” are defined as releases of water from Friant Dam, in accordance with the hydrographs that represent the base flow of the SJR, in combination with additional releases of ten percent of the applicable hydrograph (the buffer flow), made to achieve the SJRRP’s Restoration Goal (SJRRP, 2017). Geotechnical analysis showed that the uppermost three miles of the right bank of the reach (Reach O) will likely limit the release of Restoration Flows planned by the SJRRP (SJRRP, 2017a) due to associated seepage on adjacent lands and therefore require improvement to avoid causal damage. “Then-existing” channel capacity is the flow that would not significantly increase flood risk due to Restoration Flows (regular and persistent flows vs. brief flood flow conveyance), and the “then-existing’ channel capacity estimated for the Middle Eastside Bypass is approximately 580 cfs, while Restoration Flows outline regular releases of up to 5,000 cfs to mimic the natural hydrograph of large snowmelt events and juvenile outmigration (SJRRP, 2017b, 2018b). By improving the levees in this section to support water conveyance up to 2,500 cfs, the Middle and Lower Eastside Bypass can be used for Restoration Flows but their overall design flood capacities would not be increased following project completion.

In 2000, DWR raised the levees an additional two to three feet within the action area to mitigate for regional land subsidence. The design capacities for the Middle and Lower Eastside Bypasses are rated to 16,500 and 8,000 cfs, respectively. The levees in the action area are currently between 10 to 14 feet above the landside levee toe elevations. The crest widths are 10 to 12 feet, the landside slopes range from about two horizontal to one vertical (H:V) on the levee, to 3H:1V. The waterside slopes range from 2H:1V to 4H:1V.

1.3.1.1 Construction Activities and Timeline

Between Sand Slough and Mariposa Bypass, three Eastside Bypass levee segments are proposed for improvement and reinforcement with cutoff walls to meet seepage and stability criteria; approximately 1,500 linear feet of levee in Reach O-1, 5,900 linear feet of levee in Reach O-3, and 2,600 linear feet of levee in Reach O-4. The top portion of the existing levees would be degraded and a bentonite cutoff wall would be placed in the middle of the levee crown. The top portion of the levee would then be reconstructed using select levee fill material. Degraded material deemed suitable would be blended with borrow pit material and stockpiled adjacent to the levee in an approximate 24 foot wide corridor for reuse to reconstruct the top third of the levee after the cutoff wall is placed. The portion of degraded material deemed unsuitable would be separately stockpiled adjacent to the levee and would be used to fill in the borrow pit area or spoiled within the area in coordination with the landowner.

Cutoff walls will provide a lens of low-permeability material within higher permeability materials in the levees, and the levee foundations, to cut off seepage flows. The bentonite cutoff walls would be installed to depths sufficient to minimize seepage through or beneath the levees to reduce landside seepage impacts, up to approximately 35 feet deep. Depths considered sufficient to meet gradients specified by USACE will ultimately be determined by geotechnical modeling and analyses. Some of the existing levees are composed of lower permeability soil levels, therefore cutoff wall depths in those areas would be designed to augment those materials.

The One Pass Trench Method or the Open Trench Method would be used to construct soil-bentonite cutoff walls through the center of the levees for Reaches O-1, O-3, and O-4. The assumed average height above natural grade for levees is 13 feet, with a 3:1 waterside slope, 2:1 landside slope, and 12-inch crown width. The existing levee would typically be degraded by either two feet or by one-third of the levee height to create a working platform, depending on the construction method.

After the working surface has been excavated and prepared, the starter trench would be excavated to the required depths shown on the final design plans for each levee segment. Depending on the construction method, up to 50% of the cutoff wall trench cut soil would be stockpiled in the staging area and later blended with bentonite inside the trench to create the slurry. The starter trench would be backfilled with suitable compacted levee fill material and then an excavator would be used to construct slurry cutoff walls with depths ranging from approximately 23 to 32 feet and a consistent wall thickness of about 36 inches. A settlement plate and temporary soil cap may be installed depending on final design plans. The settlement plate would be removed upon approval, and suitable material would be exposed to a trench depth of one foot below the working surface. Upon adequate curing of cutoff walls, the trench excavation would be filled to elevations established as part of the final design.

The levee degrade and crown reconstruction would include a homogeneous section of suitable low permeability material. Suitability of material would be determined during final design. Proper moisture-conditioned embankment materials would be placed in accordance with accepted levee construction standards for material type, lift thickness, and compaction to restore levee height and crown. Embankment material will meet the necessary specifications and requirements for levee fill. Each lift would be moisture-conditioned and compacted to the specified density using suitable tamping foot compactors.

After the levee is reconstructed, aggregate base or asphalt concrete would be placed on the levee crown patrol road to match preconstruction conditions, and the levee slopes would be seeded and/or planted with approved vegetation. Currently, no asphalt concrete paving of levee crowns is envisioned except for localized areas where reconstruction of short paved ramps from the levee crown to a major road crossing would be needed.

The following utilities and infrastructure near the levee improvements in this action will also be modified by DWR: 1) an irrigation canal penetrating the existing levee would be modified or replaced in kind, 2) at least five drains that penetrate the existing levee would be modified or replaced in kind, and 3) a siphon owned and operated by Lone Tree Mutual Water Company on the landside section of the levee that moves water from the east side to the west side of the bypass (depending on conditions) would require that its headworks be extended or replaced in kind.

A preliminary field survey was conducted to locate readily identifiable utilities and irrigation channel crossings penetrating the levees. However, a more detailed levee survey would be performed as part of the final design to identify all levee penetrations. The cutoff walls would be constructed in areas where large underground utilities are currently present and it may be possible for the construction contractor to expose utilities and work around them while building the cutoff wall. However, it is also possible that the sizes and depths of some of the utilities may preclude working around them. At such locations, and at major road crossings, it may be necessary to leave gaps in the cutoff wall. Currently, it is anticipated that these gaps would be closed using cement bentonite panel sections placed to levels under the exposed utilities and the road pavement section. Controlled low-strength material would be placed over the wall to encase and support the utilities and complete backfilling the trench to a point approximately three feet below the levee crown or completed road surface. Backfill above the controlled low strength material would be approved levee fill, or road pavement section under the road crossings. Closure panels would overlap the adjacent slurry cutoff walls by a minimum of approximately 25 feet. If utilities are obstructions to the placement of cutoff walls, actual details for handling would be finalized as part of the final project design.

1.3.1.2 Construction Schedule, Access, and Staging

Clearing and grubbing of vegetation would take place within the designated staging area and also along the construction boundary limits for the project. Because the One Pass Trench Method requires a 20-foot-wide working platform and the Open Trench Method requires a 40-foot-wide working platform, prior to degrading the levee, grass would be also stripped down from the levee slopes within the improvement area. Stripped grass material and gravel taken from the levee crown would be salvaged to the extent possible and stockpiled in staging areas.

Staging of equipment would only occur outside of the channel. The primary staging area would be on approximately 31 acres, located south of West El Nido Road, adjacent to the Eastside Bypass levees. Approximately two acres of land from within the staging area may be used as a borrow pit to provide suitable levee fill material, but it is not anticipated that a substantial amount will be borrowed. A portion of the staging area may also be used to spoil material, in consultation with the land owner. A secondary staging area just South of West Chamberlain Road that is about two acres in size may be also used. An alternate staging area is adjacent to the levee improvement area for Reach O-1, west from a canal maintenance road off Lone Tree Road.

Construction equipment and materials would be transported via access from state route (SR) 152, heading north on SR 59, then west on West Washington Road until Harmon Road is reached. To perform the Reach O-1 levee improvements, construction equipment and materials may be alternatively transported from SR 59, heading west on Sandy Mush Road and then south on Lone Tree Road. A 24 foot wide, temporary access road would be built along the levee improvement area within the channel along the waterside toes to enable the stockpile of degraded material and provide construction access to these locations.

Construction for this project element is expected to be completed within one construction season, slated for 2019.

1.3.1.3 Operations and Maintenance Post-Modification

The Lower San Joaquin Levee District (LSJLD) operates and maintains the Eastside Bypass levees within the action area. The existing Eastside Bypass levees are currently maintained by LSJLD as provided in an agreement with the Central Valley Flood Protection Board. This includes routine vegetation management, levee inspections, levee restoration and repair, rodent control, encroachment removal, and levee patrolling during flood events. The proposed action would not change any of these maintenance needs, and LSJLD would continue to maintain the levees under its current agreement. There would be no change from existing conditions.

1.3.2 Proposed Action Element 2: Eastside Bypass Control Structure Modification

The Eastside Bypass Control Structure is at the upstream end of the Lower Eastside Bypass and works with the Mariposa Bypass Control Structure to split flood flows between the two facilities. The Eastside Bypass channel downstream of the Control Structure was designed with a flood capacity of 8,000 cfs (DWR, 1969). The bypass was designed as a trapezoidal channel with a low-flow channel at the centerline and levees on the banks to contain flood flows. Levees in this section of the Eastside Bypass vary in height from about 10 feet high upstream of the control structure to about 7 feet high downstream of the control structure.

The Eastside Bypass Control Structure is nearly 70 feet long measured longitudinally within the channel and is approximately 200 feet wide, extending across the Eastside Bypass with six 20-foot gated bays. The bays have manually-operated radial gates, with notches on the bay walls at the inlets for board placement. Surface water elevation upstream is controlled by placing boards into the bays so that flood flows may be routed into the Mariposa Bypass Control Structure when needed. Boards are currently in place in each bay at a height of approximately four feet.

Measured from upstream to downstream, the bays are 45.5 feet in length with a 15-foot concrete apron measured from the bay outlet to the channel downstream. In each bay, there are six 2 by 2 by 4 foot concrete block baffles about 45 feet from the bay inlet. At the downstream end of the concrete apron is a short sill that is about two feet tall and one foot wide, with the downstream channel associated with the sill being armored with riprap. Approximately 30 feet downstream of the riprapped section there is a pool section of the channel that has an eight foot depth and is incised.

At flows less than 700 cfs, the Eastside Bypass Control Structure does not meet fish passage criteria for Chinook salmon passage needs. At lower flows, the large drops at the sill and boards impede passage for juvenile outmigration and the water velocities and depths through the structure bays do not meet criteria for adult upstream migration. Once flows exceed 700 cfs, the sill and boards provide sufficient depths for adult salmonids to pass upstream and juveniles downstream without drops. The control structure also does not meet passage criteria for many other native fish species at lower flows, including slower swimming, non-jumping species like sturgeon, lamprey, Sacramento pikeminnow, and hitch.

Construction Activities and Timeline

To meet NMFS passage criteria for salmonids, the sill, boards, and energy dissipation blocks of the Control Structure would be saw-cut, demolished, and removed. Approximately one to two large dump trucks full of material would be removed and transported to the nearby landfill. Finally, the large pool in the channel downstream of the Control Structure would be filled and a 380-foot long rock ramp would be constructed to bring the channel bottom up to subgrade elevation.

Approximately 13,000 cubic yards (cy) of fill would be excavated from benches in the channel downstream of the ramp to construct the base for the approximately 380-foot-long ramp (to get to subgrade elevation), if the material is found to be suitable. If the material is not found to be suitable, the benches would not be excavated and fill would be imported from areas outside of the channel. New benches, approximately 100 feet wide with 3:1 side slopes, would be constructed starting at the end of the ramp and designed to inundate at flows around 1,000 cfs.

The ramp is designed to have a 1% slope down from the control structure. Laterally, the ramp would extend from bank to bank, with a 2% slope down towards the middle of the channel. The ramp would be constructed of rock mixes of two different gradations. The upper 50 feet features a larger grade of rock mix to help protect the ramp from high velocity scour, as would be expected when the gates are operated to divert flows into the Mariposa Bypass during flood flows or to allow maintenance downstream. Engineered Streambed Material (ESM) gradation on the upper portion would range from light class riprap (1.8 foot diameter) down to sand/silt. The remaining part of the ramp will be composed of gradation featuring 3-foot diameter boulders down to sand/silt. The upper portion of the ramp will also feature a boulder weir to further stabilize the ramp and create backwater conditions that will provide fish passage through the control structure. The boulder weir will be set slightly higher than the invert of the control structure and consist of boulders approximately three feet in diameter.

An additional 2.5 to 3.5 foot-thick top layer (11,500 tons) of ESM, comprised of rock mixes with a range of particle sizes from boulders to sand and silt, would be added on top of the compacted fill. The upper 50 feet would be constructed of a larger rock mix with a gradation from light class riprap (1.8-foot diameter) down to silt and sand. This section of the ramp may need to be grouted to withstand possible velocities and prevent erosion from operation of the gates during floods. The remaining 330 feet of the ramp would be constructed of a gradation featuring slightly smaller size boulders (1.3-foot diameter) down to silt and sand. The top upper most layer of material will remain un-grouted to mimic a natural channel. A larger rock gradation may also be placed near the gated culvert outflow structure to the north of the rock ramp to reduce potential erosion.

The rock ramp will also feature a low-flow, one foot deep, channel with a 10 foot wide bottom and 2:1 side slopes, to consolidate and direct low volume flows to assist in fish passage. Hydraulic modeling indicates that a low-flow channel with one foot of water depth would meet minimum fish passage depth criterion when flows were less than 45 cfs. A 1-foot-deep, low-flow trapezoidal channel would be created within the ramp, with a bottom width of approximately 10 feet and 2:1 side slopes. Individual 3- to 4-foot-diameter boulders (approximately two tons) would be placed in the low-flow channel at approximately 10-foot spacing to provide flow complexity, embedded such that one-third of their diameter protrudes from the bed. Outside of the low-flow channel, individual boulders would be placed beginning from about 150 feet upstream of the lower end of the ramp, with denser placement towards the top end of the ramp to provide resting areas for fish. A larger rock gradation may also be placed near the gated culvert outflow downstream of the structure to help alleviate erosion.

To stabilize the ramp, 30-foot-long sheet piles would be driven to a depth of 20 feet so that the top of the sheet pile is flush with the final grade elevation of the rock ramp, once the incised channel is filled in. The area contained by the sheet piles would then be backfilled with ESM. Hydraulic controls downstream of the ramp are expected to cause the bottom of the ramp to be backwatered at low flows. A sheet pile driver would be used to drive 30 feet of sheet pile to create an approximately 200-foot-long sheet pile wall at the bottom end of the ramp. The sheet pile would be driven approximately 20 feet into the ground, and extend about 10 feet above ground and key about 20 feet into the banks. The end of the ramp would then be backfilled to a 2:1 slope to stabilize the ramp so that no sheet pile is protruding into the ramp. The upper five feet would then be cut after construction is finished. If construction must occur during low flow conditions, a sheet pile wall would extend lengthwise down the center of the ramp to allow flows through a portion of the bays of the control structure and staged construction. This may require an additional approximately 380 feet of sheet pile. If the gates on the control structure cannot be closed because of Restoration Flows to work in the dry, the sheet pile wall would be extended another approximately five feet to prevent backwater from downstream going into the work area. Because of the high groundwater at the site, and the possibility of low flows within the channel, dewatering may be needed at the site.

A 2-foot-thick bank line rock mix, with the same gradation as the smaller ESM mix, would be placed along the banks of the rock ramp. Both the ESM and bank line rock mix would be in machine-tamped lifts not to exceed one foot, followed by water jetting to seal voids. Fine-grained material would be added and water jetting continued until voids are filled and water flows on the surface. Excess material would be removed from the surface prior to channel flows moving back into the work area. Water used during the jetting process would not be allowed to discharge into the channel downstream, but would be reused or pumped into an approved dewatering system. Large rocks may need to be shifted to obtain the desired rock layout and embedment.

