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

JUL 14 2017

**Refer to NMFS No: WCR-2017-7312**

Mr. David Mooney
Acting Area Manager
Bay-Delta Office
U.S. Bureau of Reclamation
801 I Street, Suite 140
Sacramento, California 95814-2536

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Fremont Weir Adult Fish Passage Modification Project in Yolo County, California

Dear Mr. Mooney:

Thank you for your letter of March 7, 2017, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), and section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1976, as amended (16 U.S.C. 1801 *et seq.*), for the Fremont Weir Adult Fish Passage Modification Project (Project).

The Bureau of Reclamation (Reclamation) proposes to implement the Project to meet the requirements of the 2009 NMFS biological opinion and conference opinion on the long-term operations of the Central Valley Project (CVP) and the State Water Project (SWP) (CVP/SWP long-term operations biological opinion) reasonable and prudent alternative action I.7. The purpose of the Project is to improve fish passage between the Sacramento River and the Yolo Bypass and within the Yolo Bypass. The Project would modify an existing fish ladder at the Fremont Weir, remove one downstream agricultural road crossing within Tule Canal, and replace another agricultural road crossing with a structure that provides improved fish passage within the Tule Canal.

This consultation covers the effects of the construction of the Project and operation and maintenance of the structures in perpetuity. The enclosed biological opinion reviews the effects of the Project on federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened California Central Valley steelhead (*O. mykiss*), the threatened Southern distinct population segment of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats, in accordance with section 7(a)(2) of the ESA.

Based on the best scientific and commercial information, the biological opinion concludes that the Project is not likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitats. 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 incidental take of the listed anadromous fish species associated with the Project.

This letter also transmits NMFS' essential fish habitat (EFH) conservation recommendations for Pacific coast salmon as required by the MSA. The EFH consultation concludes that the execution of the Project will adversely affect the EFH of Pacific coast salmon in the action area. Reclamation has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed response in writing to NMFS within 30 days of receipt of these conservation recommendations that includes a description of the measures proposed for avoiding, mitigating, or offsetting the impact of the proposed action on EFH (50 CFR 600.920 (k)). If unable to complete a final response within 30 days, Reclamation should provide an interim written response within 30 days before submitting its final response.

Please contact Brycen Swart in our California Central Valley Office via phone at 916-930-3712 or email at brycen.swart@noaa.gov, if you have any questions regarding this consultation or require additional information.

Sincerely,

Barry A. Thom
Regional Administrator

Enclosure

cc: California Central Valley Office
Division Chron File: 151422-WCR2017-SA00347

Ms. Karen Enstrom, California Department of Water Resources, 3500 Industrial Drive, West Sacramento, California 95691

Mr. Brian Luke, U.S. Army Corps of Engineers, Sacramento District, 1325 J Street, Sacramento, California 95814

Ms. Kaylee Allen, U.S. Fish and Wildlife Service, Bay-Delta Fish and Wildlife Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814

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

## Fremont Weir Adult Fish Passage Modification Project

National Marine Fisheries Service Consultation Number: **WCR-2017-7312**

**Action Agency:** U.S. Bureau of Reclamation

**Affected Species and NMFS' Determinations:**

| ESA-Listed Species | Status | Is Action Likely to Adversely Affect Species? | Is Action Likely To Jeopardize the Species? | Is Action Likely to Adversely Affect Critical Habitat? | Is Action Likely To Destroy or Adversely Modify Critical Habitat? |
|---|---|---|---|---|---|
| Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) | Endangered | Yes | No | N/A | No |
| Central Valley spring-run Chinook salmon (*O. tshawytscha*) | Threatened | Yes | No | Yes | No |
| California Central Valley steelhead (*O. mykiss*) | Threatened | Yes | No | Yes | No |
| North American green sturgeon (*Acipenser medirostris*) | Threatened | Yes | No | Yes | No |

**Essential Fish Habitat (EFH)**

| Fishery Management Plan That Describes EFH in the Project Area | Does Action Have an Adverse Effect on EFH? | Are EFH Conservation Recommendations Provided? |
|---|---|---|
| Pacific coast salmon | Yes | No |

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

**Issued By:**

Barry A. Thom
Regional Administrator

**Date:** JUL 14 2017

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# 1. INTRODUCTION

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

## 1.1. Background

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

NMFS 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) of 1976, as amended (16 U.S.C. 1801 *et seq*.), and implementing regulations at 50 CFR 600.

NMFS 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 (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' Public Consultation Tracking System (https://pcts.nmfs.noaa.gov). A complete record of this consultation is on file at NMFS' California Central Valley Office in Sacramento, California.

## 1.2. Consultation History

On June 4, 2009, NMFS issued its Central Valley Project (CVP)/State Water Project (SWP) long-term operations biological opinion. Reducing migratory delays and loss of salmon, steelhead, and sturgeon at Fremont Weir and other structures in the Yolo Bypass was one of the Reasonable and Prudent Alternative (RPA) actions, RPA Action I.7, required in the biological opinion to avoid jeopardy to listed species. The proposed action partly achieves compliance with RPA Action I.7.

From 2011 through 2017, Reclamation and DWR have developed the Fremont Weir Adult Fish Passage Modification Project (FWAFPM) Project along with NMFS and USFWS through a technical working called the Yolo Bypass Fisheries and Engineering Technical Team. This team was established to bring in experts to develop analytical tools, review screening criteria, document assumptions of analytical tools, evaluate fisheries impacts of restoration actions, and to develop an adaptive management strategy.

On September 12, 2012, Reclamation and DWR submitted to NMFS the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan. The plan set forth a strategy and compliance process with RPA Actions I.6.1 and I.7.

On November 5, 2012, NMFS concurred via letter with the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan.

On February 3, 2017, NMFS received an email from the California Department of Water Resources (DWR) with a request to review the draft biological assessment (BA) for the Project.

On February, 14, 2017, NMFS emailed comments on the draft BA to DWR.

On March 7, 2017, NMFS received a letter and final BA from the U.S. Bureau of Reclamation (Reclamation) requesting formal section 7 consultation. Reclamation determined that the Project may affect and is likely to adversely affect Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*O. tshawytscha*) and its critical habitat; California Central Valley steelhead (*O. mykiss*) and its critical habitat, the Southern distinct population segment (sDPS) of North American green sturgeon (*Acipenser medirostris*) and its critical habitat. The project may also adversely affect EFH, pursuant to the MSA.

### 1.3. Proposed Federal Action

"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).

Reclamation and its applicant, the California Department of Water Resources (DWR), propose to implement the FWAFPM Project in the northern half of the Yolo Bypass in Yolo County, California. The purpose of the FWAFPM Project is to improve adult fish passage in the Yolo Bypass. Specifically, the FWAFPM Project includes modification of the existing Fremont Weir fish ladder, improvements to the channel extending from the existing fish ladder upstream to the Sacramento River and downstream to an existing deep pond, removal of earthen Agricultural Road Crossing 3, and the replacement of Agricultural Road Crossing 2 (Figure 1). The FWAFPM Project would be implemented to comply with the NMFS 2009 CVP/SWP long-term operations biological opinion, and as part of the California Eco-Restore initiative. Reclamation is the lead federal action agency for this ESA Section 7 consultation. In addition, United States Army Corps of Engineers (USACE) proposes to issue a Clean Water Act Section 404 permit and Section 408 permission to alter an existing civil works project.

The FWAFPM Project is part of a larger restoration and fish passage suite of actions in the Yolo Bypass as required in the 2009 CVP/SWP long-term water operation biological opinion. These actions include the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Project, Wallace Weir Fish Rescue Project, Lower Putah Creek Restoration Project and Lisbon Weir Fish Passage Project. Each project will be subject to its own section 7 consultation process.