A weir, spanning the entire channel and featuring 3-foot-diameter boulders, would be installed about 30 feet downstream of the control structure. The weir would have two levels of rocks, a footer level to provide support and an upper level with its top at final grade.

Infrastructure associated with the Eastside Bypass Control Structure would not be modified in this proposed action. Existing auxiliary infrastructure include: an underground siphon that conveys water in the Eastside Canal, a gated overflow structure located about 180 feet downstream within the right levee operated by LSJLD for drainage service from Owens and Deadman Creeks, and a control building on the left bank that houses the control equipment for the structure gates and the utilities for the building. There is also a maintenance road that crosses over the downstream end of the gate bays that would not be modified. There is a stream gage located approximately 550 feet downstream of the control structure. To ensure this gage is not influenced by the new flow dynamics of the rock ramp and can accurately represent stage data from this location, the gage will be replaced and relocated to 1,000 feet downstream of the rock ramp.

Construction Schedule, Access, and Staging

The site would be accessed from the north from Highway 99, then south on Highway 59 for 7 miles to Sandy Mush Road. From the south, the site would be accessed from Highway 99 to Highway 152, then north on Hwy 59 to Sandy Mush Road. Once at Dan McNamara Road, the two possible construction routes follow the levees located west of Dan McNamara Road along the Eastside Bypass. No public road closures would be necessary because the two construction routes near the Action Area are not accessible to public vehicles. Nevertheless, the construction area would be clearly marked with construction fencing to indicate to public foot traffic that the construction area is restricted. In addition, signs would be posted at the transition of Sandy Mush Road and Dan McNamara Road to let the public know not to enter the construction area. If needed, monitors would be used to keep the public out of the construction area.

Primary staging for equipment would be located along the west side of the action area outside of the levees. In addition, staging of materials (rock, sheet pile, etc.) and equipment could be required within the channel itself. Temporary access ramps into the bypass would be necessary to allow for equipment to move into and out of the channel. Staging and construction footprint areas would be cleared and grubbed. The borrow area would be located in the channel downstream of the rock ramp action area.

Construction is scheduled to begin towards the end of the spring pulse flows, when Restoration Flows would be at a minimum. The construction of this element is expected to be completed within one construction season, slated for 2019.

Operations and Maintenance Post-Modification

The Eastside Bypass Control Structure is operated and maintained by LSJLD. The LSJLD operates the structure to direct flood flows between the Lower Eastside Bypass and the Mariposa Bypass. The new rock ramp and modifications would not change LSJLD’s ability to operate the structure during flood events. Operating conditions at the modified control structure would influence how flows are split between the Eastside Bypass and the Mariposa Bypass. The design condition shows there is nearly 700 cfs of additional flows that could be diverted through the Eastside Bypass Control Structure after project completion compared to existing conditions. If needed, control structure gates could be operated/the boards could be replaced during flood flows to divert additional flows into the Mariposa Bypass. Gates have not been operated during normal floods in the past and would continue similarly with the proposed action. Such events are predicted to be rare, and may occur when flows from flood events need to be diverted or when maintenance needs access to the wetted channel or structures downstream of the Eastside Bypass Control Structure. During these conditions, fish passage through the structure would be impeded as before modification, however the blockage is expected to be infrequent and temporary, and may be scheduled to occur when salmonids are not present in the area.

Maintenance of the Eastside Bypass Control Structure would not change as a result of the proposed action. However, maintenance to clear debris from the rock ramp may be necessary after large flood events. Furthermore, there is a slight chance that operations of the structure during floods could cause rock movement in the rock ramp and require some maintenance. If a majority of the gates are closed during a flood operation, the flow velocities may cause rock to move within the ramp and require maintenance to retain its shape. It is very unlikely that LSJLD would operate the gates in that manner based on future expected operational needs and historical gate operation.

Any required maintenance performed on the rock ramp would be performed by DWR during the first five years after construction or until funding for maintenance runs out. An agreement would be needed between DWR and the private landowner to allow DWR maintenance. The agreement would likely allow maintenance in perpetuity to allow DWR to maintain the structure as long as funds are available. As such time, the SJRRP or Reclamation may be approached to help fund ongoing maintenance through DWR. Dedication of Federal funds would require environmental review as directed by the ESA, and NMFS would likely be requested for consultation at that point.

1.3.3 Proposed Action Element 3: Dan McNamara Road Crossing Culvert Replacement

Dan McNamara Road is owned by Merced County and is a publically accessible, gravel-armored, low-flow crossing approximately 12 miles southwest of the City of Merced. The road crosses the channel of the Eastside Bypass less than two miles upstream of the Eastside Bypass Control Structure. During flows of July 2010, the road was observed to be partially submerged at flows 40 to 80 cfs (photo submitted with BA). The crown of the road is about 30 feet wide and sits on a 60 foot county right-of-way (ROW). There are two culverts under the road crossing, one at the low-flow channel within the center of the road and the other within the floodplain, closer to the right levee.

The culvert within the low-flow channel (also at the center of the road) is a single circular corrugated metal pipe of culvert that is 50 feet long and 30 inches in diameter. This culvert does not include an apron and protrudes approximately 10 feet from each side of the road. The culvert inlet and outlet are armored with cobble and concrete riprap with no flared end sections. The culvert is perched within a three foot drop to an incised low-flow channel just downstream that covers a 175 foot wide section. This culvert capacity is estimated to be about 20 to 25 cfs. Any flows directed down the Eastside Bypass in excess of 25 cfs are expected to overtop the road and culvert capacity. The second culvert within the floodplain is a circular reinforced concrete culvert that is 24 inches in diameter. This culvert is partially silted in and does not appear to effectively pass flows.

Dan McNamara Road crossing is considered a partial barrier for juvenile and adult Chinook salmon because of the insufficient depths over road and also the high velocities within the existing culvert under the road when flows are lower (or until the road is overtopped). When the road is overtopped, it generally has sufficient flows and depth that allow for passage. Hydraulic models indicate this inflection point is greater than 600 cfs (DWR, 2012). Dan McNamara Road crossing also does not meet passage criteria for many other native fish at lower flows.

1.3.3.1 Construction Activities and Timeline

To improve fish passage at Dan McNamara Road crossing, the existing culvert under the road would be replaced with a series of up to three pre-cast concrete box culverts. The road itself would remain within the existing Merced Country ROW. The new culverts and road design would incorporate the Merced County Improvement Standards and Specifications required for a two-lane, 60 foot wide, rural roadway (Merced County, 2009). Only travel lanes and shoulders would be constructed in this project, resulting in a two-lane road approximately 40 feet wide. Riprap would be placed along the new road embankments for erosion control and covered with native material, if warranted.

The existing 30-inch corrugated metal pipe would be removed under the road crossing. Existing barbed wire fencing and other debris would also be removed upstream and downstream of the project work area. Existing riprap protection would be moved and reused, if possible. Unwanted demolished items and debris would be loaded and transported by dump truck off site to a nearby landfill. At the location where the existing culvert would be removed, an excavator would over-excavate to a depth of approximately eight to 10 feet by 60 feet long and 60 feet wide that would total approximately 600 cy of material to create space for the pre-cast concrete box culverts and wing walls. The excavated material would be re-used to backfill once the culverts are set in place.

Once the area has been properly staked and graded, a front-end loader, excavator, and sheepsfoot roller compactor would be used to backfill along the sides of the culvert up to the design road subgrade (95% compaction) before the 12-inch aggregate base layer is placed. The aggregate base layer would then be placed and compacted with a roller compactor also to 95% compaction before installing the culverts. Additional compacted fill may need to be imported. At this time, the channel subgrade would be prepared for placement of the ESM or native material, as appropriate. Approximately 880 tons of ESM may be placed upstream of, downstream of, and inside the culverts. It is assumed that all three culverts would be filled with six feet of ESM or native material when complete; however, heights of the ESM or native material in each culvert may change after further hydraulic analysis is done to improve fish passage. All culverts would be embedded six feet deep with approximately 350 cy of ESM or native material to improve natural fish passage features and for expected future changes in the channel bed from erosion, deposition, and subsidence. Approximately 2,000 cy of material would be excavated from 500 feet downstream and also 200 feet upstream of the new culverts to establish a low-flow channel.

This low-flow channel would be about 45 feet wide with 2:1 side slopes and convey smaller flows through the culverts.

A crane would be used to unload and place the pre-cast box culverts in the proper location; an excavator would be used occasionally to assist. The box culvert dimensions would be 10-foot tall by 12-foot wide and 40-foot long. The side walls would be a minimum of 8-inches thick, while the top and bottom thicknesses would be at least 12 inches. Three culverts would be placed side-by-side to increase flow capacity and improve fish passage through the crossing. The corners of the culverts would also be made rounded to accommodate passage needs of Pacific lamprey.

The top of the culverts would be set at the finished grade of the road, and no additional aggregate base or concrete paving would be used on top of the culverts to form the road crossing. However, up to 200 feet of road on either side of the culvert would be regraded and covered with six inches of aggregate base, followed by a covering of six inches of concrete. A motor grader, roller compactor, and water truck would then be used to grade and compact (95% compaction) the road subgrade and prepare it for aggregate base placement. Transfer trucks would be used to deliver approximately 190 tons of aggregate base to the project site and the same equipment would be used to grade and compact (95% compaction) the aggregate base prior to paving the road with concrete. Approximately 144 cy of concrete would need to be delivered to pave the road on both sides of the box culvert and to construct curbing, as needed. Safety features may be added to the road to prevent vehicles from driving off the road crossing, such as guard railings or a curb. After the concrete pavement cures after several days, erosion control measures (riprap) along the new road embankments would be placed and barb wire fencing installed. Access gates would also be installed on each side of the levees to prevent public access when flows overtop the crossing.

If DWR elects to remove the existing culvert without replacement, construction may be greatly simplified. In this case, the existing culvert would be removed and the streambed graded at the site. A front-end loader, excavator, and sheepsfoot roller compactor would be used to backfill the culvert up to the design road subgrade. Additional compacted fill may need to be imported in this case.

1.3.3.2 Construction Schedule, Access, and Staging

Clearing and grubbing would take place in the designated staging area, and also along the construction boundary limits of Dan McNamara Road Culvert Replacement. The construction contractor would determine if any mature trees within the construction footprint could be preserved and marked to be saved.

The site is accessed from the south from Highway 99 to Highway 152, then north on Highway 59 for seven miles to Sandy Mush Road. Construction equipment and materials would use either of these routes to mobilize equipment to the site.

Construction is scheduled to occur in the summer when Restoration Flows would be at a minimum so dewatering would be minimal or not needed. However, if water in the channel is present, temporary earthen dams would be constructed upstream and downstream of the low-flow crossing to divert the flow into an existing secondary channel or new temporary channel/culverts to bypass the work area. This secondary channel and existing culvert under the road may need maintenance or the new temporary channel would require excavating materials to allow the diverted flows to pass through. Public road closures would be necessary because the roads adjacent to the Action Area are accessible to public vehicles. The construction area would be clearly marked with proper road closure signs and detours to indicate that the construction area is restricted.

Construction for this project element is expected to be completed within one construction season, slated for 2019.

1.3.3.3 Operations and Maintenance Post-Modification

Merced County currently performs operations and maintenance within the Dan McNamara Road ROW for traffic crossing. Operations currently occur during flood events as the County closes the road, provides a 1.5-mile detour along the bypass levee, and posts the closure and detour on its website. Closing the road includes placing blockades or signs and opening and closing gates to access the detour. Maintenance activities by the County currently include re-grading the road and debris removal from the top of the road after flood events, as necessary. It does not appear that the county currently maintains the existing culvert.

Flood flows generally close the road from several weeks to several months every four or five years on average. The new culverts would allow for vehicle access while the Eastside Bypass conveyed Restoration Flows less than 200 to 400 cfs, depending on culvert final design. Flows higher than these would result in the road still being overtopped and restricting vehicle access. Road closures due to Restoration Flows (not flood flows) are estimated to be 10 days (November 1st through November 10th) during Fall pulse flows, and 120 days (March 1st through July 1st) during Spring flows, for the wettest year types. Because there is variability associated with flow periods in October, the latter part of November, and February, road closures may occur earlier or later than these predictions, depending on the water year type and how Restoration Flows are implemented. During Restoration Flows, the road would likely be closed up to twice per year during the spring and fall pulse flows when the road and culverts are overtopped.

Road closures due to Restoration Flows would also include detour signs and closing of gates as needed. When the road becomes inundated, gates or some other temporary barrier is expected to be placed at each end of the road to limit access and facilitate safe road closure. Warning signs of such a possibility are already present and are not proposed to be removed. After Dan McNamara Road overtopping events and prior to the irrigation season for agriculture, the crossing would be inspected and any debris would be removed from the culvert openings. Maintenance activities are expected to increase due to Restoration Flows overtopping the road up to twice annually in planned events.

Maintenance would also be required to remove excess sediment and debris from the culvert openings, as necessary, to ensure unobstructed fish passage. If the ESM near the site begins to erode, the material would be replaced. If the low-flow channel needs to be re-established, additional earthwork may be necessary. DWR has met with the County regarding the County's continued maintenance obligation at the road during flood flows and Restoration Flows. DWR and the County would enter into an agreement to describe the activities that would be needed by the County to maintain the road to improve fish passage in perpetuity.

Cattle currently graze in and around the channel, and would continue to graze under future project conditions. There is existing fencing and gates to prevent access to adjacent private lands and to ensure that livestock herds remain segregated as required. To keep cattle from crossing the road or getting into the new culverts after construction is complete, break away fencing or some other cattle exclusion barriers will need to be installed 10 feet upstream and downstream of the culvert openings and at the edge of the ROW. Additional measures to keep cattle out of the culverts are being considered, and include: installing metal piping at the opening of the culverts or floating gates. Options must be evaluated so they will not affect fish passage.

1.3.4 Proposed Action Element 4: Merced NWR Weir Removal and Well Replacement

A section of the Eastside Bypass overlays the Merced NWR. Just south of Sandy Mush Road are two weirs that were constructed to facilitate water diversions to Merced NWR, to support seasonal wetlands and pools for migratory birds. Lower Merced Weir #1 is less than one mile south of West Sandy Mush Road, approximately 1.4 river miles (RM) downstream of Upper Merced Weir #2. The lower weir is used to divert flows from the Eastside Bypass into Merced NWR wetlands that are located within the bypass levees on the left overbank/on the west side of the refuge, also known as the Mariposa Wetlands. To divert water into this area, wooden boards are manually installed to raise water surface elevations in the pool upstream of the lower weir during low-flow periods (typically September through March). The upper weir prevents the water from flowing upstream, and when its boards are installed, together creates a small lake between the two weirs. Weir board installation schedule and general operation is conducted by the USFWS.

The lower weir is 62 feet from bank to bank and 6.5 feet tall. It has a three foot wide metal grate on top to allow for pedestrian access to the metal I-beams used to hold the wooden boards. There are 14 bays which average a 4.5 feet width. A concrete apron extends from the bottom of the weir out to about six feet on the downstream side. There are also two concrete sills on the apron, with the most downstream sill measuring one foot high by 10 inches wide. This small sill is usually submerged at all flows. The second sill is approximately two feet higher than the concrete apron and is located where the boards are placed into the weir. The lower weir structure has concrete abutments on the right bank and cobble armoring on the left bank. The cobbled bank, which is west towards the left overbank, is overtopped by flows before the weir is overtopped while boards are inserted.

The upper weir is approximately 60 feet long and six feet high. It is capped by wooden planks that provide pedestrian access to install the wooden boards. This weir has 12 bays that average a four foot width. A concrete apron extends out at least four feet from the weir but is buried in sediment and could be longer. The weir has concrete abutments that tie into the channel banks.