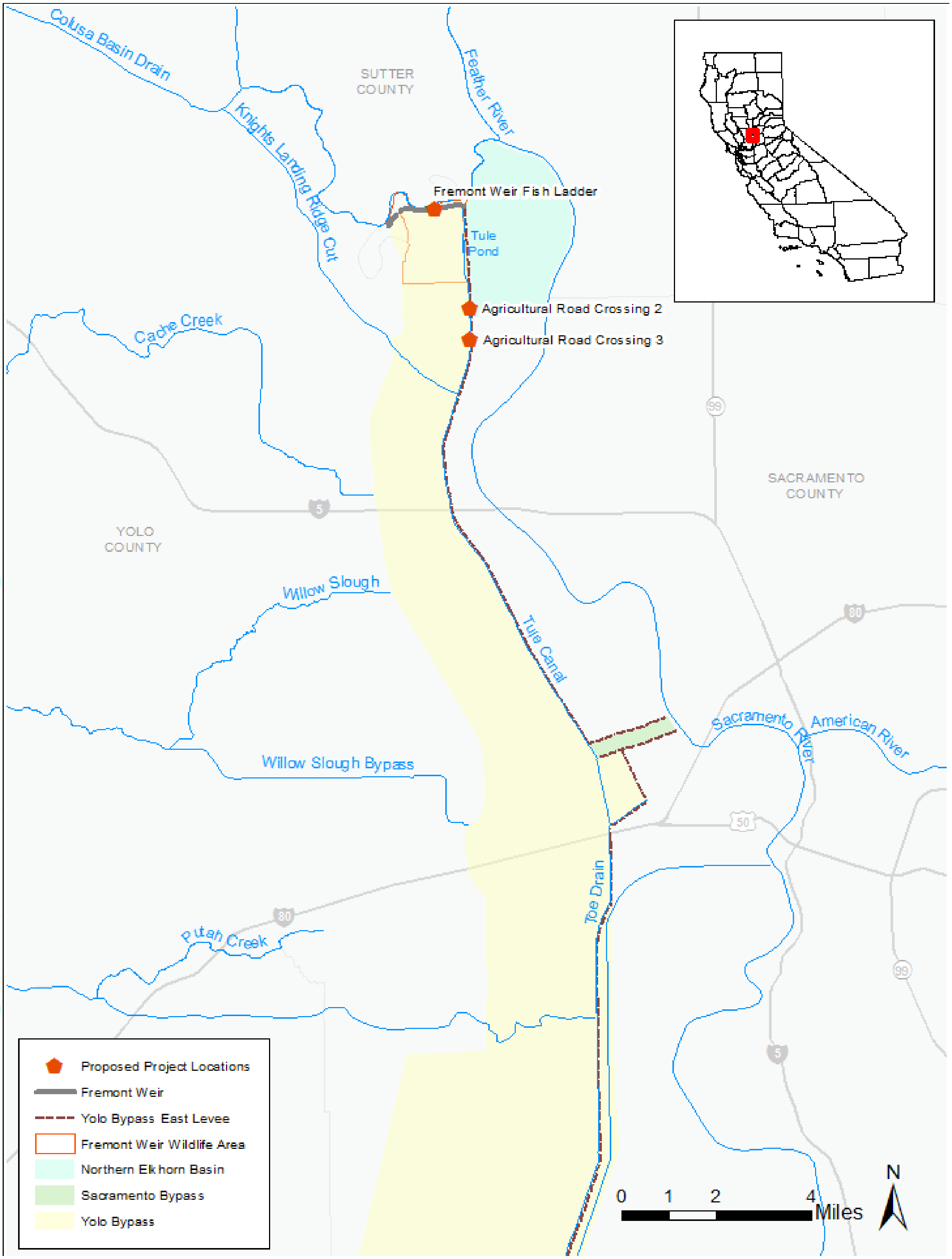


**Figure 1. Proposed Project Features and Locations (DWR 2017).**

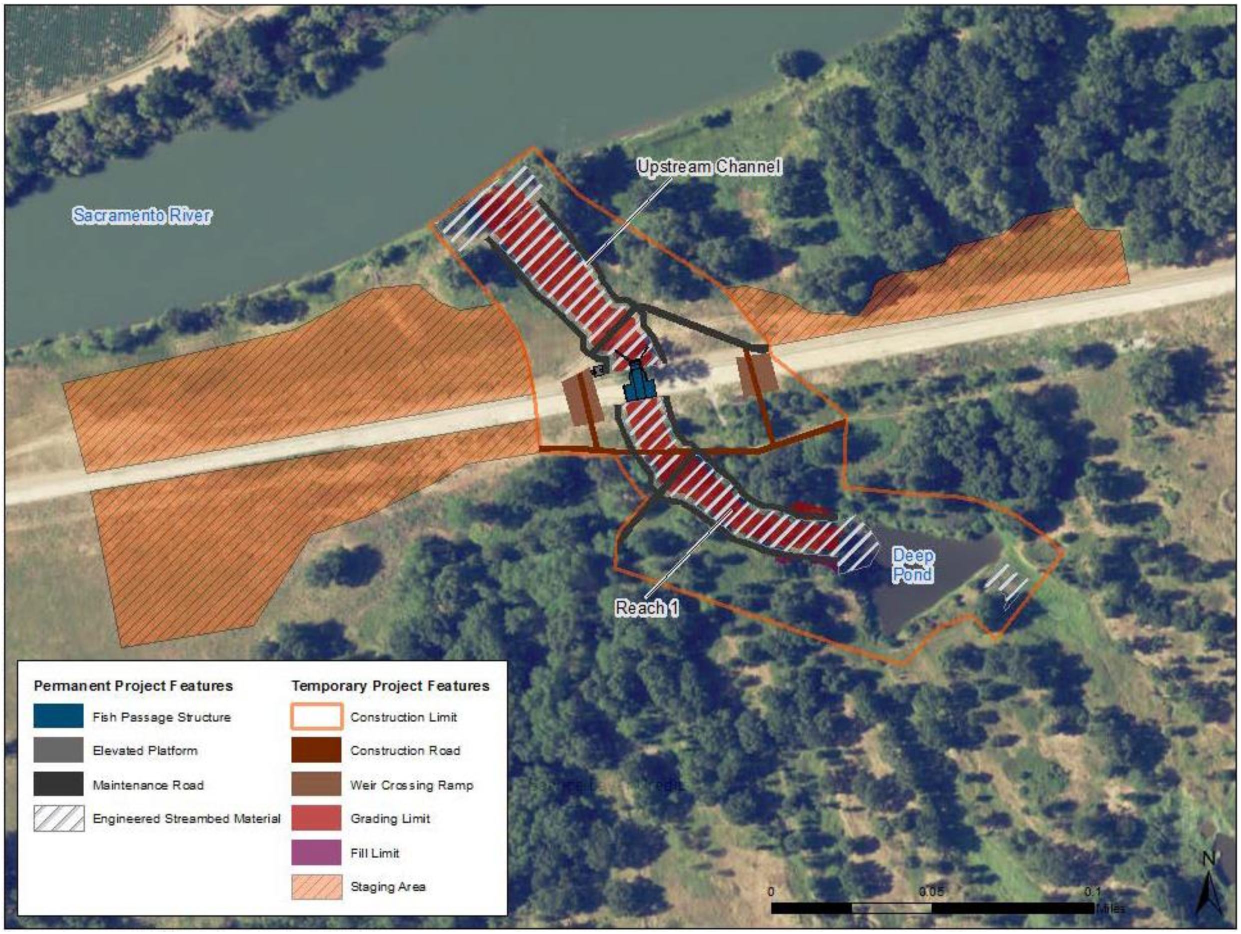


**Figure 2. Proposed construction limit, staging areas, and project features at the Fremont Weir (DWR 2017).**

### 1.3.1. Construction

#### 1.3.1.1. Fremont Weir Fish Ladder Modification

The existing Fremont Weir fish ladder and upstream and downstream adjoining channels would be widened and deepened to increase depth and decrease velocity for salmonids and sturgeon. Specifically, the existing 26-foot bottom elevation, 4-foot-wide and 6-foot-deep fish ladder would be replaced by a gate operated, 22-foot bottom elevation, 15-foot-wide, and 8.5-foot-deep fish passage structure. The components of the fish passage structure would include a sheet pile wall, concrete wingwalls, concrete rectangular gate housing, and a concrete box culvert. The maximum flow through the fish passage structure would be limited to approximately 1,100 cubic feet per second (cfs) when the Sacramento River reaches an elevation of 31.8 feet, the point at which the Fremont Weir begins to overtop. The more favorable depth, velocity, and increased cross-sectional area would provide a greater attraction flow, making it easier for fish to find and ascend the fish passage structure. Also, this flow limit would minimize impacts on existing land uses in the Yolo Bypass and avoid impacts on water diverters along the Sacramento River.