The lower and upper weirs impede upstream migration of adult Chinook salmon at various flows, depending whether or not the weir boards are installed (DWR, 2012). Because the weirs work together to create a pool when both sets of boards are installed, the lower weir acts as the primary barrier that controls the water surface elevation at the upper weir. Unimpeded fish passage is possible when both sets of boards are installed and flows exceed 3,000 cfs, because the upper weir is completely submerged when boards are installed in the lower weir. At lower flows, the weirs do not meet passage conditions for many other native fish species.

1.3.4.1 Construction Activities and Timeline

The lower and upper weirs would be removed by demolishing and removing the concrete foundation, apron, metal grating, and all other metal work/structure. Part of the armored berm on the left bank at the lower weir would be removed to relieve a pinch point in the channel. This berm also creates a depression and could become a potential predator ambush location. The extent of the armored berm removal has not been finalized however a plan for the weir removal will be created before demolition. The removal areas would then be regraded and the disturbed areas would be returned to natural grades typical for both the channel and the bank. The banks would be revegetated with a native seed mix approved by the refuge.

To replace the water supply provided to the Merced NWR by this diversion, a new well would be installed to replace either an abandoned well near the west levee or near where an existing gator pump is located. The well would need to pump about 400 to 600 acre-feet of water per year to meet the irrigation needs of the Merced NWR and replace their current water diversion. Any replacement well would be screened because it is a shallow aquifer area and is estimated to have a target discharge rate of 1,500 gallons per minute (gpm), or 6.6 acre feet per day. The pump would be a constant speed of 120 horsepower vertical turbine pump that produces 1,500 gpm at up to 250 feet of head. At this rate, it is estimated that the pump would need to operate about 90 days within the seven month period that the Merced NWR requires ponded water. Ultimately the amount of groundwater extracted depends on water year type and availability of other supply sources, but the net use amount of water is not expected to change.

An exploratory well would need to be drilled to determine where a replacement well would be best suited. The new well would have a 30 inch conductor casing and 16 inch steel casing. The top of the well casing would extend through a four by four by four foot reinforced concrete well pump foundation. The pump motor would be connected to a long stem pipe mounted above flood stage and about two feet above the pump foundation, depending on final build out. An access ladder will be attached to the pump foundation so that the motor can be maintained. Discharge piping would include at least 70 feet of 16 inch diameter pipeline connected to the existing pipe system to feed the different units of the Mariposa Wetlands. Additional power lines and associated piping infrastructure to move water will be required if the new well is installed near the gator pump location.

There is a stream gage which may be relocated during construction and remain at the new location following project completion. Demolition and well replacement for this project element is expected to be completed within one construction season, scheduled for 2020.

Dump trucks would remove and transport material from the weir removal and other miscellaneous items to a nearby landfill. Removal of the existing lower weir includes removing the middle concrete walls, metal walkway grating, and miscellaneous structural steel, as well as removing the concrete sill, sediment, and debris. The concrete abutment and the grouted cobbles on the spillway may be left intact if it will not cause scour or fish passage issues. Removing the existing upper weir includes demolishing and removing the concrete foundation, apron, metal grating, and miscellaneous metal work, before regrading and any necessary dewatering.

An existing well to provide irrigation to the refuge would be replaced. The replacement well would be drilled and screened within the shallow aquifer with a 30-inch conductor casing, 16-inch steel casing, and would discharge at a rate of approximately 1,500 gpm. A 120-horsepower vertical turbine pump would produce 1,500 gpm at up to 250 feet of head. It would discharge water to the wetlands through a 16-inch-diameter pipeline connected to the existing pipe system.

1.3.4.2 Construction Schedule, Access, and Staging

The two weirs and groundwater well are within the Merced NWR, approximately 18 miles southwest of the City of Merced. Access to both weirs would be from Sandy Mush Road and then the levees within the Merced NWR. To access the weirs for removal and to drill the new well, a temporary road down to each weir would need to be constructed. Construction equipment and materials would use either of these routes to mobilize equipment to the site.

Clearing and grubbing would take place in the designated staging area and also along the construction boundary limits of the project element. The construction contractor, in consultation with the Merced NWR, would determine what vegetation within the construction footprint could be preserved and marked to be saved.

Construction is scheduled to occur during the summer to ensure that dewatering would be minimal or not needed. However, if water in the channel is present, a temporary coffer dam would be installed to allow flows to bypass the work area.

1.3.4.3 Operations and Maintenance Post-Modification

The Merced NWR operates and maintains the weirs that are being removed as part of the proposed action. The refuge also operates and maintains several groundwater wells and a portable gator pump that supplies water to wetlands within the refuge. The removal of the weirs would reduce any future operations and maintenance of these structures. The new replacement well would have similar operations and maintenance of the well it is replacing. In general, the life expectancy of the well pump is assumed to be 10 years and that of the well up to 25 years. Operations would be expected to follow the pump manufacturer's operations manual. The Merced NWR would continue to operate and maintain the well in the same manner as the well being replaced.

The replacement well would operate in a fashion similar to other refuge wells by providing close to 400 to 600 acre-feet per year with an anticipated average operating time of up to 90 days over the 7-month operating period to meet the irrigation needs of the refuge. The exact location of the well would be determined based on factors such as groundwater availability, the presence of salinity and boron, sodium-absorption ratio, and related parameters after conducting a hydrogeological assessment of the area by a qualified driller or professional consultant. The assessment would include a location that would limit the impacts of subsidence and take into consideration the factors above for final well design.

1.3.5 Proposed Construction Measures

In general, construction activities within the flood channels are anticipated to occur between April 1st and November 15th, though exact construction timing by project element will vary depending on the construction needs and location variability. Completion of activities occurring outside of the flood channel, on the levee crowns and landside levee banks, may continue outside of this work window until the end of the year. Construction start dates will depend on the water elevations at each project element site. In all cases, construction would occur during daylight hours from 0700 to 1800 Monday through Friday. Work hours may be extended into the evening or into the weekend in an effort to avoid wet seasons and complete construction modifications on-time, unless doing so would negatively affect a sensitive species.

Construction areas would be clearly marked with temporary construction fencing to indicate the restriction of public foot traffic and notice that the area was closed to the public. If needed, monitors would be utilized to enforce the 'no entry' policy.

1.3.6 Proposed Project Conservation Measures

As the main purpose of the proposed action is to improve fish passage through the Eastside Bypass at the various locations of the project elements, design of the Eastside Bypass Control Structure and Dan McNamara Road crossing elements include fish passage components based on criteria in "Anadromous Salmonid Passage Facility Design" (NMFS, 2011) and "Guidelines for Salmonid Passage at Stream Crossings" (NMFS, 2001), as applicable. Specifically, the element modifications to these structures will provide suitable hydraulic conditions when adult salmonids are migrating upstream and when juvenile salmonids are out-migrating downstream, and reduce passage time and stress to the fish. All fish passage designs meet passage criteria for Chinook salmon and steelhead at flows from 45 to 4,500 cfs. These modifications are also expected to improve the migration conditions for other native fishes besides salmonids. The step of considering fish passage needs is considered a conservation measure since it modifies project design to provide beneficial outcomes for fish.

In addition, the PEIS/R (SJRRP, 2012) includes a Conservation Strategy that outlines a comprehensive strategy to conserve listed or sensitive species and habitats and minimize negative impacts, to be implemented in coordination with the jurisdictional agencies. The summarized aspects which apply to this proposed action are:

- Use avoidance, minimization, monitoring, and management measures (i.e., avoidance and minimization measures (AMMs)) whenever possible, as consistent with adopted recovery plans
- If avoidance and minimization measures are impractical for the scope of the target action, further consultation and potentially mitigation measures will be pursued with the appropriate regulatory agency
- Management actions should target to obtain a net benefit for riparian and wetland habitats within the Action Area, i.e.:
    - Conserve riparian vegetation and waters of the State and of the United States, and wetlands,
    - Control and manage invasive species

- Conserve special-status species (all species identified by USFWS, NMFS, or California Department of Fish and Wildlife (CDFW), including candidate and sensitive status)

The following conservation measures, which are consistent with the SJRRP Conservation Strategy, will be implemented as part of the proposed action to avoid and minimize potential effects of the proposed action on CCV steelhead, CV spring-run Chinook salmon, and Pacific salmon EFH:

a. All work will occur between April 1 and November 15 when the Eastside Bypass is driest and the chance for storm events is low. Prior to construction activities and potential maintenance activities, Reclamation will coordinate with the Implementing Agencies on the specific actions planned to dewater the action area, if necessary, and develop a plan for potential fish rescue activities, as appropriate.

b. A Spill Prevention, Control and Countermeasure Plan will be required where release of oil and oil products have the potential to enter into the channel in quantities that may be harmful. Spill prevention kits will be in close proximity to the project site at all times and workers will be trained in their use.

c. The project proponent or its contractor will prepare and implement a Storm Water Pollution Prevention Plan that includes details on the installation and monitoring of erosion control devices.

d. Tracked out material on the paved portion of access roads near the project site will be swept up once a day to minimize sediment in stormwater runoff.

e. The contractor will be required to keep their equipment in good working condition in order to prevent leaks and spills of petroleum products or other fluids into waters of the U.S.

f. All equipment will be washed prior to arriving at the project site to remove soil and seeds to prevent spread of noxious weed seeds.

g. The limits of project disturbance in the field will be identified with stakes or other markers, which will be removed once work is finished.

h. All Project-related vehicle traffic will be restricted to established roads, and designated Action Areas.

i. All food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in securely closed containers and removed at least once every day from the entire project site.

j. A trained and agency approved fisheries biologist will be onsite during all potential dewatering or fish rescue activities.

k. If individuals of listed species are observed present within the Action Area, NMFS will immediately be notified. If CCV steelhead are detected during monitoring activities related to the Steelhead Monitoring Plan, Reclamation will immediately notify NMFS.

l. Additional avoidance and minimization measures required by all applicable permits will be implemented.

After the construction is complete, all maintenance activities, when possible, would be timed to minimize potential impacts to fish and wildlife. Access and safety concerns, as well as timing of flows, may also affect timing of future maintenance activities.

1.3.7 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).

Reinforcing select portions of the levees in the Eastside Bypass as proposed in this project ensures that adjacent lands not owned by Reclamation will no longer experience excessive seepage and damage once the project is complete, removing flow limitations in that aspect. Related to increasing flow capacity in the Eastside Bypass, Reclamation obtained seepage easements along the Eastside Bypass to allow for Restoration Flows to obtain their maximum flow of 4,500 cfs without causing damage or hardship associated with other areas prone to seepage. Reclamation purchasing seepage easements is interrelated and interdependent to this action, because otherwise the purchase of these lands have little value to Reclamation as the main implementing agency of the proposed action and the SJRRP, if seepage-related capacity limitations continued to exist in other parts of the Eastside Bypass channel and levee system, restricting restoration flow releases. Therefore, Reclamation's purchase of these lands for seepage easements will be considered interdependent on the action reviewed in this opinion.

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, Federal action agencies consult with NMFS and 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.

Reclamation determined the proposed action is not likely to adversely affect sDPS North American green sturgeon or their critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations (section 2.12).

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 “to jeopardize the continued existence of” a listed species, which is “to engage in an action that 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 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 (PBFs) essential to the conservation of a species or that preclude or significantly delay development of such features” (81 FR 7214; February 11, 2016).

The designations of critical habitat for CCV steelhead and sDPS green sturgeon use the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414; February 11, 2016) replace this term with PBFs. The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

- 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 critical habitat; 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 and critical habitat.

- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

2.2.1 CCV Steelhead DPS Status

- Originally listed as threatened (63 FR 13347; March 19, 1998); reaffirmed (71 FR 834; January 5, 2006)
- Designated critical habitat (70 FR 52488; September 2, 2005)

The Federally listed DPS of CCV steelhead and its designated critical habitat occur in the action area and may be affected by the proposed action. 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 (McEwan, 2001). 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 returns to hatcheries and redd surveys conducted on a few rivers. 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 have averaged 2,895 fish. 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 (Chase, 2010; Hannon, 2005). 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.

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the CCV 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 CCV. 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 based on consistent hatchery releases. Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the production of wild steelhead relative to hatchery steelhead (CDFW, 2018). 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.

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). Many historical 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. Steelhead are well-distributed throughout the CV below the major rim dams (Good et al., 2005; NMFS, 2014, 2016a). Most of the steelhead populations in the CV 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.

The CCV steelhead abundance and population growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley et al., 2006). Recent reductions in population size are supported by genetic analysis (Nielsen, et al., 2003). Garza & Pearse (2008) 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). Steelhead in the CV historically consisted of both summer-run and winter-run Chinook salmon migratory forms. Only winter-run (ocean maturing) steelhead currently are found in CCV rivers and streams as summer-run have been extirpated (McEwan & Jackson, 1996; Moyle, 2002).

Although CCV steelhead will experience similar effects of climate change to Chinook salmon in the CV, as they are also blocked from the vast majority of their historical spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the CV, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 57 degrees Fahrenheit (°F) to 66°F (14 degrees Celsius (°C) to 19°C). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough, 2001). In fact, McCullough (2001) recommended an optimal incubation temperature at or below 52°F to 55°F (11°C to 13°C). Successful smoltification in steelhead 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 potentially at the expense of decreased survival due to higher metabolic demands and greater presence and activity of predators. Stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations.

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 within the near future throughout all or a significant portion of its range (NMFS, 2016a). All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good et al., 2005; NMFS, 2016a); the long-term trend remains negative. Hatchery production and returns are dominant. 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. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild fish.

2.2.2 CV Spring-Run Chinook Salmon ESU Status

- Originally listed as threatened (64 FR 50394; September 16, 1999); reaffirmed (70 FR 37160; June 28, 2005)
- Designated critical habitat* (70 FR 52488; September 2, 2005) *does not occur within the action area

The Federally listed CV spring-run Chinook salmon may occur in the action area and may be affected by the proposed action. Its designated critical habitat does not occur within the action area and according to the most recent status review (NMFS, 2016b), this ESU would not be expected to be affected by this proposed action however, since 2015, the SJRRP has been reintroducing spring-run Chinook salmon incrementally back into the SJR mainstem far upstream of the construction area. These actions are to meet a Settlement goal that also fulfills a NMFS's recovery goal regarding this ESU. According to ESA Section 10(j) rules, these reintroduced CV spring-run Chinook salmon are officially designated as a non-essential experimental population (NEP) inside of the Restoration Area of the SJRRP, (i.e., from the base of Friant Dam to the SJR confluence with the Merced River). The number of NEP spring-run

Chinook salmon returning to the upper SJR in the Restoration Area is expected to increase overtime, as experimental hatchery release numbers increase, adult spawning returns increase, and the number of juveniles produced naturally in the Restoration Area increases.

Since the independent populations in Butte, Deer and Mill creeks have the most abundant and reliable runs, these creeks are the best trend indicators for ESU viability. NMFS evaluates the spring-run ESU risk of extinction based on VSP parameters calculated for 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 (PVA) 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 spring-run Chinook salmon was at moderate extinction risk according to the PVA 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 they 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.

In the latest status review (NMFS, 2016b), the authors found, with a few exceptions, CV spring-run Chinook salmon populations had increased through 2014 returns since the previous status review (2010/2011), which moved the Mill and Deer creek populations from the high extinction risk category, to moderate, and Butte Creek remained in the low risk of extinction category. Additionally, the Battle Creek and Clear Creek populations continued to show stable or increasing numbers the last five years, putting them at moderate risk of extinction based on abundance. Overall, the SWFSC concluded in their viability report (T. H. Williams et al., 2016) that the status of CV spring-run Chinook salmon (through 2014) has probably improved since the 2010/2011 status review and that the ESU's extinction risk may have decreased, however 2015 and 2016 observed sharp declines (California Department of Fish and Wildlife (CDFW), 2018). Therefore, the ESU is still facing significant extinction risk, and that risk is likely to increase over the next few years as the full effects of the most recent severe drought are realized (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 & 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 San Joaquin River watersheds to the south.

An analysis on CCV steelhead's response to climate change is not available, but one has been conducted considering Chinook salmon (*Oncorhynchus tshawytscha*) 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, if the climate warms by 5°C (9°F), it is questionable whether any CV Chinook salmon populations can persist (J. G. Williams, 2006). 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).

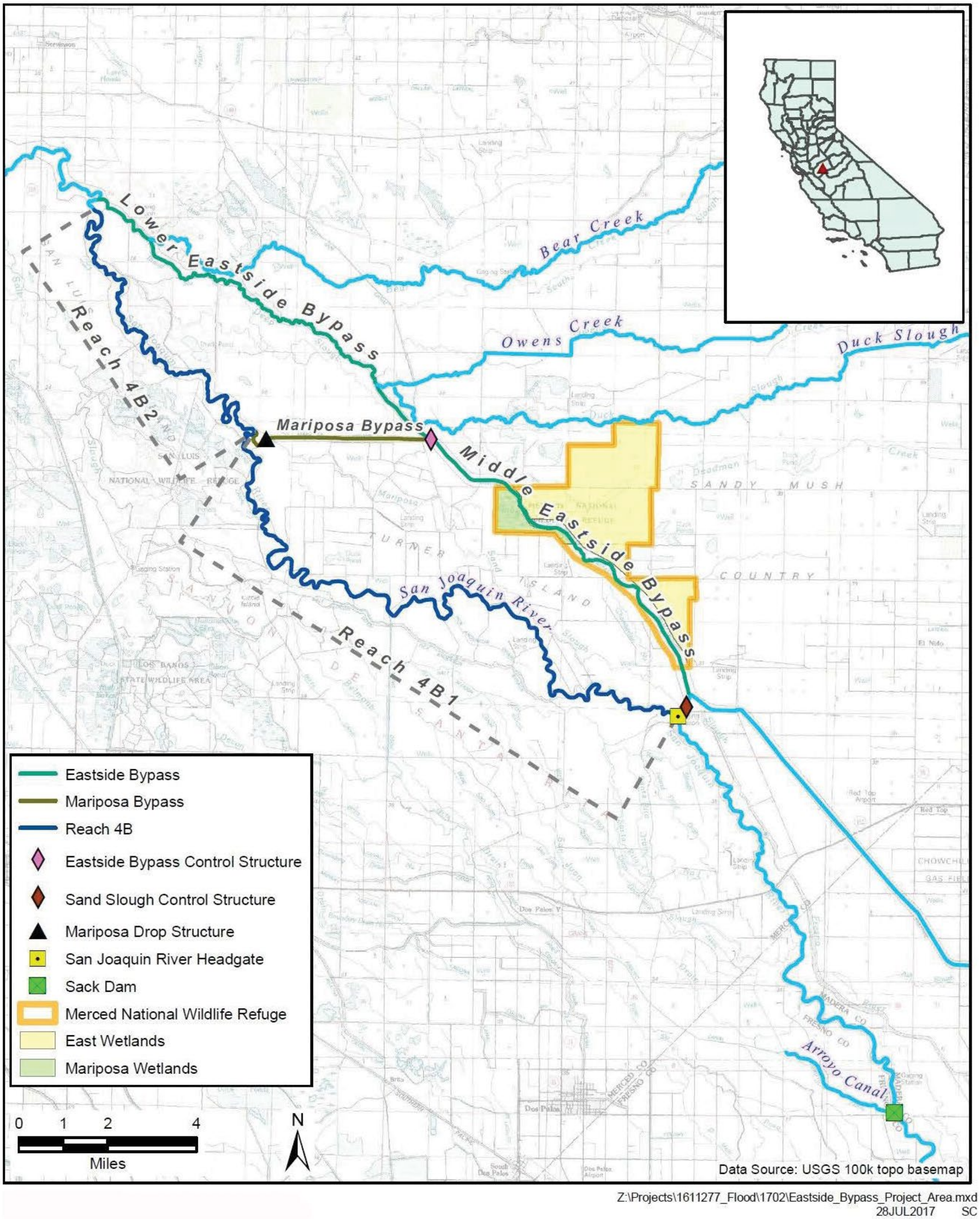
Although both CCV steelhead DPS and CV spring-run Chinook ESU will likely experience detrimental effects of climate change similar to those projected for all runs of Chinook salmon, the adverse effects may be even greater in some cases, as juvenile steelhead need to rear in freshwater streams for one to two summers prior to emigrating as smolts and adult spring-run need to hold in deep cold pools over summer before spawning. In the CV, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than Chinook salmon (McCullough, 2001). McCullough (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F), and successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (Richter & 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 potentially at the expense of decreased survival due to higher metabolic demands and greater presence and activity of predators. Stream temperatures that are currently marginal for spawning and rearing are likely to become too warm to support wild steelhead populations, severely curtailing the range of suitable reproductive habitat for this DPS.

In summary, observed and predicted climate change effects are generally detrimental to all anadromous species as they rely on abundant cold water to successfully spawn and rear in freshwater habitats (M. McClure, 2011; M. M. McClure et al., 2013; Wade et al., 2013), so unless offset by improvements in other factors, the statuses of the CCV steelhead DPS and the CV spring-run ESU 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 there is uncertainty associated with projections, which increases over the amount of time of the projections, the direction of change is relatively certain (M. M. McClure et al., 2013) and is expected to exacerbate the extinction risk of the DPSs addressed in this opinion.

2.3 Action Area

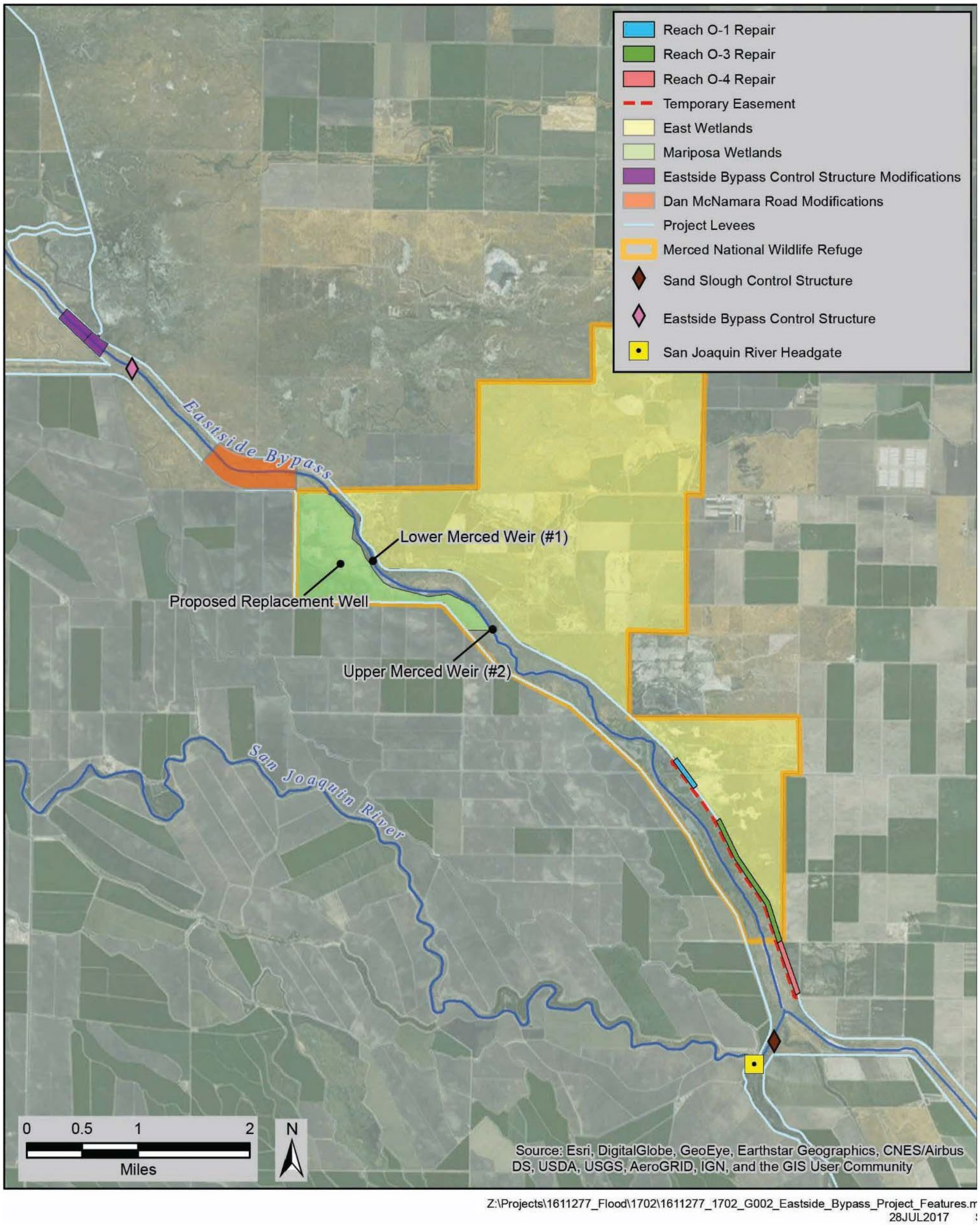
"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The project area is located between Merced and Los Banos in Merced County, California, in association with the Eastside Bypass (Figure 1, Figure 2). The Eastside Bypass is a flood control channel east of the San Joaquin River, located in United States Geological Survey 7.5-minute Turner Ranch quadrangle, or hydrologic unit code 1804001 Middle San Joaquin-Lower Chowchilla Watershed.



Source: GEI Consultants, Inc., 2017

Figure 1. Proposed project vicinity map of the Eastside Bypass and San Joaquin River, California.



Source: GEI Consultants, Inc., 2017

Figure 2. Proposed project area with individual Eastside Bypass Improvement Project elements identified.

NMFS considers the action area of the proposed project to include the project areas for each element displayed in Figure 2, but also the wetted areas in Merced NWR since juvenile salmonids may use these areas during and after project completion, and SJRRP's Reach 4A and 4B (Figure 1) because the channel and levee modifications will lead to changes in the amount, duration, and connectivity of the SJR basin due to Restoration Flows routed through this reach.

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 in the Action Area

The Federally listed anadromous species that are expected to use and occupy the action area at times are adult and juvenile CCV steelhead and CV spring-run Chinook salmon. Due to their anadromous life histories, these species will migrate through action area at least twice in order to successfully complete their life cycles. When the area offers volitional passage, this pathway will become the primary migration corridor for both adult and juvenile life stages to suitable freshwater habitats in the upper SJR mainstem in the SJRRP's Restoration Area. In Reach 1A and 1B of the Restoration area, conditions are suitable for holding, spawning, egg incubation, and juvenile development and rearing. The wetted areas within the action area, Reach 4B, may also provide some suitable rearing conditions but is mostly considered a migratory pathway to the Delta where they may continue to rear until ready to move into the marine environment.

2.4.1.1 CCV steelhead

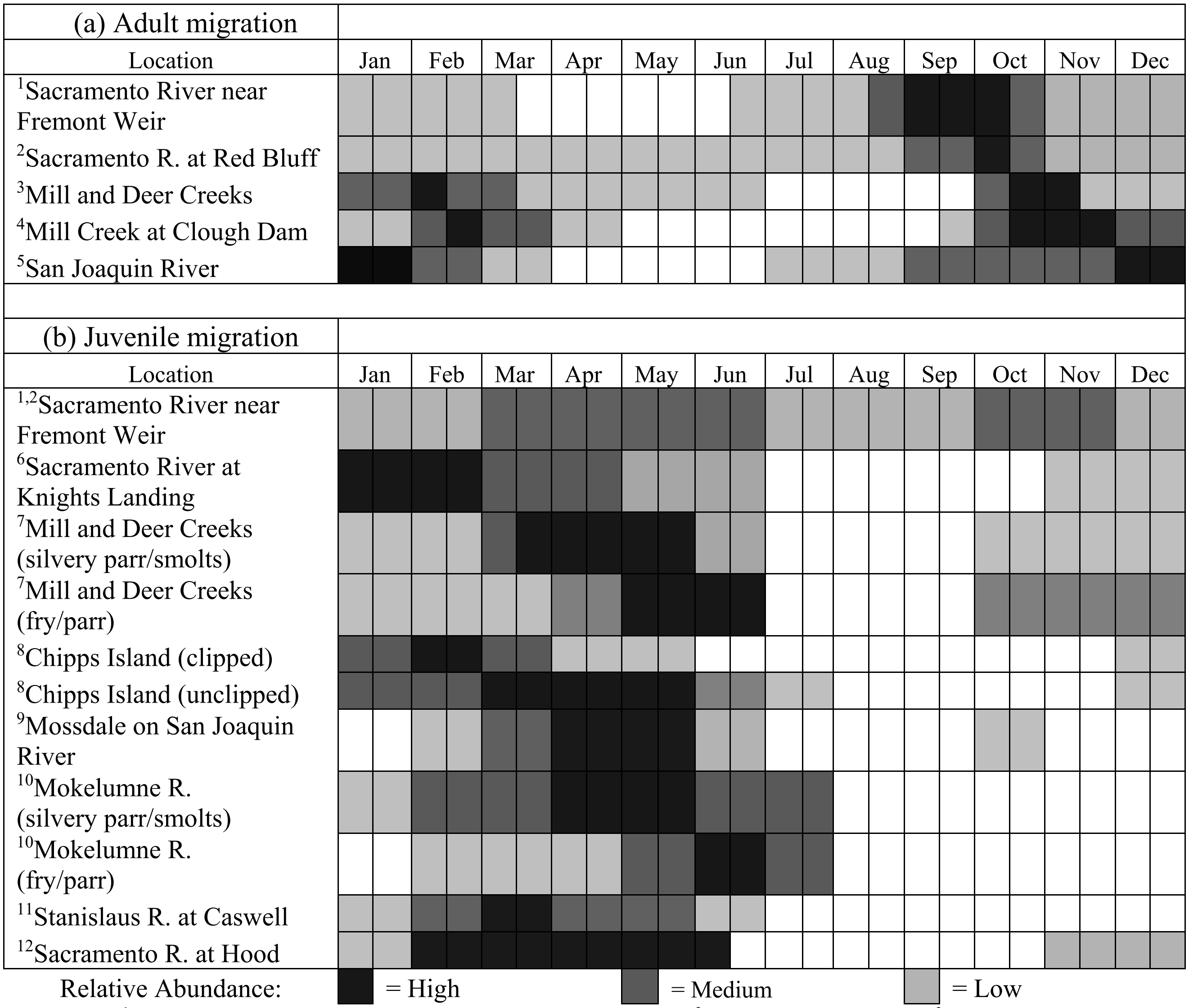
Scientists believe that all current stocks of CCV steelhead have a winter run timing, meaning they may migrate up rivers in the winter starting with the first pulse of notable rain run-off (Moyle et al., 1995). The life history strategies of steelhead are extremely variable between individuals, and it 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 enter freshwater from the Pacific Ocean in August (Moyle, 2002) and peak migration of adults moving upriver occurs in September through February in the SJR (Figure 3, Hallock, et al., 1957). Adult steelhead will hold until flows are high enough in the tributaries to migrate upstream where they spawn from December to April (Hallock, et al., 1961). After spawning, surviving steelhead kelts migrate back to the ocean and reach the mainstem of large rivers during March and April, and have a high presence in the Delta in May.