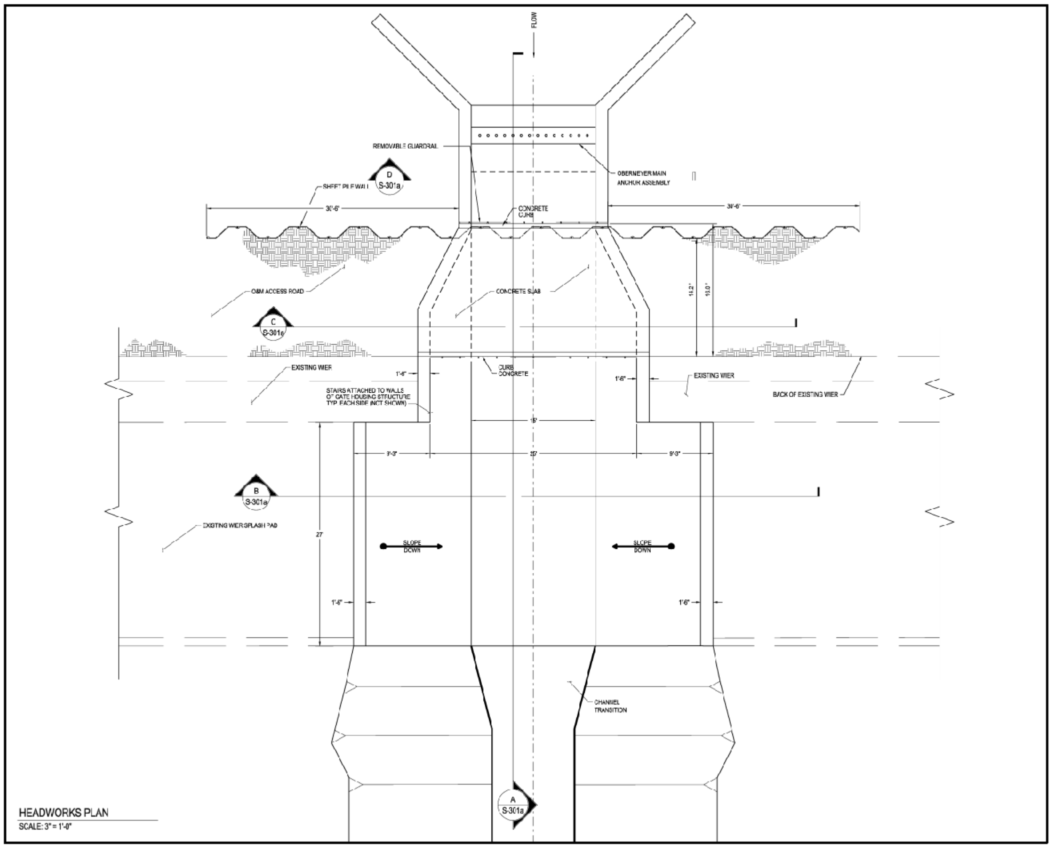


**Figure 3. Plan view of the Fremont Weir fish passage structure (DWR 2017).**

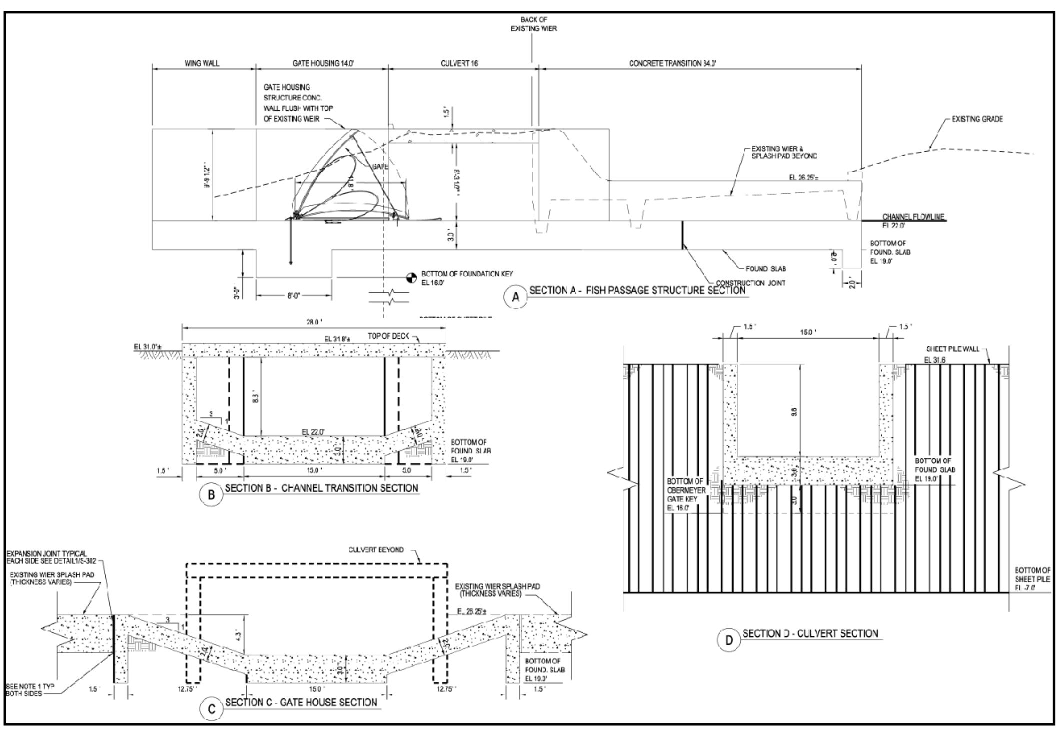


**Figure 4. Cross-section views of the Fremont Weir fish passage structure (DWR 2017).**

The existing fish ladder would be demolished and removed. In the location of the demolished fish ladder, a 36-foot by 60-foot area would be excavated approximately 9 feet in depth to an elevation of 17 feet. An 18-foot by 8-foot section within this area, on the northern side, would be excavated 3 feet deeper, for a total depth of approximately 12 feet, for the foundation key. The excavated area would be formed and concrete would be poured to create the fish passage structure.

At the upstream end of the fish passage structure, a 14 feet long by 15 feet wide concrete rectangular-shaped gate housing would house an 11-foot 8-inch tall bottom-hinged steel gate. The gate would be raised and lowered by inflatable air bladders to control flow through the structure. The gate would require an operation control unit, air compressor, and power supply to allow pre-programmed and remote operation of the gate. The power supply and control unit would consist of a battery bank, solar panels, and an inverter. All elements needed to provide remote gate operation would be located on a raised equipment platform. Two 24-foot-long concrete wingwalls would be placed at 45 degree angles to the concrete gate housing. The wingwall height would begin two feet above the trapezoidal channel finished grade and end at a height of 10 feet at the concrete gate housing.

A concrete box culvert would be located downstream of the gate housing. The concrete box culvert would be 16 feet long with a transitional width from 15 feet wide at the upstream end to 25 feet wide at the downstream end. The transition would occur over the first 11 feet of the structure. The top elevation of the concrete box culvert would be 32 feet, the top wall thickness would be 1.5 feet, and the inside height of the box culvert would be 8 feet 6 inches tall. The floor of the box culvert would have a 15-foot bottom width at elevation 22 feet with 3:1 side-slope transitions along both sides. The concrete box culvert would be traffic-rated to accommodate expected equipment that operates within the bypass and would be aligned perpendicular to the existing access road to allow for continued access. The downstream end of the box culvert would include a recessed housing for installation of the adaptive resolution imaging sonar (ARIS) fish monitoring system. The concrete box culvert would open up into a 34-foot-long concrete transition channel. The concrete transition would begin with a 7-foot long by 10-foot tall vertical headwall from the concrete box culvert extending through the existing weir wall. The headwall would include waterstop expansion joints to connect to the existing weir. The channel floor through the headwall would be 25 feet wide with a 15-foot bottom width and 3:1 side-slope transitions. The remaining 27 feet of the concrete transition would be through the existing stilling basin and include a channel bottom width of 15 feet, 3:1 side-slope transitions, and a top width of 40 feet. The concrete channel transition would terminate at an earthen outlet channel.

To address potential underseepage issues, a sheet pile wall would be installed beneath and embedded on the upstream side of the fish passage structure. The sheet pile wall would extend 30 feet beyond each side of the structure. The sheet piles would be driven to an elevation of negative 7 feet and extend to existing grade beyond the sides of the structure. A crane would be used to pile drive the sheet pile wall. The sheet pile wall would be installed to elevation 32 feet and would serve as a temporary weir in the event larger flows were to occur at the Fremont

Weir prior to the completion of construction activities. After the bottom-hinged gate is installed and operational, the sheet pile wall would be cut to the bottom of the foundation slab at elevation 19 feet.

A raised equipment platform would be approximately 50 feet northwest of the fish passage structure, upstream of the Fremont Weir. The steel equipment platform would be elevated by four 30-inch-wide steel columns. The width of the steel columns would be confirmed prior to final design. The steel columns would each be buried in a 4.5-foot by 4.5-foot by 3.0-foot concrete spread footing for the foundation. The dimensions of the platform would be 15 feet by 15 feet. The bottom of the platform would be at an elevation of 47 feet, and the top of the footing would match the existing grade elevation of 29 feet. The equipment platform would be enclosed by guardrails, with steel plates on the outside of the guardrails, for the protection of the solar, communication, and electrical or mechanical equipment components. The power supply would also enable operation of an ARIS system that would monitor how fish behave at the fish passage structure. Concrete-encased duct bank would connect all electrical and air lines from the platform to the fish passage structure.

Permanent piles would be used to reinforce the front of the new fish passage structure. The piles will be driven on land, away from open water, using an open-end (single acting) diesel impact hammer. Twenty sheet piles would be installed, each 4 feet in length, 25 feet in height, and 18 inches in depth, for a total length of 80 feet. Pile driving will occur during standard construction work hours. Driving sheet piles is estimated to take 20 hours of impact hammering to complete. Each strike of the impact hammer is estimated to push down the sheet pile 0.25 inches and that there would be three seconds between strikes. At this rate, each sheet pile would take 1,200 strikes and one hour to install to a depth of 25 feet. It would take 12,000 strikes per day to install 20 sheet piles over the course of 2 days.