Outmigrating juveniles have a large presence at Mossdale Bridge on the SJR downstream of the action area from February through June, with the core of their migration occurring March through May. Larger juveniles in the process of smoltification (parr to smolt stage) have been captured until July on the Mokelumne River (Figure 3). If steelhead spawning upstream in the SJRRP Restoration Area produced outmigrating juveniles, they would be expected to use the construction areas during February through July if suitable water quality conditions persist.

Currently, the anadromous form of *O.* mykiss, or steelhead, have extremely low and inconsistent returns in the SJR basin upstream of the confluence of the Merced River (NMFS, 2014, 2016a, 2016c) due to the regular operation of Hills Ferry fish barrier during regular adult migration timing, mid-December through mid-September). In addition to this fish barrier, the upper SJR basin has only connected and met the Merced River in recent years due to implemented Restoration Flows. *O. mykiss* have been captured in the three main tributaries of the SJR (Stanislaus, Tuolumne, and Merced rivers, also critical habitat for CCV steelhead (NMFS, 2014)) but are not known to occur in the SJRRP Restoration Area (Reach 5 and upstream within the SJR or Eastside Bypass; Eilers 2010). The SJRRP has been conducting a steelhead monitoring program since 2012 but has so far has not documented a steelhead within the Restoration Area (SJRRP, 2015).

During project implementation, it may be possible that adult steelhead bypass fish barriers and monitoring fyke traps to enter the action area on their way upstream to spawn below Friant Dam. If adults are able to spawn in the Restoration Area, surviving kelts and emigrating juveniles may be expected in subsequent seasons and during proposed project construction. Adults would be expected in the action area July through March, and juveniles February through July (Figure 3, the monthly ranges for each life history stage is an estimate based on Sac River Basin timing due to lack of information on steelhead use of the upper SJR basin.)



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).

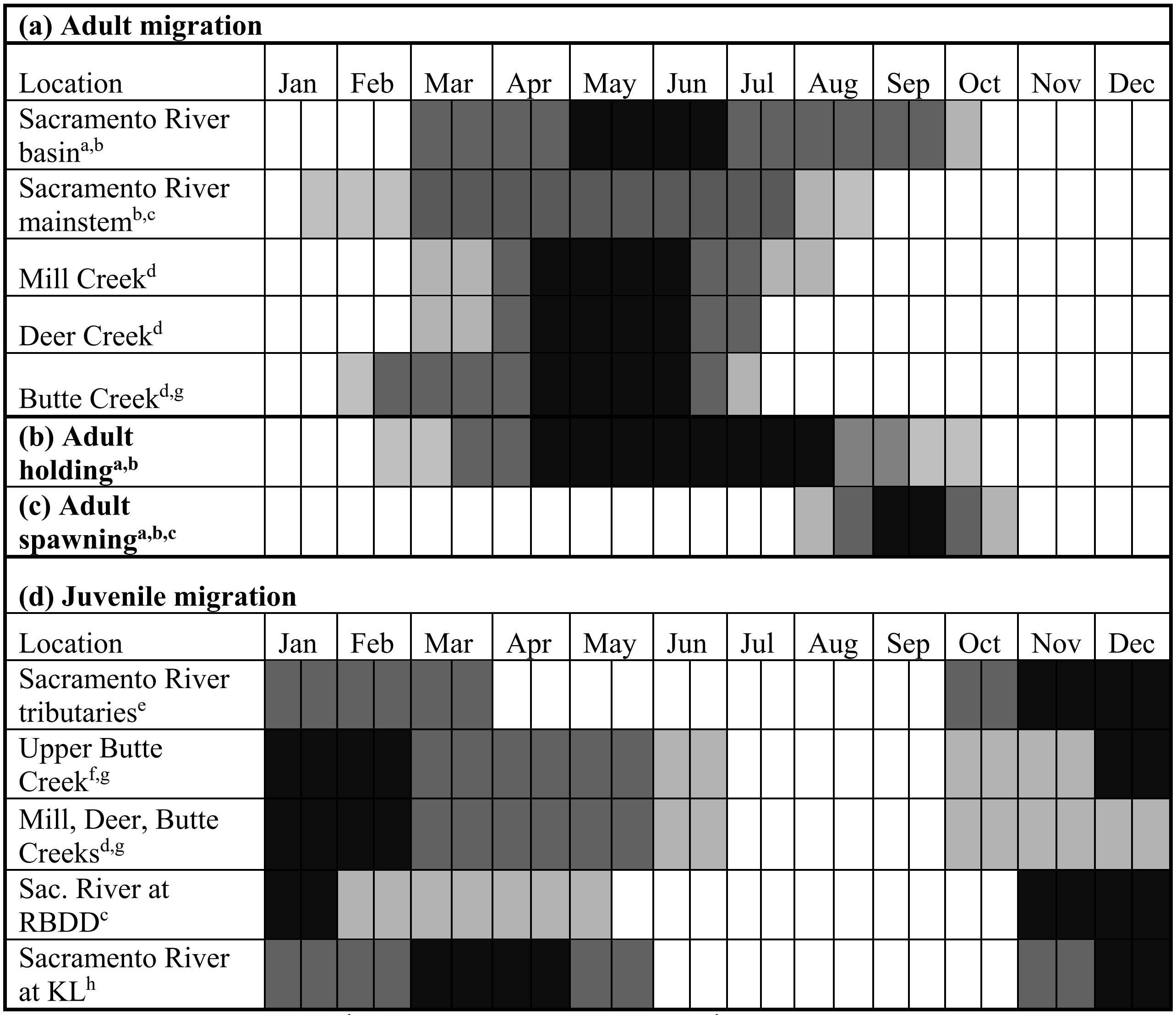
Figure 3. The temporal occurrence of (a) adult and (b) juvenile CCV steelhead at locations throughout the CV. Darker shades indicate months of greatest relative abundance.

2.4.1.2 CV spring-run Chinook salmon

Typical CV spring-run life history patterns involve adults returning to freshwater basins in March (Sacramento River basin, Figure 4a). Capitalizing on spring-time run off, adults travel to holding pools where available in preparation to over summer. Adults arrive in an immature state and hold over the summer months (Figure 4b) and develop gonads until ready to spawn in late summer through mid-autumn (Figure 4c).

CV spring run Chinook salmon are considered functionally extirpated from the Southern Sierra Nevada diversity group despite their historical abundance in the SJR basin (NMFS, 2016b). There have been observations of low numbers of spring time running fish returning to major SJR tributaries that exhibit some typical spring-run life history characteristics. While the genetic disposition of such fish remains inconclusive, the implementation of reintroduction of the spring-run Chinook salmon into the SJR has begun and has resulted in over 700 wild-spawned juvenile spring-run Chinook salmon ((NMFS, 2018a); unpublished data/weekly biological reports, Don Portz, SJRRP/Reclamation, 2018). These juveniles should be imprinted to the upper SJR mainstem below Friant Dam, and when volitional passage is achieved, are expected to return as adults when river conditions are suitable (NMFS, 2016b).

Based on estimated spring-run life history timing and limited information of use of the SJR basin, smolts are expected to be passing through the Eastside Bypass March through June, while yearlings may pass September through March (SJRRP, 2017b). Returning adults are expected to travel through the action area most likely from March through September (Figure 4a). Again, exact timing of CV spring-run use of the action area would depend on in-river water being adequate in quality, amount, and temperature, and for connectivity of the waterways to be somewhat achieved.



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 4. The temporal occurrence of adult (a) and juvenile (b) CV spring-run Chinook salmon in the Sacramento River. Darker shades indicate months of greater relative abundance.

2.4.2 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 in California according to average total annual flow (the Sacramento River being the largest). The SJR has an average mean flow of six million acre feet per year compared to the Sacramento River's 18 million acre feet (Reclamation, 2016). It drains the central and southern portions of the CV 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 considered a navigable water that is reasonably permanent, though primarily fed (receiving two thirds of its water) by the melting snowpack of the Sierra Nevada Mountains.

The primary storage reservoir on the SJR is the Friant Dam, which was completed in 1944. Friant Dam created Millerton Lake/Reservoir and can hold more than 500 thousand acre feet in water storage. Friant Dam diverts Sierra snowmelt 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/State Water Project (CVP/SWP). Except for releases to manage floods and to meet the requirements of riparian water rights holders, the entirety of SJR's flow is impounded by the Friant Dam and directed into the canals for distribution. See the existing Coordinated Long-term Operation of the CVP and SWP, and their effects on ESA-listed species and their critical habitats that have been analyzed in the 2009 NMFS CVP/SWP Operations opinion (NMFS, 2009) for more information on the effects of Federal and state water management on listed species under NMFS jurisdiction. From the high degree of water management of the SJR, in a typical year, all of the SJR's flows were allocated to water users. Historically, the river ran dry annually for a 40 mile stretch, only connecting to the Delta during flood releases from Millerton. In recent years, mandated river restoration flows have reconnected the SJR to the Delta (see below, section 2.4.3 Conservation and Restoration efforts).

2.4.3 Conservation and Restoration Efforts

There are many efforts by Federal and state agencies to restore aspects of the SJR back to its natural physical state and biological functionality. For example, the State Water Resources Control Board (SWRCB) is pursuing new narratives and revisions for the previously existing 2006 Bay-Delta plan that outline lower SJR flow requirements than 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, 2016). 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 well-managed surface water provides to the communities of California. While ESA-listed salmonids needs are addressed in the Bay-Delta plan (SWRCB, 2016), these efforts focus more on restoring the functionality of the available existing habitat. Other agencies are implementing efforts that are more directed to restoring specific salmonid populations in the SJR basin.

2.4.3.1 NMFS recovery plans for CCV steelhead and CV spring-run Chinook salmon
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 species in the California 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 (NMFS, 2014). The NMFS Recovery Plan that includes both CCV steelhead and CV spring-run Chinook salmon (NMFS, 2014) identifies recovery goals for the SJRRP area population that includes the proposed action area. Recovery efforts focus on addressing several key stressors that are vital to both CCV steelhead and CV spring-run Chinook salmon: (1) elevated water temperatures affecting adult migration and holding; (2) low flows and poor fish passage facilities, affecting attraction and migratory cues of migrating adults; and (3) possible catastrophic events (e.g. fire or volcanic activity).

CV Spring-run Chinook Salmon Specific Recovery Plan Key Stressors:

A. Low spatial structure distribution (criteria includes two viable populations within the SJR Basin)
B. Passage Impediments/barriers
C. Warm water temperatures for holding and rearing
D. Limited quantity and quality of rearing habitat
E. Predation on juveniles in river and in the Delta
F. Agricultural diversions and entrainment

CCV Steelhead Specific Recovery Plan Key Stressors:

A. Low spatial structure distribution (criteria includes two viable populations within the SJR Basin)
B. Passage Impediments/barriers
C. Warm water temperatures for rearing
D. Hatchery effects
E. Predation
F. Loss of historical habitat/degradation of remaining habitat

Recovery actions identified in the recovery plan that are relevant to this consultation include: implementing restoration flows outlined in the SJRRP settlement agreement, reintroducing CV spring-run Chinook salmon, implementing channel modifications as outlined in the SJRRP settlement agreement (Proposed Action Elements 1 - 4), minimizing entrainment in non-viable migration pathways, and construction of a Mendota Pool Bypass.

2.4.3.2 The San Joaquin River Restoration Program

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, 2018a). 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.

As previously noted, 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.

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 'effects analysis' will proceed as follows: the direct effects of the construction of the action elements, the direct effects of the elements once complete and as designed, and finally, indirect effects of the action as a whole and under implemented status.

2.5.1 Direct Effects of the Construction of the Action Elements

The construction work window proposed (April 1st through November 15th) is generally the season in which the driest conditions would be expected however, wetted habitats may still be present in the construction area depending on water year type. CV spring-run Chinook and CCV steelhead adults are expected to use channels in the action area for migration purposes from the fall through the spring. Based on return timing for CV spring-run Chinook from the Sacramento River Basin (Figure 4, (NMFS, 2014)), any returning adults would be expected to have passed through the action area before the construction window opens and should be holding in deep pools below Friant Dam before the work window opens, therefore would not be expected to be affected by the construction aspect of this project. In the later portion of the work window, potentially the months of October and November, adult CCV steelhead could be present in the action area as they travel upstream (Figure 3, (NMFS, 2014), though passage through the action area to suitable spawning areas in Reach 1 of the SJR would be difficult with current passage impediments, unless significant flows were occurring through the Eastside Bypass. And if flood runoff/significant flows were occurring in Eastside Bypass channels, it is unlikely construction in the channels could reasonably continue, so it is unlikely that adult CCV steelhead would be directly affected by construction.

Restoration Flows are currently routed through the Eastside Bypass in this portion of the action area, and juvenile CV spring-run have successfully used the bypass to exit the SJR basin into the Delta (NMFS, 2018a). Initial SJRRP data indicate that juvenile CV spring-run are still present in Reach 1A of the SJR mainstem until at least early June, though water temperatures downstream may prevent outmigration as daily water temperature highs begin to exceed lethality thresholds (SJRRP, 2017b); unpublished data/weekly water temperature reports, Andy Shriver, SJRRP/CDFW, 2018)). To date, neither adult nor juvenile steelhead have been observed in any portion of the Restoration Area, though monitoring is ongoing. However, because of recent river connectivity due to flood waters and the planned restoration efforts that will eventually provide volitional fish passage, CCV steelhead recolonization of the Restoration Area is expected. At that point, CCV steelhead juveniles and kelts would also use the Eastside Bypass route to leave the spawning and rearing areas in Reach 1A. The timing of their passage through the action area of this project would also overlap with the early part of the work window, from April through May (Table 6-1, (Reclamation, 2018)). Therefore, juvenile salmonids from both populations and steelhead kelts are expected to be present in the wetted channel as they migrate out in the early portion of the proposed work window (April and May), depending on water year type and while water temperatures are below lethal limits (>23.9 °C prolonged exposure for spring-run (SJRRP, 2010), >22.2 °C for CCV steelhead (NMFS, 2014)). There are no portions of the action area that can support spawning, holding, egg incubation, or fry development for either population, so these life history stages are not expected to be affected by the construction of the action elements. Potential impacts to listed salmonids are examined below.

2.5.1.1 Effects of equipment operations in/near wetted channels

All project elements feature heavy equipment operation to complete each action, from early site preparation work until site clean-up. The heavy equipment operation and general human presence and activity near waterways will propagate loud noises and vibrations into the water column. Fish occupying waterways affected by artificial vibrations are expected to be startled and alter their normal behaviors. This may include area avoidance, which could temporarily delay juvenile and kelt out-migration and movement patterns during work hours. Or conversely, artificial disturbance may cause fish to startle when they would otherwise be resting, sheltering, or feeding in the nearby areas, which could expose them to increased predation risk, induce their stress levels to increase from baseline, or reduce their energy intake. These effects would be expected to overall decrease the likelihood of individual juvenile survival or the likelihood that a kelt would successfully return to the marine environment.

These adverse effects to juvenile salmonids and kelts are expected to be temporary and only persist as long as work is active. Some movement studies have suggested that juvenile salmonids move mostly during nighttime and crepuscular periods (Chapman et al., 2012; Keefer et al., 2012), so the proposed daily work schedule of 0700 and 1800 helps reduce the adverse impacts of disturbance on their normal behaviors by letting fish pass through the action area and use the area as normal while construction activities are not occurring. In addition, as construction progresses into the summer, fish are increasingly less likely to be exposed to adverse effects associated with the construction of this element because they will decreasingly occupy the action area, until the point at which water temperatures become consistently lethal (from June 1st through the summer months). Most elements will only take one work season to complete, but some may take two seasons, therefore the duration and frequency of these adverse effects will be relatively limited.

2.5.1.2 Effects of clearing and grubbing sites, vegetation removal

For all elements, clearing and grubbing will occur to create staging areas and prepare the construction footprints for the following activities. These areas will be cleared of vegetation, and debris, and likely graded. Any mature trees within the construction footprint will be preserved if possible, but smaller vegetation will be removed outside of wetted areas in designated areas. These activities will occur during the work window, and are expected to have the same adverse effects as described above for heavy equipment operations, since heavy equipment will be used.

These activities may also create fugitive dust that may settle into nearby waterways. Turbidity increases caused by dust input and may have a slight adverse 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. Turbidity increases due to sedimentation discharges into the waterway are not expected due to best management practices (BMPs) to control erosion incorporated into the project description.

In addition, these activities are expected to reduce some of the overhanging vegetation and in-water vegetation in the action area. Overhanging or in-channel vegetation that provides shade is important to mitigate solar radiation and the associated increases in water temperatures. Vegetation removal in the riparian zone is generally linked with decreases in juvenile salmonid survival (Bjornn & Reiser, 1991). However, based on site photographs, existing riparian vegetation at these sites is mostly sparse and low-lying (Reclamation, 2018). And 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.

2.5.1.3 Effects of creating temporary roads for access

For all elements, access to the staging areas and construction areas will be via established roads (paved, unpaved, and/or levee topped roads), but in the case of the Eastside Bypass Levee Reinforcement (Element #1) and Eastside Bypass Control Structure Modification (Element #2), temporary roads or ramps will also be built within the channel so that the areas waterside of the existing levees can be accessed. During temporary road construction, adverse effects are expected as above regarding fugitive dust effects, since grading activities are not so different from temporary road creation. These adverse effects are expected to be temporary as well since the effects will persist only as long as the road is under construction. Use of existing roads for construction access is not expected to have adverse effects to fishes.

2.5.1.4 Effects of creating staging areas, borrow pits, and spoil/material storage areas

The creation of staging areas, storage areas, and borrow pits will occur prior to construction at the construction sites of all elements. Each construction site will require the establishment of a primary staging area adjacent to the waterways, and such creation will have adverse effects to fishes, similar to the heavy equipment operations and clearing/grading/road construction described above. In the case of the Eastside Bypass Control Structure Modification element, the staging area and borrow pits will be established within the Eastside Bypass channel itself. With the incorporation of multiple erosion BMPs and AMMs already in the project (sections 1.3.5 & 1.3.6), no additional effects are expected for this element despite its location in the channel and proximity to fishes.

2.5.1.5 Effects of cofferdam establishment and dewatering

For the Eastside Bypass Levee Reinforcement, Dan McNamara Road Crossing Culvert Replacement, and Merced NWR Weir Removal elements (Elements 1, 3, & 4), work in a wetted channel will be required, so either cofferdams and dewatering, or flow redirection tactics, must be used. For the Eastside Bypass Control Structure Modification and Merced NWR Weir Removal elements, vibratory pile driving will be used to set a temporary sheet pile cofferdam to create dry areas if water is present in the channel. The temporary cofferdams will redirect flows and keep the work area in the dry. Overlap between pile driving for cofferdam installation and fish use of the Eastside Bypass channels is expected. Depending on the amount of flows present during the pile driving, the extent of the area affected by underwater sound and equipment disturbance could be large. Adverse effects to fishes caused by pile driving are examined below in section 2.5.1.7.

In some locations, the cofferdam installation may create ponded water areas that require dewatering. It is possible that juvenile salmonids may become trapped in this ponded water. Prior to dewatering, fish rescue will be performed if fishes are observed. Adverse effects of fish rescue are examined below in section 2.5.1.6.

In the case of the Dan McNamara Road Crossing Culvert Replacement element, since the road is basically through the channel, flows may be present and will require diversion to allow construction work. In such case, temporary earthen dams will be constructed upstream and downstream to direct flows to bypass the work area. Redirecting flow via earthen dams will occur early in the construction sequence and may expose fishes to increased turbidity as disturbed sediments mix with flows. At elevated levels of turbidity, above 25 nephelometric turbidity units (NTUs), juvenile steelhead can experience sublethal effects, such as reduced growth rates (Berg, 1982), while mobile juveniles tend to avoid areas with turbidities over 167 NTUs (Sigler et al., 1984). CV spring-run Chinook juveniles are assumed to have similar reactions to turbidity.

In combination with adverse effects of general construction noise and other earthwork activities expected in site preparation, salmonids when present are expected to experience adverse sublethal effects like reduced growth rates, potentially increased respiratory stress, and temporary disruption to their normal behaviors, all of which is likely to decrease their individual survival probabilities. These effects are expected to be limited in duration, only as long as turbidity persists locally, and are likely to affect only a few individual fish.

2.5.1.6 Effects of fish capture, handling, and transport during dewatering

Fish rescue may be a necessary component of dewatering construction of project elements Eastside Bypass Control Structure Modification and Merced NWR Weir Removal and Well Replacement if fishes become trapped in ponded areas. Prior to dewatering, fish will be captured, handled, and transported from the construction site to suitable release locations. During the process of capture, transport, and release, individuals may be injured, stressed, and experience temperature shock, potentially to the level of mortality. Typically, a 3% morality rate is expected when handling juvenile salmonids, even with experienced fish handlers executing the rescue and maintenance of ideal transport conditions (Carmichael et al., 2001). These direct adverse effects should only need to occur once per site where dewatering is necessary and the total number of juveniles needing rescue is expected to be few (e.g., less than ten CV spring-run juveniles per construction site, and two or less steelhead juveniles per site, due to the differences in outmigration timing).

Ocean-returning steelhead kelts are not expected to require fish rescue though their presence may co-occur with cofferdam construction. Due to their strong swimming ability and sensitivity to disturbance, it is likely that kelts will be able to swim out and away from ponded areas slowly being enclosed by a sheet pile cofferdam, in contrast to juveniles that may react by sheltering in place. Therefore, fish rescue activities are not anticipated to affect CCV steelhead kelts.

2.5.1.7 Effects of pile driving

Pile driving to establish temporary cofferdams may be necessary at the Eastside Bypass Control Structure and the Merced NWR Weir Replacement sites. The underwater pressure waves generated from driving piles into channel substrate can 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 swim bladders expand and contract in response to the pressure oscillations (Gisiner, 1998; Popper et al., 2006). Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish's viscera (Gaspin, 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings, 1995). 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. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper & Hastings, 2009) than larger fish of the same species. Multiple studies have shown responses in the form of behavioral changes in fish due to human-produced noise (Popper & Hastings, 2009; Slotte et al.; Wardle et al., 2001).

Generally, NMFS uses a dual metric criteria to assess onset of injury for fish exposed to pile driving sounds (Caltrans, 2015). However, for this project, the pile driving is limited to use of a vibratory hammer, which is expected to produce pressure exposure levels below the interim thresholds for injury identified by the Fisheries Hydroacoustic Working Group. When pressures generated are expected to be below injurious levels, as a conservative measure, NMFS uses 150 dB_{RMS} as the next threshold expected to illicit temporary behavioral effects on ESA-listed fish species (observed in salmon and trout). The background root mean square (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. 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. 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 100 meters from the location of the pile being driven, assuming a transmission loss constant of 15 (NMFS calculation sheet (Caltrans, 2015)).

Therefore, depending on the innate behavior that is being disrupted, the direct adverse effects could be varied and are expected to result in harassment, but are not expected to include injury to fish. Fish may also exhibit movements that displace them from a position normally occupied in their habitat for short or long durations. In the context of the proposed action area, the migratory behavior of juvenile salmonids and kelts may be adversely affected by various pile driving and acoustic impacts. Though pile driving may affect migratory behavior, it is not expected to completely prevent passage downstream because pile driving will not be continuous through the day, will not occur at night, and the 100 meter affected distance does not stretch completely across the SJR mainstem at the location of the outfall. Pile driving activities will be also be further limited in duration, occurring only during cofferdam installation and removal.

Sheet piles will also be installed to stabilize the base of the new rock ramp at the Eastside Bypass Control Structure via vibratory pile driving, however this will be accomplished in the dry in the middle of summer, removing the possibility of fishes being present in the channel to be affect by this action. The sheet pile wall would be backfilled so that the sheet pile wall would not protrude from the rock ramp surface. Because this wall is designed as a sub-surface component fishes will not interact with, it is not expected to adversely affect fishes when the project is complete.

2.5.1.8 Effects of structure demolition

Structure demolition will occur at the Eastside Bypass Control Structure and the Merced NWR Weir Removal sites. However, since these activities to occur in the dry channel or behind a cofferdam in the day, there is little risk of fish injury from demolition activities. It is unlikely that fish will be present during these activities, since it will likely be summertime when demolition begins and water temperatures will have exceeded lethal limits. Therefore, demolition activities are not expected to adversely affect listed fishes.

2.5.1.9 Effects of debris removal, excavation, and earthwork

Debris removal resulting from the demolition activities described above (Eastside Bypass Control Structure Modification and Merced NWR Weir Removal), and other earthwork and excavation activities (all project elements), have the potential to generate fugitive dust in the process. The effects of mobilized dust may enter the wetted portions of the channel and have adverse effects to fishes as described for clearing and grubbing effects (section 2.5.1.2), however given the standard construction BMPs that address air quality concerns, in-channel turbidity is not expected to increase measurably from dust creation. In addition, these activities should occur in the summertime when water temperatures exceed lethal thresholds, so additional adverse effects to fishes is not expected.

When the areas are rewetted again through either the cofferdam removal or the first flush following precipitation, any potential turbidity increases will either occur when water temperatures in late summer will exceed lethal limits (precluding salmonid presence), or water will be already highly turbid precipitation runoff. Therefore, these effects are expected to be temporary as the suspended sediments move out of the system, and turbidity is expected to decrease and return to normal within a short period. In addition, the project is planning on developing and implementing a Stormwater Pollution Prevention Plan (SWPPP) prior to beginning construction. And while water is present in the channels, during instream construction, a turbidity curtain will be used and downstream water quality monitoring to ensure sediment effects are controlled. These actions will help avoid and minimize any potential impacts related to increase suspended sediments and turbidity.

2.5.1.10 Effects of creating rock ramps

Rock ramps will be constructed to make these areas more easily passable by adult and juvenile salmonids at the Eastside Bypass Control Structure and Dan McNamara Road Crossing Culvert Replacement sites. In general, the banks of the rock ramp will also be graded with an ESM mix and machine-tamped to set in dry channel conditions. Water jetting in conjunction with addition of fine-grained material would also be used to seal voids. Excess materials from this process will be removed from the surface before Restoration Flows come into contact with this area of the channel. Any water used during this process would be kept separate from water flow in the channel and either be reused in the process or pumped into a dewatering system. Because of these precautions, it is unlikely that turbid water created in this process would adversely affect listed fishes, in large part because summer temperatures would preclude fish presence even if water were still present in the channel. Therefore, adverse effects to listed fishes associated with the creation of re-grading the channels and creation of the rock ramps is not expected.

2.5.1.11 Effects of pollution and contamination into waterways

The construction process of all the elements has the potential to introduce or increase the amount of hazardous materials in the waterways in the action area and downstream. Petroleum-based fuels and lubricants, fertilizers, and herbicides are expected to be brought into the action area in support of construction or replanting activities. 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 AMMs and BMPs integrated into the proposed action to control such pollutants and the implementation of an appropriate SWPPP.

In particular, the Eastside Bypass Levee Reinforcement element has the potential to introduce bentonite in the adjacent waterways to the levees being reinforced. Bentonite can be toxic to salmonids when it enters waterways in sufficient concentrations for sufficient time periods (Sigler et al., 1984), causing mild to lethal suffocation and resulting in reduced growth rates. During construction there is not much probability that bentonite will come into contact with flows and enter the ecosystem because work will proceed in the dry and the crew will operate under a spill prevention plan. If a spill does occur, there is a spill response and cleanup plan that is expected to minimize and reduce water quality impacts to the extent practical. Bentonite material will not be in contact with Restoration Flows after the levee improvements are complete since any bentonite fill will exist in the middle of the improved levee, covered and compacted with native soils already existing in the levee or from the proposed borrow pits. Therefore contact by juvenile or adult salmonids with bentonite clay is not expected, so adverse effects are not expected.

2.5.1.12 Effects of construction site clean-up/utility restoration

As part of finishing the Eastside Bypass Levee Reinforcement element, after the improvements are complete and the levee is reconstructed, several services that existed before project implementation will be re-established. The levee crown will be repaved with either aggregate base or asphalt concrete similar what existed before levee improvements. The previously existing utilities and infrastructure will be re-established in kind and continue operations: 1) an irrigation canal that goes through the levee, 2) drains that also go through the levee, and 3) a siphon that moves water from the landside section of the levee from east to west of the Eastside Bypass will be extended or replaced. Field investigations will be conducted to determine the best placement for these structures in/on the levee. The planning and re-establishment of these utilities are not expected to change the habitat functionality or salmonid use of the channel, and so these actions are not expected to have adverse effects to salmonids while in operation.

For other sites, construction materials and equipment will be removed and staging areas/borrow pits will be returned to their base states. Since clean-up activities will occur late into the work season, near the end, fish presence is not expected and so adverse effects should not occur.

2.5.1.13 Effects of stream gage re-establishment
As part of the Eastside Bypass Control Structure Modification and the Merced NWR Weir Replacement elements, one stream gage per site will be moved so that the changing current dynamics caused by channel modifications will not affect the collection of future stream stage data. Gage replacement and movement will occur within the work window and is a minor component of this action, not anticipated to cause measurable adverse impacts to listed species. The end result is not expected to be markedly different from status quo when the movement is complete, so impacts to listed fishes are not expected.

2.5.1.14 Effects of establishing a well
These effects pertain to the Merced NWR weir element only. Exploratory well sites will be drilled to determine the best place to set the replacement well, but since drilling will be far from wetted areas, impacts to listed fishes are not expected. There is associated infrastructure and pipe placement needed to use the new pump and transport the water around the Merced NWR, but since these structures will be placed outside of wetted channel areas, impacts to listed fishes are not expected by their establishment.

2.5.1.15 Effects of replanting disturbed areas
For all elements, after the construction portions are complete, areas will be re-seeded or replanted to replace vegetation removed during site preparation and access routing. Fishes are not expected to be present during replanting activities since they will occur at the end of the work window, when water of suitable temperatures and fish are least likely to be present in the channels. Revegetation may include the use of herbicides to control the establishment of invasive non-native plant species, however pollution BMPs/AMMs will be implemented to prevent the introduction of these chemicals into the waterway. As such, adverse effects to listed fishes would be avoided.

2.5.2 Direct Effects of the Completed Action and Long-term Operations

2.5.2.1 Element 1: Eastside Bypass Levee Reinforcement
When the Eastside Bypass Levee Reinforcement element is complete, the improvement of the levees in this section will increase the channel capacity of the Eastside Bypass in this section. These improvements will allow passage of Restoration Flows in addition to flood flows, but without increasing the seepage risk for adjacent properties, up to 2,500 cfs. Full implementation of Restoration Flows is expected to benefit CV spring-run Chinook salmon and CCV steelhead

populations as increased flows will be implemented and provide connectivity between SJR spawning habitat and the Delta for adults, and will also provide a better conduit for juveniles produced in the Restoration Area to leave and enter the Delta/Pacific Ocean.