The staging areas and construction limit would be cleared and grubbed. Any mature trees within the construction limit that could be preserved would be identified and construction fencing would be placed around those trees so that they will not be removed. The timing of construction would coincide with the dry season, therefore dewatering at this location is not anticipated. If the construction limit includes ponded water, the deep pond would be pumped down to an elevation below 17 feet to allow nearby water to drain toward the deep pond. The lowest pond bottom elevation surveyed was negative 5.5 feet, so dewatering to below 17 feet would leave more than 20 feet of depth for fish. This action would not require a fish rescue. If dewatering near the Fremont Weir is required, then water would be diverted south toward the existing scour channel that drains to the Tule Pond. Reclamation or DWR staff will collect any fish stranded in these channels.

Approximately 975 cubic yards of material would be excavated during the construction of the fish passage structure, of which 116 cubic yards would be reused as fill material at that location. The remaining spoil material would be removed and transported to either a privately-owned, existing agricultural field in the Elkhorn Area (referred to as Elkhorn Area) or to an established spoil site on the western portion of the Fremont Weir Wildlife Area (referred to as

Mt. Meixner). The levee roads used for construction access would be repaired to pre-project conditions, if affected by project construction. Reclamation, DWR, and the construction contractor would document conditions of levee roads prior to the start of construction.

#### 1.3.1.2. Fremont Weir Stilling Basin Modification

The portion of the Fremont Weir stilling basin in line with the fish passage structure would be lowered to an invert elevation of 22 feet, with a 15-foot bottom width and 3:1 side slopes that tie into the existing bottom of the stilling basin. The modified section of the stilling basin would serve as the transition from the fish passage structure to Reach 1. The modified area would become the deepest portion of the stilling basin. As the deepest point, it would be likely to attract fish as the stilling basin drains. This configuration is predicted to further reduce stranding in the stilling basin by increasing the likelihood of connecting with the Sacramento River.

An approximately 40-foot-wide portion of the Fremont Weir stilling basin in line with the location of the fish passage structure would be saw-cut, demolished, and removed. Approximately 175 cubic yards of material would be removed from the fish ladder and the Fremont Weir stilling basin. Once the concrete is removed, roughly 6 feet of dirt would be excavated to an elevation of 17 feet. This depth of excavation would allow for 2 feet of aggregate base and 3 feet of new concrete to be poured in place, bringing the 15-foot bottom width to invert elevation 22 feet, matching that of the fish passage structure. For the remainder of the trapezoidal channel at the stilling basin, the concrete would be formed with 3:1 side slopes to tie back into the existing concrete bottom of the stilling basin. Approximately 375 cubic yards of concrete would be poured for the fish passage structure, Fremont Weir stilling basin, and spread footings.

Dewatering is not anticipated, but if the channel becomes wetted, the deep pond would be pumped down to an elevation below 17 feet, to allow the area to drain into the deep pond. When construction is complete, the earthen ramps would be removed and material would be removed and transported either to the Elkhorn Area or Mt. Meixner spoil location.

#### 1.3.1.3. Upstream Channel Modification

The Upstream Channel would provide connection from the fish passage structure to the Sacramento River for salmonids and sturgeon in the bypass as flood waters recede. The Upstream Channel itself would be excavated, compacted, lined on the bottom with two feet of rounded rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$) to final grade, and lined on the side slopes with 1 foot of angular rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$; 15-inch $D_{100}$ placed on outside channel bends) for erosion protection. The resulting channel would be 400 feet long with a 10-foot-wide bottom and 3:1 side slopes. The channel would start at the Sacramento River with a final grade bottom elevation of 21 feet. It would slope upward toward the Fremont Weir and terminate at the upstream end of the fish passage structure at an elevation of 22 feet. Starting at the wing walls of the fish passage structure, the channel would transition from a 10-foot-wide bottom to a 15-foot-wide bottom to match the width of the opening of the concrete gate housing. This negative upstream slope would allow the fish passage structure to drain toward the Sacramento River at lower stages. The south bank of the Sacramento River, where the Upstream Channel meets the Sacramento River, would be lined with Class 3 riprap over an area of approximately 175 feet long by 75 feet wide down to an elevation of 17 feet. Additional material would be removed near the Fremont Weir fish ladder to expand to a 5:1 side slope for the future access of maintenance vehicles. A 50-foot portion of the Upstream Channel, located approximately 40 feet upstream of the fish passage structure and in line with an existing earthen road, would transition from a 3:1 side slope to a slope of 5:1 for 20 feet, then transition back to a 3:1 slope to allow vehicles to continue using the earthen road. The earthen road would generally be limited to use by maintenance vehicles, as the primary road crossing would be constructed over the top of the concrete box culvert.

Approximately 5,404 cubic yards of material would be excavated from this channel and transported to either the Elkhorn Area or Mt. Meixner spoil location. Along the Sacramento River, no in-water work is planned because the limit of work is anticipated to be above the 17-foot stage elevation. If the river stage were to reach a stage of 17 feet, then placement of riprap would be delayed until the river stage dropped low enough that placement would not require in-water work. Also the Upstream Channel is not expected to need dewatering. If the site is wet, then it would likely mean that the Sacramento River is too high to begin construction. Because the Sacramento River is usually below 17 feet during the identified construction window (based on water years 1996 to 2013, 73% of the time the Sacramento River stage was below 17 feet between May 1 and October 31), the approach to dewatering, if needed, would be to wait until the Sacramento River recedes enough to allow the site to dry. Construction at the Upstream Channel could be completed at any time during the work window as it is not a precursor to the construction of other project features.

#### 1.3.1.4. Reach 1 Modification

Reach 1 would be realigned and deepened to connect the fish passage structure to the deep pond south of the stilling basin. The bottom elevation at the upstream end of Reach 1 would be 22 feet to match the bottom elevation of the fish passage structure. The first 10 feet of Reach 1 would transition from a 15-foot bottom width to a 10-foot bottom width throughout the remaining length of the channel. The entire channel would have 3:1 side slopes. The alignment of Reach 1 would curve toward the east and then back toward the deep pond to lengthen the reach to 400 feet, which would achieve a desirable slope for fish passage as it connects to the deep pond at an elevation of 20 feet.

The majority of the channel would be excavated, compacted, lined on the bottom with 2 feet of rounded rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$) to final grade, and lined on the side slopes with 1 foot of angular rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$; 15-inch $D_{100}$ placed on outside channel bends) for erosion protection. Reach 1 would be excavated along a new alignment to a depth of 19 feet at its upstream end and to a depth of 17 feet at its downstream end. The finished channel would be 400 feet long and include a 10-foot bottom width with 3:1 side slopes. A 100-foot segment of Reach 1 near the deep pond would be backfilled with approved fill material and compacted to raise the elevation to the proposed final grade prior to placing 1 foot of angular rock engineered streambed material on the side slopes and lining the bottom of the channel with 2 feet of engineered streambed material.

A 50-foot portion of Reach 1, located approximately 100 feet downstream of the fish passage structure and in line with an existing earthen road, would transition from 3:1 side slopes to 5:1 side slopes for 20 feet, then transition back to 3:1 side slopes to allow vehicles to traverse the channel and continue using the earthen road. To better meet fish passage criteria, the outlet of the deep pond would be raised from the side slope of the deep pond toward the existing downstream scour channel for 55 feet at a slope of 15:1 to elevation 20.5 feet, and would transition back to existing grade at a 4:1 slope for approximately 10 feet. The raised section would be 75 feet wide. The area would be raised with approved backfill material and compacted prior to placing engineered streambed material.

Excavation of this channel would include the removal of trees and existing vegetation, but would be aligned to minimize the need for removal of mature trees. Approximately 3,605 cubic yards of material would be removed, including a portion of riprap on the downstream edge of the stilling basin. Approximately 327 cubic yards of the excavated soil would be utilized as fill in low spots along Reach 1. The remaining 3,278 cubic yards of material would be excavated from this channel and would be transported to either the Elkhorn Area or Mt. Meixner spoil location.

If the water surface elevation of the deep pond is greater than 17 feet, this area may be wetted at the beginning of the construction season. However, the water surface elevation of the deep pond is typically lower than this target elevation. If the deep pond exceeds this water surface elevation, then it would be lowered through pumping as described in the above section.

Construction for the Fremont Weir fish ladder, stilling basin, upstream channel, and Reach 1 is estimated to take 16 weeks.