Eastside Bypass levees are maintained by the LSJLD and regular activities include vegetation management, levee inspections, levee restoration and repair, rodent control, encroachment removal, and levee patrolling during floods. Changes to the long-term maintenance plans and operations is not described or anticipated for this element, so adverse effects are not expected through these avenues.

2.5.2.2 Element 2: Eastside Bypass Control Structure Modification

The purpose of removing the control structure is to remove the structure that did not meet NMFS fish passage criteria, was acting as a blockage to adult salmonid passage at flows less than 700 cfs, and had large drops that impeded juvenile outmigration. The rock ramp addition was engineered to meet passage/hydraulic criteria outlined in "Anadromous Salmonid Passage Facility Design" (NMFS, 2011) and "Guidelines for Salmonid Passage at Stream Crossings" (NMFS, 2001), therefore NMFS concurs that implementation of this element will improve passage conditions for all life stages of steelhead and Chinook salmon through the Eastside Bypass at flows from 45 to 4,500 cfs. In summary, the modification of the Eastside Bypass Control Structure and construction of the rock ramp and low-flow channel is expected to have long-term benefits to CV spring-run Chinook salmon and CCV steelhead because it improves fish passage between the SJR mainstem below Friant Dam and the Delta, and will not have adverse effects in the long term.

Once the Eastside Bypass Control Structure is modified and the rock ramp is constructed, the LSJLD will continue to operate the structure to direct flood flows. The modification will also influence how flood flows will be split between the Lower Eastside Bypass and the Mariposa Bypass, but the change is expected to be slight and would not result in a change to status quo operations. During gate operations, fish passage through the structure is expected to be effectively blocked while flood flows are being redirected. This operation plan is no different than the current operational plan. Total fish blockage due to flow redirection is expected to be rare in future gate operations as the LSJLD has not operated the gate during normal sized floods in recent years (Reclamation, 2018), though they may in an effort to control excessively high flows.

After large flood events, LSJLD expects to regularly clear debris from the rock ramp and inspect the ramp for rock movement or scour. Any required maintenance of the rock ramp would be performed by DWR for the first 5 years after construction, after which a different agreement will be formed. Maintenance is expected to be required in perpetuity so that the ramp continues to function as designed and allow fish passage with relative ease. If large scale maintenance or regrading is required in the future, such actions will likely be funded and carried out at least in part by Federal agencies and will therefore undergo consultation again at that time. Therefore potential adverse effects of future maintenance will not be analyzed here, however regular maintenance to ensure rock ramp fish passage performance is likely to be beneficial rather than negative to listed fishes.

2.5.2.3 Element 3: Dan McNamara Road Crossing Culvert Replacement
The purpose of this element is to remove the small culvert at Dan McNamara Road, which was a barrier to both juvenile and adult Chinook at low flow and unusable as a road at flows that allowed for fish passage, with a larger road crossing and culvert over the channel that would allow both fish and car passage at a variety of flows. The new culverts will allow for vehicle crossing of the channel during flows less than 200 to 400 cfs (depending on final design) while passing flows and fish unimpeded. The rock ramp addition in this element was engineered to meet passage/hydraulic criteria outlined in "Anadromous Salmonid Passage Facility Design" (NMFS, 2011) and "Guidelines for Salmonid Passage at Stream Crossings" (NMFS, 2001), therefore NMFS concurs that implementation of this aspect of the element will improve passage conditions for all life stages of steelhead and Chinook salmon through the area at flows from 45 to 4,500 cfs. Road closures are still anticipated for up to130 days per year during the wettest year types in the future, resulting in minimal adverse effects to listed fishes.

Cattle grazed around and in the channel prior to project implementation and are expected to graze similarly after construction completion. As an AAM, break away fencing or other cattle exclusion barriers will be used from 10 feet upstream and downstream of the culvert openings and at the edge of ROW to keep cattle from standing and blocking fish passage through the culverts at lower flows. This will be an ongoing maintenance/operations activity that is expected to reduce the impacts of cattle use of the channel on fishes.

Merced County currently performs operations and maintenance on Dan McNamara Road ROW, and regularly reroutes traffic around the flooded roadway when necessary, as well as debris removal and regrading. When the new culvert is in place, such maintenance will not be necessary as often but will still be needed periodically. Specifically, inspection of the rock ramp and low flow channel will be needed to assess if the area needs to be regraded/re-established. DWR and Merced County are likely to enter into an agreement addressing continuing maintenance needs and obligations, and NMFS anticipates such activities will undergo environmental review at that time.

In summary, the Dan McNamara Road crossing and culvert replacement, and construction of the rock ramp and low-flow channel, is expected to have long-term benefits to CV spring-run Chinook salmon and CCV steelhead because it improves fish passage between the SJR mainstem below Friant Dam and the Delta, and will not have adverse effects in the long term.

2.5.2.4 Element 4: Merced NWR Weir Removal and Well Replacement
Before weir removal, the passage of both adult and juvenile salmonids were impeded when boards were installed to pool water in the Merced NWR, until flows of 3,000 cfs or more occurred. When the construction of this element is complete, Merced NWR will no longer impede adult and juvenile fish passage, and a potential juvenile salmonid predator ambush location will be filled in so localized juvenile mortality rates should be reduced, therefore completion of this element is expected to have long-term benefits to CV spring-run Chinook salmon and CCV steelhead, and not have long-term adverse effects.

In addition, utilizing the available aquifer, rather than surface water, allows for listed fishes to use the area and water when they need, and the shallow aquifer should be recharged by

Restoration Flows. The rate at which the new well will be pumped is not expected to exceed the amount the aquifer can supply, so overdraw that may negatively affect river level is not expected though the same amount of water is required by the Merced NWR for normal operations. Operations of the new well away from the connected channel is not expected to disturb fishes using the connected channel once the project is complete.

2.5.3 Indirect Effects of the Completed Action

The action will not have direct effect on the amount or duration of flows during construction, since areas will be dewatered or flows rerouted to allow work in the dry. However, after project completion, the reinforced levees and channel refurbishment will allow for passage of continuous Restoration Flows up to 2,500 cfs in the Eastside Bypass in conjunction with other seepage easement actions, up from a current maximum of 300 cfs (Reclamation, 2018). Indirectly, allowing for increased in maximum Restoration Flows, will enable adult Chinook salmon to migrate upstream through the modified Eastside Bypass system, and also allow juvenile salmonids to migrate downstream out of the system.

While opening the upper SJR basin (below Friant Dam) to anadromous fish use is expected to have a beneficial impact on the CV spring-run Chinook salmon ESU, and the CCV steelhead DPS, it also carries potential for a portion of the returning adults to be attracted to and stray into areas that are unsuitable for holding or spawning, effectively causing the loss of the potential contribution of these individuals back to the population. Tributaries like Bear and Owen creeks historically connected to the SJR, and have been identified as potential returning adult traps. Rain gauge data show that these creeks only flow and connect into the SJR/Eastside Bypass during large rain events, most often in January through May, and only in the wettest years. It is most likely that adults straying under such conditions would have ample time to re-orient and turn around at the first blockage before being trapped and expire. Such delays are expected to slightly reduce their reproductive fitness through additional metabolic expenditure and the increase potential to encounter predators during the delay. The slight potential negative effect of reduced spawning potential in some straying individuals is greatly outweighed by the expected benefit of reintroducing salmonids to SJR basin through volitional migration to suitable holding, spawning, incubating, and rearing areas below Friant dam.

A different but related beneficial indirect effect of the action is that water temperatures in the Eastside Bypass are expected to decrease during the spring through fall periods with increased Restoration Flow volumes enabled in part by completion of the proposed action. The SJR system is over 100 miles from any cold water pool releases managed by Friant Dam operations, and any low volume flows present in the CV floor readily fluctuate with ambient air temperatures and solar radiation, so much so that water temperatures in the Eastside Bypass quickly become unsuitable to host migrating juvenile salmonids when air temperatures begin routinely exceed lethal water temperatures (>75°F in late spring, April through June). By indirectly enabling SJRRP to fully implement Restoration Flows at potentially maximum volumes, water temperatures are expected to decrease in the Eastside Bypass as large water volumes are less responsive to changes in air temperatures, and so the water temperatures in the lower reaches of the SJR should stay suitably cooler over a longer portion during spring-time juvenile outmigration. These expected effects to water temperatures are anticipated as being beneficial to the recovery of listed salmonid populations.

After the old structures are removed (weirs, road crossings, and the Eastside Bypass Control Structure), the storage of sediments that continuously accumulate behind the structures and the depositional areas would be eliminated. When the Restoration Flows first are released for the first time after construction completion, and the amount released is more than what has been passed through the channels in recent history, an initial increase in suspended sediment and turbidity is expected, as sediment areas that were previously immobile are redistributed according to the new channel and flow dynamics. These effects are expected to be temporary and limited to the first few weeks after Restoration Flows resume, the anticipated end of construction/initial implementation of Restoration Flows potentially being October through the end of the fall. Spring-run salmon would not be expected to be using the action area during this time based on their life history requirements but CCV steelhead adults may be trying to access the SJR basin during this time period (Figure 3). Temporary turbidity increases associated with channel reconstruction is not expected to measurably affect adult CCV steelhead since adult steelhead regularly tolerate turbidity spikes associated with first flush rain/flood events, as they typically capitalize on these flows to climb far into tributaries.

2.5.4 Interrelated and Interdependent Effects of the Action

Associated to the proposed action under consideration, Reclamation has obtained seepage easements on some properties adjacent to the Eastside Bypass to allow those areas to still experience seepage and possible water damages while other areas of the levee will be reinforced, as reviewed in this consultation. The seepage easements would have little value to Reclamation without the action of also reinforcing other levee sections, because otherwise the channel capacity would still be limited, limiting Restoration Flow releases that could not be fully implemented without property damage to third parties. Adverse effects to fish associated with Reclamation obtaining seepage easements are not expected, because these purchases will allow for more flow to be released into the Eastside Bypass for the benefit of listed fishes and releases will be implemented under the direction of the SJRRP. On the ground construction is not expected for this associated interdependent effect.

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.

Water resource projects, resource management plans/programs, general outdoor recreation, and various types of land development projects are anticipated to co-occur with the proposed action. However, most of these actions are likely to involve Federal funding and/or require a Federally-issued permit, and are therefore not considered as cumulative effects in this consultation since environmental review will occur for such actions but through a different avenue. State or private actions that may potentially affect CCV steelhead and CV spring-run Chinook salmon include, but are not limited to, activates such as: habitat conservation, habitat fragmentation, herbicide/pesticide application, vegetation management near/along waterways, discharge of contaminates to waterways, human presence and activity along waterways, dispersion of invasive species, and water diversions. Also, the human population of the CCV is expected to increase (Reclamation, 2016) and is likely to adversely affect salmonids populations through continued habitat alterations as regional urbanization and land development also increase.

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

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk 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 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.

Unfortunately, the abundance of the CCV steelhead DPS has continued to decline in recent years and is on track to become endangered in the near future throughout a significant portion of its range (NMFS, 2016a). Its decline is attributed in large part to its continued blockage from approximately 80% of its historical spawning and rearing habitat (NMFS, 2014), and the persistent large-scale habitat degradation which has occurred to the remaining habitat. Habitat degradation of currently accessible habitat is also expected to increase as further development for urban, agricultural, and industrial uses of the CV is expected to increase with increased human population and activities. In addition, increased water use is expected though surface water supply levels are expected to remain the same, putting fish needs of abundant cold clear water in competition with urban and agricultural demands and current water management decisions (NMFS, 2009).

The CV spring-run Chinook salmon ESU still suffers from many of the same threats identified in the 2014 recovery plan, and the population had seemed to maintain their abundance until 2014. Recent data, 2015 through 2017 escapement estimates, have shown sharp declines (California Department of Fish and Wildlife (CDFW), 2018), with 2018 preliminary counts observing a precipitous decline in total abundance, but especially in creeks supporting wild populations (Battle and Clear Creek). These poor returns are believed to be a result of the severe 2011-2017 California drought and low returns are expected to continue for several years. Climate change predictions for the upcoming decades indicate that greater extremes in precipitation and snowpack are expected, and regime changes between wet and dry water years will become more rapid (Reclamation, 2016), including a severe drought situation similar to the one California recently experienced. Temperature increases and decreases in cold water availability will negatively affect both CCV steelhead and CV spring-run Chinook spawning, egg incubation, natal rearing and migration, but spring-run are especially vulnerable because their life history requires them to over summer in freshwater pools while they mature before spawning. Water use and management already impacts the amount and availability of cold water suitable to support holding, but climate change models predict that the amount of snow fall at high elevation will decrease (potentially to zero), and even if a snowpack forms, it will not persist as long into the summer as past climatic data would predict. Without very cold snowmelt inputs to keep water temperatures below lethal thresholds, adult spring-run will not be able to survive the summer to spawn.

Past and current water use choices have effectively extirpated both CCV steelhead and CV spring-run Chinook salmon from the SJR basin (NMFS, 2016c, 2016d). Starting with the construction of Friant Dam in 1942, combined with increased water use for irrigation, surface flows of the SJR mainstem have not been sufficient to pass fish up to the base of Friant for decades. Prior to Friant Dam and large-scale water diversions, the largest portion of the spring-run Chinook salmon ESU returned to the SJR and its tributaries but when critical habitat was designated for CV spring-run in 2005, SJR basin waterways were not included in the listing. However, since the historical SJR channel cannot currently covey full Restoration Flows without flooding or seeping adjacent properties, the Eastside Bypass was selected as a suitable passage route for fish between the Restoration Area and the Delta/Pacific Ocean while other restoration and passage project works are ongoing.

The construction process of the Eastside Bypass Improvement Project elements has few adverse effects, potentially including alteration of natural behaviors, increased stress, area avoidance, and injury or mortality during capture and relocation. However, these adverse effects are expected to be temporary, short in duration, and will likely impact a low number of individuals, especially since the project is intended to benefit these fish in the long-term. After construction is complete, each element is designed to either 1) allow passage of more volume of surface water through Eastside Bypass channels or 2) improve passage conditions for both adult and juvenile salmonids through removing impediments and creating channel conditions that assist in passage through the action area. Both of these effects are beneficial to both populations over the long-term; reintroduction or recolonization of the upper SJR basin is a recovery action identified in their recovery plan (NMFS, 2014). In addition, the Eastside Bypass Improvement Project is one component of the SJRRP's reintroduction and reconnection plans. Other plans include the Sack Dam and Arroyo passage improvement plans and fish screens. Once all components are implemented, continuous volitional passage should be possible between the Delta and holding/spawning/rearing areas in the Restoration Area, and the SJRRP can focus on reintroduction/recolonization efforts and tailoring water flow scheduling further.

Therefore, the implementation of the proposed action is not expected to decrease the likelihood of survival and recovery of CCV steelhead and CV spring-run Chinook salmon, instead it will likely increase recovery, despite some limited adverse effects to a few individuals during the construction phase. Designated critical habitat for either species is not found within the action area, so the proposed action is not expected to diminish its value.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS's opinion that the proposed action is not likely to jeopardize the continued existence of CCV steelhead or CV spring-run Chinook salmon, or adversely modify or destroy designated critical habitat for these listed species.