#### 1.3.1.5. Agricultural Road Crossing 2 Modification

The hydraulic capacity of Agricultural Road Crossing 2 would be increased to more closely match that of the Tule Canal, by replacing the earthen road crossing and culverts with a box culvert bridge composed of six 24-foot-wide precast concrete culverts. In total, the length of the box culvert bridge would be 157 feet 3 inches. An approximate 170-foot by 20-foot area would be excavated to an elevation of 5 feet. Approximately 530 tons of aggregate base would be placed on the bottom of the excavated area to a depth of 3 feet. A crane would be used to place each of the six concrete culverts on top of the aggregate base. Each culvert would be 24-foot inside width with a 9-foot 4-inch inside height and an 18-foot total length, likely in 6-foot segments. The wall thickness would be 1 foot 10 inch at the top and bottom and 1 foot on the sides. The culverts would be placed side by side and sealed with 3 inches of slurry cement. Approximately 15 cubic yards of concrete slurry would be placed in between the individual culverts, and approximately 52 cubic yards of concrete would be poured on top of all of the culverts to a depth of 6 inches. Cast-in-place wing walls would be placed at either end of the bridge. Approximately 35 cubic yards of concrete would be poured to create concrete footings and wingwalls on the four corners of the crossing. The wing walls would be 1 foot thick, 10 feet long, and 14 feet 6 inches tall. The bridge would be traffic rated for heavy farm equipment. Both sides of the bridge would have a 6-inch-tall curb affixed with removable 3-foot-tall metal guard rails along the entire bridge length. The bridge would have a bottom chord elevation of 19 feet and a top of deck elevation of 21.5 feet. In addition, an existing 24-inch culvert upstream of the bridge that drains the adjacent western agricultural fields would be replaced with a double flashboard riser to reduce sediment loading from adjacent agricultural fields.


**Figure 5. Proposed construction limit, staging area, and project features for Agricultural Road Crossing 2 (DWR 2017).**

Thirty-five feet upstream and downstream of the Tule Canal as well as inside the bottom of the culverts would be armored with approximately 2,200 cubic yards of engineered streambed material. The Tule Canal would be lined on the bottom with 2 feet of rounded rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$) to final grade, and lined on the side slopes with 1 foot of angular rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$) for erosion protection. The inside bottom of the culverts would be lined with 2 feet of rounded rock engineered streambed material (0.08-inch $D_{20}$ to 12-inch $D_{100}$). The final grade of the engineered streambed material would be 14 feet. Within the armored portion of channel upstream of the bridge, a 12-foot wide segment of the Tule Canal banks would be graded to have a slope of 5:1 to the channel bottom to allow maintenance access.

The staging area and construction limit would be cleared and grubbed. Reclamation and DWR would determine if any of the mature trees within the construction limit could be preserved and would provide fencing around those trees. Aquatic vegetation in the channel would be removed prior to any in-channel work and would be disposed of off-site. Approximately 4,400 cubic yards of material, including from the earthen dams, would be excavated from this channel and would be transported to either the Elkhorn Area or Mt. Meixner spoil location.

Agricultural Road Crossing 2 would potentially be surrounded by water during the proposed construction window, depending on the path landowners choose to route irrigation water. Thirty days prior to the start of construction in this area, Reclamation and DWR would ask landowners to reroute water through other irrigation canals to keep the construction area dry. Removal of Agricultural Road Crossing 3 (described in Section 1.3.1.6) would improve drainage and increase the likelihood that the site would drain naturally and not require dewatering activities. If water cannot be routed away from Agricultural Road Crossing 2, then temporary earthen dams would be constructed with approximately 1,050 cubic yards of clean fill material upstream and downstream of the existing crossing. Silt fencing would be used to prevent increases in turbidity and suspended sediments downstream. The area would be drained prior to removal of the existing crossing. If needed, bypass pumping would be used to divert flow around the project area. The upstream earthen dam would be constructed for access regardless of the need to dewater.

Construction of Agricultural Road Crossing 2 is estimated to take 12 weeks.

#### 1.3.1.6. Agricultural Road Crossing 3 Removal

Agricultural Road Crossing 3 will be removed and the upstream and downstream channels adjacent to the site would be graded to create a consistent Tule Canal channel bottom profile of approximately 34.1 feet through the area.

The staging area and construction limit would be cleared and grubbed. Aquatic vegetation in the channel would be removed prior to any in-channel work and would be disposed of off-site. Approximately 1,000 cubic yards of material would be removed from Agricultural Road Crossing 3 and transported to either the Elkhorn Area or Mt. Meixner spoil location. Thirty days prior to the start of construction in this area, Reclamation and DWR would ask landowners to reroute water through other irrigation canals to keep the construction area dry. Dewatering, if needed, would consist of placing sandbags across the channel, adjacent to the toe of the crossing, to isolate the area from water in the Tule Canal.

Construction and removal at Agricultural Road Crossing 3 is estimated to take 2 weeks.


**Figure 6. Proposed construction limit, staging areas, and project features for Agricultural Road Crossing 3 (DWR 2017).**

#### 1.3.1.7. Schedule

The proposed construction activities are anticipated to take place between early-August through October 2017, which is outside of the flood season (November 1 through April 15) and when ESA-listed fish species would least likely be present. However, the construction start date is dependent on water elevations at the time and permit acquisitions. If construction at the weir does not occur in 2017, then woody vegetation will be cleared within the proposed construction footprint during the fall of 2017 to avoid potential impacts to ESA-listed and migratory birds. Construction would commence after May 1, 2018, when conditions are appropriate.

Construction will occur at each site (Upstream Channel, Fremont Weir structures, Reach 1, the deep pond, Agricultural Road Crossing 2, and Agricultural Road Crossing 3) concurrently. Construction would begin and end at each site independent of one another. The only exception would be if higher than usual water levels are present in the Tule Canal. In this instance, Agricultural Road Crossing 3 could be removed first in an attempt to expedite natural drainage at Crossing 2.

### 1.3.2. Operations and Maintenance

#### 1.3.2.1. Fremont Weir Fish Passage Structure

The fish passage structure would incorporate a bottom-hinged gate that would be operated remotely or be accessed by light duty vehicles travelling on the levee access road and then walking along the weir to the fish passage structure. The fish passage structure would operate in conjunction with any Fremont Weir overtopping event that may occur between November 1 and May 31. During the dry season when the river water surface elevation is below 22 feet, the gate would be left in the down position to reduce the risk of vandalism.

The maximum flow through the fish passage structure would be limited to approximately 1,100 cfs when the Sacramento River reaches an elevation of 31.8 feet, the point at which the Fremont Weir begins to overtop. This flow limit would minimize impacts on existing land uses in the Yolo Bypass and avoid impacts on water diverters along the Sacramento River. Hydraulic modeling has shown that 1,100 cfs is the maximum flow that can be conveyed while keeping the flows confined within the banks of the Tule Canal (DWR 2016c).

The gated structure would be opened following a Fremont Weir overtopping event once the Sacramento River reaches a stage of 32.3 feet, at the location of the new structure. This stage would allow for a flow depth of 0.5 foot over the weir and the resulting flow into the Yolo Bypass would reduce scour velocities through the fish passage structure because of the higher tailwater conditions downstream. Once it is opened, Reclamation will implement one of two scenarios to operate the fish passage structure:

- Scenario 1: The fish passage structure remains open for three days after the Fremont Weir stops overtopping.

- Scenario 2: The fish passage structure remains open for one day after the Fremont Weir stops overtopping, reopens when the river stage falls below 27 feet, and closes when the river stage reaches 24 feet for no longer than five days.

Initially, Scenario 1 would be operated and evaluated for performance. If fish are stranded in the vicinity of the project area following overtopping events, Scenario 2 would be operated for future overtopping events and would undergo evaluation for stranded fish. The scenario that tends to perform the best would continue to be used.

If an overtopping event is brief or minor, fish would be unlikely to access the project location. Operating the fish passage structure during smaller events may add risk to migratory fish because of the lower Sacramento River stages associated with minor overtopping events. CDFW, NMFS, Reclamation, and DWR would work together to determine the relative risk to migratory fish and decide if the structure should be opened during each overtopping event.

The fish passage structure would be closed, as necessary, for maintenance and repairs. Stop logs would be added to the concrete gate housing to enable maintenance of the bottom-hinged gate. The fish passage structure would be monitored regularly during operation. After each gate operating cycle when the river stage recedes below the channel invert, the gate would be inspected and cleared of debris. Potential maintenance equipment could consist of an excavator, loader, dozer, and dump truck, dependent upon the type of maintenance that needs to be performed.

Outside of the flood season, routine maintenance would be performed at the fish passage structure. Maintenance of the gate would include washing the steel components to reduce corrosion, applying erosion coating, inspecting the air bladder and repairing leaks or tears, inspecting air compressor components, and torqueing main anchor bolts once in the spring and once in the fall, or as needed. Maintenance of the raised equipment platform would include cleaning exterior and interior equipment and cabinets of dust and debris, checking tightness of screws and bolts and tightening as needed, and inspecting and replacing batteries, solar panels, and the inverter. The concrete at the fish passage structure would be cleared of debris and sediment and inspected and repaired for cracking, scaling or spalling. The sheet piles would be inspected and repaired for misalignment to insure no interlock separation, holes, cracks, or dents. Potential maintenance equipment could consist of an excavator, loader, dozer, dump truck, crane, and mower, dependent upon the type of maintenance that needs to be performed.

#### 1.3.2.2. Fremont Weir Stilling Basin

The location of the fish passage structure would become the deepest portion of the Fremont Weir stilling basin. As such, it would likely accumulate a small amount of sediment, less than 10 cubic yards, following a Fremont Weir overtopping event. The accumulated sediment would be removed after the flood season (April 16 through October 31), when operation of the fish passage structure would not be necessary until the next overtopping event and when there is no hydrologic connection to the Sacramento River. Potential maintenance equipment could consist of an excavator, loader, dozer, and dump truck, dependent upon the type of maintenance that needs to be performed.

#### 1.3.2.3. Upstream Channel

The Upstream Channel configuration would be maintained outside of the flood season by mowing vegetation, preventing trees from growing through the project channel, and removing sediment to preserve performance. Sediment deposition is anticipated to occur following overtopping events, and up to 520 cubic yards of sediment may be removed annually. This sediment would be placed in low points created by scour within Reach 1 or disposed of at the Yolo County Central Landfill. The channel would also be inspected each year for areas of potential scour in the engineered streambed material. Additional engineered streambed material would be placed, as needed. Lastly, any large debris would be removed from the channel. Potential maintenance equipment could consist of a mower, excavator, dozer, loader, dump truck, and hand tools such as chainsaws or weed whackers.

#### 1.3.2.4. Reach 1

The Reach 1 configuration would be maintained outside of the flood season by preventing large trees from growing through the project channel and removing sediment to preserve performance. As much as 520 cubic yards of sediment may be removed annually. This sediment would be placed in low points created by scour within Reach 1 or disposed of at the Yolo County Central Landfill. The channel would also be inspected each year for areas of potential scour in the engineered streambed material. Additional streambed material would be placed, as needed. Lastly, any large debris would be removed from the channel. Potential maintenance equipment could consist of a mower, excavator, dozer, loader, dump truck, and hand tools such as chainsaws or weed whackers.

#### 1.3.2.5. Agricultural Road Crossing 2

Because the hydraulic capacity of Agricultural Road Crossing 2 would be increased to more closely match that of the Tule Canal, maintenance is expected to be low. After Fremont Weir 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. If the engineered streambed material near the site begins to erode, the material would be replaced. Potential maintenance equipment could consist of an excavator, loader, dozer, and dump truck, dependent upon the type of maintenance that needs to be performed.

### 1.3.3. Monitoring and Adaptive Management

Following construction of the FWAFPM Project, Reclamation and DWR plan to monitor and evaluate fish passage success at Fremont Weir. Reclamation and DWR anticipate using an annual adaptive management framework for assessing the performance of the fish passage structure and stranding reduction measures. Using an adaptive management strategy will allow for iterative feedback and accelerate learning regarding what actions are necessary for a successful operational plan. Each activity anticipated as part of the Post-Construction Monitoring, Evaluation, and Adaptive Management Plan will be developed during the spring and summer as a Study Plan, presented to the Yolo Bypass Fisheries and Engineering Technical

Team (FETT) for consideration, along with a recommendation by Reclamation and DWR. Results from the Study Plan will be generated, presented to the FETT, and summarized in an annual technical memorandum. The technical memorandum will provide an aggregation of information and provide recommendations for the next water year's adaptively managed Operational Plan. The FETT will decide on the Operational Plan.

#### 1.3.3.1. Sonar-Imaging Observation

An ARIS camera will be installed in the fish passage structure at the Fremont Weir. This device uses sound waves to generate a high-resolution image in turbid, low-light, environments. The ARIS camera will provide video that will allow for direct observation of fish behavior at the structure. These videos will be reviewed to qualitatively compare fish passage performance in the structure at various stages. This review will allow the determination of river stages that are critical for operation of the fish passage structure. Footage will be continuously recorded during operation of the fish passage structure, except for periods of maintenance.

#### 1.3.3.2. Telemetry

There are currently two separate telemetry studies ongoing in the Yolo Bypass utilizing a shared receiver array of 14 telemetry receivers monitored by DWR and University of California, Davis (UCD) staff[1]. While these telemetry studies are not part of the FWAFPM Project because they are permitted through the ESA Section 10(a)(1)(A) process, the data from these studies will help inform the success of the FWAFPM Project.

The first study investigates residence and movement patterns of adult fall-run Chinook salmon in the Yolo Bypass. The study began in 2015 and will continue through 2017. This study stemmed from a previous telemetry study conducted in the Yolo Bypass by UCD from 2012 through 2014, where both adult Chinook salmon and adult white sturgeon were tagged. The second telemetry study, planned for 2017, examines how adult white sturgeons behave in the Yolo Bypass. Like the salmon study, sturgeon will be tagged and their residency and movement patterns will be monitored. An additional receiver has been placed in the deep pond located downstream of Reach 1 because it is believed that sturgeon may hold in the deeper water.

Fish are collected either from a DWR fyke trap in the Toe Drain of the Yolo Bypass or via gill netting. Chinook salmon receive external acoustic tags capable of transmitting through the migration season, while White Sturgeon receiver larger, surgically implanted tags capable of transmitting for up to 10 years. Effects analyses of these telemetry studies have been included in their respective permit applications prior to receiving approval from the appropriate resource agency.

[1] The sites from north to south include: Wallace Weir, Knagg's Ranch, Road 22, Above Agricultural Road Crossing #4, Below Agricultural Road Crossing #4, I-80 Bridge, Above Lisbon Weir, Below Lisbon Weir, Rotary Screw Trap, Base of Toe Drain, and an array of 4 receivers at the Cache Slough Confluence.

The fall-run Chinook salmon telemetry study is permitted through 2017, and the white sturgeon telemetry study is permitted through 2019. Upon completion of each study, Reclamation and DWR will seek updated permits to continue the study through 2022 and annual proposals will be developed and reviewed through the FETT. DWR and Reclamation will add an additional receiver immediately upstream of the fish passage structure in the Sacramento River at the interface of the upstream channel in an effort to monitor how fish behave at each structure. The additional receiver will be covered under the telemetry study permit.

Combining the data received by the receiver in the deep pond (downstream of structure) with the receiver in the Sacramento River (upstream of structure) would detail the movement of tagged fish as they navigate through the Fremont Weir fish passage structure. These receivers would provide information on residence time in the stretch from the deep pool to the river, and assist crews in determining whether or not a passage delay or barrier may exist in the structure. Any future modifications would be proposed in a separate consultation and permitting process. Coupling this fish movement data with the Sacramento River stage at Fremont Weir would provide further insight as to how fish behave during overtopping events, particularly by illustrating stages where fish passage begins to be compromised.

#### 1.3.3.3. Hydraulic Monitoring

Following an overtopping event, DWR field crews will access the Fremont Weir fish passage structure by boat and deploy a portable Doppler-type flow meter (PDFM) and measure water stage in the structure. Stage-flow rating curve will be developed with these datasets. This rating curve will be used to estimate average velocity in the structure to verify predicted values for depth and velocity.

#### 1.3.3.4. Fish Rescue and Stranding Reduction

Under an existing ESA Section 10(a)(1)(A) research permit, CDFW conducts fish rescue surveys on the Yolo Bypass and returns the fish to the Sacramento River (permit # 18181-3A). These efforts will continue near the Fremont Weir after an over topping event occurs and the fish passage structure has been closed again. These surveys will assess where adult fish are being stranded by the operational plan.

#### 1.3.3.5. Adaptive Management

The ability to adaptively manage gate operations at the fish passage structure would be the principal management tool available. Initially, the gated structure would be opened automatically following a Fremont Weir overtopping event once the Sacramento River reaches a stage of 32.3 feet, at the location of the fish passage structure. This stage would allow for a flow depth of 0.5 foot over the weir and the resulting flow into the Yolo Bypass would reduce scour velocities through the fish passage structure because of the higher tailwater conditions downstream.

If an overtopping event is brief or minor, fish would be unlikely to access the project location. Operating the fish passage structure during smaller events may add risk to migratory fish because of the lower Sacramento River stages associated with minor overtopping events. CDFW, NMFS, DWR, and Reclamation would work together to determine the relative risk to migratory fish and annually decide on an operational plan for the fish passage structure. This annual plan will describe which operational scenario will be used and how long the fish passage structure should be opened during different overtopping events.

If stranded fish are regularly observed in the vicinity of the fish passage structure, Upstream Channel, or Reach 1, as direct result of project implementation and the operational plan, these stranding locations will be remedied through earthwork to the extent feasible as needed in accordance with conservation measure 1.3.4.9. Modifications would be proposed in a separate consultation and permitting process.

Long-term operations and maintenance will be adapted to conform to future conditions following implementation of the upcoming Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Section 1.4).