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 section 2.5, adverse effects to juvenile CV spring-run Chinook salmon were identified and included in this opinion. Because these juveniles occur in the SJRRP Restoration Area, and these fish are considered 10(j) NEP individuals, take of these fish is not federally prohibited for otherwise lawful activities. The analysis on CV spring-run Chinook salmon is for informational purposes only at the request of Reclamation. Therefore, there will be no take issued for CV spring-run Chinook salmon as part of this opinion, and the experimental population of CV spring-run Chinook salmon is not further addressed in this ITS. However, since harm to CV spring-run Chinook salmon juveniles would occur in a similar manner as that described for CCV steelhead juveniles (below), and BMPs/AMMs/Reasonable and Prudent Measures/Terms and Conditions identified to reduce take of CCV steelhead juveniles are expected to benefit the NEP by also reducing the impact of general construction to juvenile salmonids caused by the proposed action.

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

1. CCV juveniles and kelts are likely to be harassed and harmed by general construction activities, including experiencing: alteration of their normal behaviors, increased stress, migration delay, startle/flushing from hiding spots, increased predation risk, and result in decreased likelihood of individual survival (section 2.5.1.1, 2.5.1.2, 2.5.1.3, & 2.5.1.5).

2. CCV steelhead juveniles and kelts are likely to be harassed and harmed through construction activities and equipment operations disturbing and mobilizing sediments into waterways via erosion or fugitive dust, including experiencing: increased respiratory stress, alteration of behaviors as described above, and avoidance of areas with increased turbidity (sections 2.5.1.2, 2.5.1.3, 2.5.1.5, & 2.5.1.9).

3. CCV steelhead juveniles and kelts are likely to be harassed and harmed through the propagation of underwater noise and pressures from vibratory hammer installation of cofferdams in wetted channels, including experiencing: alteration of their normal behaviors, increased stress, migration delay, startle/flushing, increased predation risk, and area avoidance (sections 2.5.1.5 & 2.5.1.7).

4. CCV steelhead juveniles are likely to be trapped, captured, collected, harmed, wounded, and killed during fish rescue attempts that may coincide with cofferdam installation and dewatering, including experiencing: increased stress, increased susceptibility to disease and predation following relocation, increased risk of thermal shock, disorientation, and death in a small percentage (sections 2.5.1.5 & 2.5.1.6)

The number of CCV steelhead that are estimated to be taken during the construction of the proposed action is likely to be relatively low, as in less than two individual juveniles or kelts total per project element site. The number of CCV steelhead estimated to be taken includes individual juveniles captured during fish rescue and relocation activities (two per project element, no more than eight total for the project). Besides the juveniles encountered during fish rescue activities, the true number of fish taken is difficult to impossible to confirm, as fish may change their behavior and avoid the construction area before being observed and counted by personnel. Therefore, a surrogate of area affected by noise disturbance, pressure waves, and turbidity will be used to limit the number of fish affected, since beyond the limits at which these factors interact with the environment, fish will not experience negative impacts.

As identified in section 2.5.1.7, pile driving noise and pressure waves propagate readily through water and are likely the most severe form of disturbance the project will introduce into the environment. Within 100 meters from the location of pile driving, pressure levels are expected to readily exceed baseline (>150 dB_{RMS}) but outside of 100 meters from pile driving, underwater pressure levels are expected to recede back to baseline (<150 dB_{RMS}). Therefore, the amount of wetted area to experience pressure waves beyond baseline will be used as a surrogate as a way to measure and limit the number of CCV steelhead also using those waterways that may be taken in the course of construction. The limit of the area experiencing adverse effects and expected to result in take will be 100 meters from the boundary of the construction footprint (including existing/temporary access roads, staging areas, borrow pits, demolition, rock ramps, etc.) where construction activities occur in or adjacent to wetted areas. This limit will also include turbidity effects, i.e., a visible turbidity plume created from project activities may not extent more than 100 meters downstream of active construction. The 100 meter limit will also likely encompass the extent of all other auditory disturbances that may have otherwise been disturbed fish (e.g., general heavy equipment operations), since the noise levels produced by such actions are not expected rise to the levels produced by vibratory pile driving.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

1. Reduce or avoid impacts to migrating and rearing CCV steelhead to the extent practical.
2. Prepare and provide NMFS with fish rescue/translocation and monitoring plans prior to construction.
3. Monitor waterways and channels adjacent to construction areas for CCV steelhead presence when wetted areas host waters less than 75 °F.
4. Prepare and provide NMFS with a report on the incidental take of CCV steelhead in the action area as observed or rescued.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and Reclamation or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). Reclamation or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM 1:
   a. Construction activities shall only occur between 0700 and1800 during workdays near the wetted channels, in an effort to avoid disrupting juvenile salmonid peak crepuscular foraging and migration activities that typically occur outside of those hours.
   b. In the case of native vegetation within the boundaries of the construction sites, vegetation removal shall be limited to the extent practicable. Disturbed or removed native vegetation shall be replaced or replanted in kind to the extent that was present before construction activities. The amount of non-native vegetation removed is at the discretion of Reclamation and shall not require replacement.
   c. Reclamation shall ensure that the erosion and pollution control BMPs selected to be implemented onsite (as identified in the BA description and section 1.3.6) are installed or

implement as described and also periodically monitored for effectiveness, so that sediment and pollution incursion into waterways is prevented or limited.

d. All equipment to be used in the channel shall be in good working order and free of engine fluid drips or leaks, including periodic inspection of the equipment.
e. If a leak or spill of hazardous material occurs in the channel, crew shall excavate all soils soaked with the material and properly dispose of contaminated soils according to recommendations of the Safety Data Sheets for that material (Occupational Safety and Health Administration (OSHA), 2018), away from waterways.

2. The following terms and conditions implement RPM 2:
   a. Reclamation shall submit fish monitoring plan prior to the start of construction for NMFS review.
   b. The fish monitoring plan shall include a stipulation for an onsite biological monitor that is capable of identifying and recording the number and type of fishes observed within waterways during construction.
   c. Reclamation shall submit a fish rescue plan prior to the start of construction for NMFS review.
   d. Reclamation shall identify personnel that may perform any fish rescue activities in the fish rescue plan, and said personnel shall be qualified fish biologists with several years' experience capturing and handling live juvenile salmonids. Reclamation shall also describe in the fish rescue plan the proposed capture and handling methods, the transport equipment to be used, and the potential relocation areas identified as suitable habitat to host translocated fishes.

3. The following terms and conditions implement RPM 3:
   a. NMFS shall be notified within 24 hours if CCV steelhead are observed within the action area by the biological monitor, including: 1) the number and life stage observed and 2) the onsite water temperature (so that NMFS may assess the likelihood of fish survival).
   b. The onsite monitor shall observe and record whether turbidity plumes are created and how far downstream and how long the plumes persist, when water temperatures are less than 75 °F.
   c. The water temperatures of wetted channels and ponded areas shall be monitored onsite during construction by the biological monitor. While water temperature measurements of 75 °F or more are observed, monitoring for CCV steelhead or turbidity plumes is not required.

4. The following terms and conditions implement RPM 4:
   a. NMFS shall be contacted within 24 hours if the incidental take surrogate is observed exceeded or is suspected of being exceeded so that coordination between NMFS and Reclamation can occur.
   b. NMFS shall be notified at least 24 hours prior to any anticipated fish rescue activities, with an estimated number of fish to be rescued, if CCV steelhead are anticipated to be encountered.
   c. NMFS shall be notified within 24 hours if a CCV steelhead has died related to any project activity. If possible, the body will be retained on ice and then frozen as soon as possible to allow for later identification by NMFS or SJRRP staff.

d. NMFS shall be provided with a report by either Reclamation or an associated entity on the incidental take of CCV steelhead related to the construction of the project elements, also identifying how fish were taken (e.g. harassment = individuals observed altering behaviors, evasive movement observed, captured = fish rescue, wounded = injured or stressed during handling or transport, killed = died during fish rescue, etc.). This report shall be submitted by December 31st of the same year all construction is complete, to address:

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

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). No further conservation recommendations are available that would minimize or avoid adverse effects of the considered action on CCV steelhead.

2.11 Reinitiation of Consultation

This concludes formal consultation for the Eastside Bypass Improvement Project.

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.

2.12 "Not Likely to Adversely Affect" Determinations

2.12.1 sDPS of North American green sturgeon

- Threatened (71 FR 17757; April 7, 2006)
- Designated critical habitat (74 FR 52300; October 9, 2009); designated critical habitat does not occur in the proposed action area.

Green sturgeon, *Acipenser medirostris,* are known to range from Baja California to the Bering Sea along the North American continental shelf. During late summer and early fall, subadults and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast (Moser & Lindley, 2006). Green sturgeon encountered in the CV are exclusively from the sDPS; using polyploid microsatellite data, (Israel et al., 2009) found that green sturgeon within the CV of California belong to the sDPS, and acoustic tagging studies show that green sturgeon found spawning within the Sacramento River belong to the sDPS of green sturgeon (Lindley et al., 2011). Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and viable population parameters can be found in the 2015 5-year status review (NMFS, 2015).

In inland waters of California, sDPS green sturgeon are known to range through the San Francisco Bay estuary and the Delta up to the Sacramento, Feather, and Yuba rivers (NMFS, 2018b). Though larger rivers in the SJR basin are at times suitable for green sturgeon, until recently all accounts of green sturgeon sightings in the SJR basin were anecdotal at best or misidentification of white sturgeon (Gruber et al., 2012; Jackson et al., 2016). Late October in 2017, an adult green sturgeon was sighted in the Stanislaus River near Knights Ferry by a fish biologist and its identity was genetically confirmed by genetic analysis of environmental DNA of green sturgeon in the surrounding water (Breitler, 2017). This is the first confirmed sighting of a green sturgeon in an SJR tributary, and indicates that adult passage to the action area of the proposed action may be probable in the near future, given river flows of suitable quantity and quality, and additional restoration/recovery actions. Since only one adult was located and spawning activities in the SJR basin have never been recorded (Jackson et al., 2016), the production of juveniles from the Stanislaus is not considered likely in the near future but highlights that recolonization of the SJR basin by this sDPS may be forthcoming.

SDPS green sturgeon are not expected to have interaction with the proposed action because 1) passage to the action area is blocked to fishes the size of adult sturgeon, 2) the action area is far upstream of waterbodies in which green sturgeon have been so far encountered and confirmed, and 3) the work would primarily occur in a work window of summer months when water temperatures in the Eastside Bypass and other creeks and sloughs are expected to exceed optimal to lethal limits for sturgeon (26° to 28°C (Linares-Casenave et al., 2013)). White sturgeon have been encountered in the SJR system as far up as the Hills Ferry fish barrier at the confluence of the SJR and Merced River, however this barrier is at least 20 RM downstream from the proposed action area and should be an effective barrier to fishes the size of sub-adult and adult sturgeon. It is unlikely that green sturgeon currently utilize other areas of the San Joaquin River upriver of the Delta with regularity, and until fish passage improves, the action area of the proposed project is considered inaccessible to green sturgeon. Designated critical habitat for green sturgeon end at the southern boundary of the Legal Delta in the San Joaquin River, or at the confluence of the SJR and Stanislaus River. NMFS has therefore determined that the proposed action is not likely to adversely affect sDPS North American green sturgeon, nor their designated critical habitat.

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 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 Reclamation and descriptions of EFH for Pacific Coast salmon (PFMC, 2014) contained in the fishery management plan (FMP) developed by the PFMC and approved by the Secretary of Commerce.

3.1 EFH 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 United States Geological Survey 4th field hydrologic units identified by the FMP (PFMC, 2014). This designation includes the Middle San Joaquin-Lower Chowchilla watershed (HUC 18040001) for all runs of Chinook salmon that historically and currently use these watersheds (spring-run, fall-run, and late fall-run). The Pacific Coast salmon FMP also identifies Habitat Areas of Particular Concern (HAPCs): complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation. The HAPCs that may be directly or indirectly adversely affected by the proposed project include complex channel and floodplain habitat.

3.2 Adverse Effects on EFH

Effects to Pacific Salmon EFH and to the complex channel and floodplain habitat HAPC are discussed in context of effects to species through habitat modifications in section 2.5. No other HAPCs are expected to be affected by the proposed action. The listed actions below are expected to adversely affect only the complex channel floodplain habitat HAPC.

Structure Demolition & Debris Removal

- Temporary disturbance of soil and dust creation, leading to localized increases in sedimentation and turbidity in waterways used by salmonids
- Temporary noise disturbance

Channel Regrading, Ramp Creation, & Pile Driving

- Temporary disturbance of soil and dust creation, leading to localized increases in sedimentation and turbidity in waterways used by salmonids
- Temporary noise disturbance
- Placement of permanent artificial structures in channels used by salmonids, which may degrade and cause problems overtime without maintenance

Shore Protection & Levee Improvement

- Placement of permanent artificial materials (rock/riprap) to protect artificial water management structures, prevents natural stream processes like erosion and movement
- Modification of levees to allow more water passage regularly, however improvement of existing levees prevents their return to a natural floodplain state

Vegetation Removal

- Removal of vegetation in preparation for construction removes shade, cover, nutrients, and habitat complexity in the short term (anticipated to last several season) though long-term the replanting of native species should be beneficial

Contamination & Pollution

- Introduces additional pollution from vehicles and equipment operating in the channel, degrading water quality locally for the first season after construction is complete
- Potentially reducing aquatic macroinvertebrate production temporarily

3.3 EFH Conservation Recommendations

Chinook salmon, *Oncorhynchus tshawytscha,* are the species managed under the Pacific Coast salmon that may be affected by this project, both the fall-run and spring-run, since fall-run Chinook are known to migrate and spawn in the SJR and its tributaries, and spring-run Chinook salmon are being reintroduced to the SJR below Friant Dam by the SJRRP. Either run may use this area to migrate between the upper SJR and the Delta. The EFH of Chinook salmon is adversely effected by the proposed project through the pathways identified above: structure demolition and debris removal; channel regrading, ramp creation, and pile driving; shore protection and levee improvement; vegetation removal; and contamination and pollution. However, many of the adverse effects associated with these components of the proposed action are addressed in the terms and conditions of the preceding ESA consultation. The following are conservation recommendations (CRs) that may further reduce negative impacts to Pacific Salmon EFH and HAPCs (if a specific impact is not address, no additional CRs could be offered to lessen expected impacts).

<u>Shore Protection & Levee Improvement:</u> Within the action area, negative floodplain alterations have already occurred in this area prior to the implementation of the proposed action. The enhancement of any remaining floodplain or creation of new floodplain is important to maintain the Pacific Coast salmon populations through enhanced growth and survival of juveniles.

1. To support floodplain HAPCs, Reclamation should promote the restoration of degraded floodplains and wetlands, and the reconnection of migration channels and the SJR to disconnected floodplains and wetlands whenever possible.

2. While improving the levees in the action area, attempt to set back the levee wherever possible to begin reclaiming historical floodplain areas and allow for natural stream processes to shape natural riverine habitat. .

3. Use vegetation methods or "soft" approaches (such as beach nourishment, vegetative plantings, and placement of large woody debris) for bank erosion control in shoreline modifications whenever feasible. Hard bank protection should be a last resort and the following options should be explored (tree revetments, stream flow deflectors, and vegetative riprap). Develop design criteria based on site-specific geomorphological, hydrological and sediment transport processes appropriate for the stream channel for any stabilization, protection and restoration projects.

Fully implementing these EFH CRs would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, at least 626 acres of designated EFH for Pacific Coast salmon.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, Reclamation 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's 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

Reclamation 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's EFH CRs (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are Reclamation. Other interested users could include Reclamation's applicant, the DWR, and the implementing agencies of the SJRRP. Individual copies of this opinion were provided to Reclamation. This opinion will be posted on the PCTS website (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). 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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