### 1.3.4. Conservation Measures

#### 1.3.4.1. Conduct mandatory environmental awareness training for all construction personnel

Prior to the start of construction activities, all construction personnel will participate in mandatory worker environmental awareness training conducted by a qualified biologist. Construction personnel will be informed about the identification, potential presence, life history, habitat requirements, legal protections, avoidance and minimization measures, and applicable conservation measures for all ESA-listed species identified in this document. Construction personnel will be informed of the procedures to follow should an ESA-listed species be encountered within the action area during construction.

#### 1.3.4.2. Implement general wildlife protection measures during construction

Reclamation, DWR, and the construction contractor will implement general wildlife protection measures during construction that will include, but may not be limited to, the following:

- Confine clearing to the minimal area necessary to facilitate construction activities.
- Clearly delineate the action area limits by using fencing, flagging, or other means prior to the start of construction activities.
- Avoid wildlife entrapment by completely covering, or providing escape ramps for, all excavated steep-walled holes or trenches more than 1 foot deep at the end of each work day.
- Inspect the work area and any equipment or material left on-site overnight for ESA-listed species prior to the start of construction activities each day.
- Observe posted speed limit signs on local roads and observe a 15-mile-per-hour speed limit along ingress/egress routes.
- Dispose of garbage in wildlife-proof containers and remove the garbage from the construction area regularly during the construction period.

- Retain a qualified biological monitor to be present or on call during construction activities with the potential to affect ESA-listed species. The biological monitor will be on-site during initial ground disturbing activities. The biological monitor will ensure that any construction barrier fencing is maintained. The biological monitor will have the authority to stop work if an ESA-listed species is encountered within the action area during construction, and the appropriate regulatory agency will be notified. Construction activities will cease until it is determined that the species will not be harmed or that it has left the construction area on its own.

#### 1.3.4.3. Prepare and implement a spill prevention, control, and counter-measure plan

Reclamation, DWR, or the construction contractor will develop and implement a spill prevention, control, and countermeasure plan (SPCCP) to minimize the potential for, and effects from, spills of hazardous, toxic, and petroleum substances during construction and operation activities, as well as minimize the effects of unearthing previously undocumented hazardous materials. The SPCCP will be completed before construction activities begin. Implementation of the SPCCP will comply with State and federal water quality regulations. The SPCCP will describe spill sources and spill pathways in addition to the actions that will be taken in the event of a spill (*e.g.*, an oil spill from engine refueling will be cleaned up immediately with oil absorbents) or the exposure of an undocumented hazard. The SPCCP will outline descriptions of containment facilities and practices, such as double-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures, and spill response kits. It will also describe how and when employees are trained in proper handling procedures, as well as spill prevention and response procedures.

Reclamation and DWR will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. Reclamation and DWR will require compliance and will notify the construction contractor immediately if there is a non-compliance issue.

If a spill occurs, the construction contractor's superintendent will notify Reclamation and DWR, and Reclamation and DWR will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. A written description of reportable releases will be submitted to the Central Valley Regional Water Board and the California Department of Toxic Substances Control. This submittal will contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.

#### 1.3.4.4. Implement a stormwater pollution and prevention plan

The National Pollutant Discharge Elimination System Program (NPDES) requires projects that would result in ground disturbance of greater than 1 acre to obtain a general construction activity stormwater permit. The NPDES general construction activity stormwater permit generally requires the project applicant to prepare a stormwater pollution prevention plan (SWPPP) that describes the best management practices (BMPs) that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared by the construction contractor prior to initiating construction activities. Specific BMPs that will be incorporated into the SWPPP will be site-specific and will be prepared in accordance with the regional water board field manual. The SWPPP will include, but not be limited to, the following standard erosion and sediment control BMPs:

- **Timing of construction**. All construction activities will occur from May 1 through October 31 to avoid ground disturbance in the rainy season and when ESA-listed fish species are least likely to be present in the action area.
- **Stabilize grading spoils**. Grading spoils generated during construction may be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If a significant rain event is expected during construction, which is unlikely give the construction work window, temporary stockpiles will be covered with a geotextile material to increase protection from wind and water erosion.
- **Permanent site stabilization**. The construction contractor will install structural or vegetative methods to permanently stabilize all graded or disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls or erosion control blankets. Vegetative methods may include the application of organic mulch and tackifiers, and/or an erosion control native seed mix.
- **Staging of construction equipment and materials**. Equipment and materials will be staged in designated staging areas.
- **Minimize soil and vegetation disturbance**. The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished, in part, through establishing designated equipment staging areas, ingress and egress corridors, equipment exclusion zones prior to the commencement of any grading operations, and protection of existing trees.
- **Install sediment barriers**. The construction contractor will install silt fences, fiber rolls, or similar devices to prevent sediment-laden water from leaving the construction area.

#### 1.3.4.5. All in-water construction work will be preceded by a dewatering/fish rescue effort

Reclamation and DWR will submit a dewatering and fish rescue plan to NMFS and CDFW for approval prior to construction. NMFS- and CDFW-approved fish biologists will conduct fish rescues in isolated pools and channels within the project area prior to pumping operations. At the agricultural road crossings, earthen dams may need to be installed to dewater the area. Fish relocation at these sites will be done downstream of the agricultural road crossings within suitable habitat in the Tule Canal. If dewatering is needed at the Fremont Weir, native fish species will be transported approximately 400 feet away to the Sacramento River and nonnative fish species will be transported to the deep pond. Fish will be collected using a fine-mesh beach seine to reduce the risk of gills becoming entangled in the beach seine. Small fish will be held temporary in aerated coolers with clean, locally-sourced water. Efforts will be made to keep densities low enough to reduce stress and to maintain suitable dissolved oxygen (DO) levels and water quality in the cooler. Fish will be shuttled to the nearest suitable habitat and released using water-to-water transfers. Large fish will be moved immediately after collection and transferred to suitable habitat via fish cradles.

After efforts have been made to remove as many fish as possible, pumps fitted with NMFS-approved fish screens will be used to further dewater the site (NMFS 2011a). The field crew will continue to monitor for and rescue fish as the water levels decrease, and relocate fish to suitable habitat. In the event that groundwater infiltration continues to occur following a fish rescue and dewatering effort, pumps will remain operational to keep the project area dry. All ESA-listed fish species observed will be logged into a project database and reported to NMFS and CDFW.

#### 1.3.4.6. Develop turbidity monitoring program for construction activities

The Basin Plan for the Sacramento River and San Joaquin River basins (Fourth Edition) (Central Valley Regional Water Quality Control Board 2011) contains turbidity objectives. Specifically, the Basin Plan states that where natural turbidity is less than 1 Nephelometric Turbidity Unit (NTU), controllable factors will not cause downstream turbidity to exceed 2 NTUs; where natural turbidity is between 1 and 5 NTUs, increases will not exceed 1 NTU; where natural turbidity is between 5 and 50 NTUs, turbidity levels may not be elevated by 20 percent above ambient conditions; where ambient conditions are between 50 and 100 NTUs, conditions may not be increased by more than 10 NTUs; and where natural turbidity is greater than 100 NTUs, increases will not exceed 10 percent.

When water is flowing through the project area, Reclamation, DWR, or the construction contractor will monitor turbidity approximately 500 feet downstream of construction activities to determine whether turbidity is being affected by construction. Grab samples will be collected at a downstream location that is representative of the flow near the construction site. If there is a visible sediment plume being created from construction, the sample will represent this plume. A sampling plan will be developed and implemented based on specific site conditions and in consultation with the Central Valley Regional Water Quality Control Board.

Silt fencing and turbidity curtains would be implemented where necessary. If turbidity limits exceed Basin Plan standards, construction-related earth-disturbing activities will slow to a point that would alleviate the problem. Reclamation and DWR will notify the Central Valley Regional Water Quality Control Board of the issue immediately and provide an explanation of the cause.

#### 1.3.4.7. No construction will be done during a Fremont Weir overtopping event

Though unlikely to occur during the May 1 through October 31 work window, work will be suspended in the event that a Fremont Weir overtopping is forecasted to occur during the work window, to reduce the likelihood of encountering ESA-listed fish species that may be drawn into the Yolo Bypass during an overtopping event. Based on water years 1996 to 2013, the probability of the Sacramento River exceeding the crest of Fremont Weir in May and June is 2.8% and 1.5%, respectively. The probability of the Sacramento River exceeding the crest of Fremont Weir from July through October is 0%.

#### 1.3.4.8. Implement protective measures for work during non-daylight hours near ESA-listed fish habitat

If project activities must occur during non-daylight hours, a qualified biologist will establish monitoring measures, including frequency and duration, based on species, individual behavior, and type of construction activities. Juvenile salmonids are particularly active during low-light periods, when they migrate or move into shallow water to forage. Construction-related activities may impede their ability to forage during these times. When night work cannot be avoided, night lighting will be used only within the portion of the project actively being worked on (limited to a minimum distance of 200 feet from ESA-listed fish species habitat), and focused directly on the work area. Lights on work areas will be shielded and focused to minimize lighting of ESA-listed fish species habitat. If the work area is located near surface waters, the lighting will be shielded such that it does not shine directly into the water. If ESA-listed fish species are showing signs of distress or are attracted to the lighted areas, work activities will be modified to prevent ESA-listed fish species from altering their migration or feeding behavior. At any time, the biologist will have the authority to halt work if there are any signs of distress or disturbance that may lead to delayed migrations or increased predation. Work will not resume until corrective measures have been taken or it is determined that continued activity would not negatively affect ESA-listed fish species.

#### 1.3.4.9. Compensate for permanent loss of shaded riverine aquatic habitat

The permanent loss of riparian habitat, which may contribute shaded riverine aquatic habitat, will be compensated for by purchasing credits at a NMFS-approved conservation or mitigation bank at a 3:1 ratio. Since the project design allows some riparian trees to be avoided, a portion of the impacts will be mitigated before construction begins and the remainder will be mitigated after full impacts are known.

### 1.4. Interrelated or 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). There are no interdependent or interrelated activities associated with the proposed action.

## 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.

## 2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and/or 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 biological 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 essential to the conservation of a species or that preclude or significantly delay development of such features” (81 FR 7214).

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

NMFS uses 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 likely 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 to assess the risk that the proposed action poses to species and critical habitat.
- Reach jeopardy and adverse modification conclusions.
- If necessary, define a reasonable and prudent alternative to the proposed action.

## 2.2. Rangewide Status of Listed Species and Critical Habitat

This biological 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 biological opinion also examines the condition of critical habitat throughout the designated area, evaluates the current conditions 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 determine the value of the habitat for the conservation of the species.

The descriptions of the status of species and conditions of the designated critical habitats in this biological opinion are a synopsis of the detailed information available on NMFS' West Coast Region website. The following federally listed species evolutionarily significant units (ESUs) or distinct population segments (DPSs) and designated critical habitat occur in the action area and may be affected by the proposed action.

**Sacramento River winter-run Chinook salmon ESU** (*Oncorhynchus tshawytscha*)
Listed as endangered (70 FR 37160, June 28, 2005)
Action area for the project is not within designated critical habitat

http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/chinook/sacramento_river_winter_run/sacramento_river_winter_run_chinook.html

**CV spring-run Chinook salmon ESU** (*O. tshawytscha*)
Listed as threatened (70 FR 37160, June 28, 2005)
Critical habitat designated on September 2, 2005 (70 FR 52488)

http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/chinook/central_valley_spring_run/central_valley_spring_run_chinook.html

**CCV steelhead DPS** (*O. mykiss*)
Listed as threatened (71 FR 834, January 5, 2006)
Critical habitat designated on September 2, 2005 (70 FR 52488)

http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/steelhead/california_central_valley/california_central_valley_steelhead.html

**Southern DPS of North American green sturgeon** (*Acipenser medirostris*)
Listed as threatened (71 FR 17757, April 7, 2006)
Critical habitat designated on October 9, 2009 (74 FR 52300)

http://www.westcoast.fisheries.noaa.gov/protected_species/green_sturgeon/green_sturgeon_pg.html

### 2.2.1. Sacramento River Winter-run Chinook Salmon

- First listed as threatened (August 4, 1989, 54 FR 32085).
- Reclassified as endangered (January 4, 1994, 59 FR 440), reaffirmed as endangered (June 28, 2005, 70 FR 37160).

The Sacramento River winter-run Chinook salmon ESU is represented by a single naturally-spawning population in the Sacramento River. It has been displaced from nearly all of its historical spawning and rearing habitat in the upper Sacramento River (upstream Shasta Dam), McCloud River, Pitt River, and Battle Creek with the construction of Shasta Dam in 1943 blocking access to all of these water except Battle Cree, which has its own impediments to upstream migration. The remaining spawning and rearing areas are completely dependent on cold water releases from Shasta Dam in order to sustain the remnant population. In addition, an artificial propagation program at the Livingston Stone National Fish Hatchery (LSNFH) produces winter-run that are considered to be part of this ESU (June 28, 2005, 70 FR 37160).

Adult winter-run Chinook salmon first enter San Francisco Bay from November through June and migrate up the Sacramento River past the Red Bluff Diversion Dam, with peak passage occurring in mid-March (Hallock and Fisher 1985). They are sexually immature when upstream migration begins and must hold for several months in suitable habitat prior to spawning (Healey 1991). Females deposit their eggs into redds, gravel nests, where they are fertilized by male salmon and subsequently buried by the female. Spawning occurs in the mainstem Sacramento River between Keswick Dam [River Mile (RM) 302] and the Red Bluff Diversion Dam (RBDD) (RM 243), though the majority of spawning occurs within the first 10 miles below Keswick Dam (CDFW unpublished data). Spawning occurs between late-April and mid-August, with the peak in July (Vogel and Marine 1991). Eggs incubate for 40-60 days and embryos develop and hatch into alevins, a larval stage reliant on yolk for nutrition, and remain in redds until the yolk is completely consumed for an additional 30-40 days. Alevins then emerge from redds as fry and start exogenous feeding (Fisher 1994).

Fry emergence typically begins in July and continues through October. Emigration of juvenile winter-run Chinook salmon is highly variable between years and even between downstream migrant groups during a single year. Fry rear in the upper Sacramento River with emigration past RBDD primarily occurring as early as mid-July, with peak abundance occurring at the end of September and extending to November; although emigration can continue through March in dry years (Poytress *et al.* 2014). Juveniles migrate into the Delta as early as September and exit the Delta at Chipps Island as late as May. Typically, the bulk of emigrants arrive in the Delta (Knights Landing) in December and leave the Delta (Chipps Island) in March (del Rosario *et al.* 2013). The Delta serves as an important rearing and transition zone for juvenile winter-run as they feed and physiologically adapt to marine waters during the smoltification process (change from freshwater to saltwater).

Winter-run smolts enter the Pacific Ocean mainly in spring (March–April), staying near the California coast and distribute from Point Arena southward to Monterey Bay. Winter-run have high metabolic rates, feed heavily, and grow fast; doubling their length and increasing their weight more than ten-fold in the first summer at sea (Quinn 2005). Winter-run spend approximately 1-2 years rearing in the ocean before returning to the Sacramento River as 2-3 year old adults.

Historically, Sacramento River winter-run Chinook salmon (winter-run) population estimates were as high as 120,000 fish in the 1960s, but declined to less than 200 fish by the 1990s. When carcass surveys began in 2001, the highest adult escapement occurred in 2006 with 17,296 fish. However since then, the population has shown a precipitous decline with a low of 827 adults in 2011 (CDFW 2016a). Escapement in 2011 represents the lowest run since the construction and operation of the LSNFH conservation hatchery in 1997. According to the last viability assessment from 2016, the total population size of 11,770, estimated as the sum of the estimated run sizes for 2012-2014, and mean population size of 3,923, the average of the estimated run size for 2012-2014, satisfies the low risk criterion of census population size greater than 2,500 (Johnson and Lindley 2016).

The population growth 10-year trend is negative (-0.15), suggesting a 15% per year decline in the population, indicating that the population has been steadily declining rather than increasing over the past decade. The maximum year-to-year decline in population size reached 67%, an increase from 38% in the previous 2010 viability assessment (Williams *et al*. 2011, Johnson and Lindley 2016). The recent declining trend is likely due to a combination of factors such as poor ocean productivity, drought conditions, and low in-river survival rates (NMFS 2016c). However, the percent decline does not exceed the catastrophic decline criteria (>90% decline in one generation or annual run size < 500 spawners; Lindley *et al*. 2007).

The observed levels of hatchery influence exceed the low-extinction risk criteria that was met in the previous viability assessment and place the genetic integrity of the population at a moderate risk of extinction (Lindley *et al*. 2007). Consistent with guidelines from the Hatchery Scientific Review Group (HSRG) for conservation hatcheries, the proportion of LSNFH-origin spawners in the river was from 5% to 10% prior to 2005 (HSRG 2012). However, the hatchery proportion has increased since 2005 and reached approximately 20% in 2005, 2014, and >30% in 2012. The average over the last 12 years (approximately four generations) is 13% (SD= ±8%) with the most recent generation at 20% hatchery influence, placing the population at a moderate risk of extinction for hatchery influence.

The greatest risk factor for winter-run lies within its spatial structure (NMFS 2016c). The winter-run ESU comprises only one population that spawns below Keswick Dam. The remnant and remaining population cannot access 95 percent of their historical spawning habitat and must therefore be artificially maintained in the Sacramento River by spawning gravel augmentation, hatchery supplementation, and regulation of the finite cold-water pool behind Shasta Dam to reduce water temperatures. Winter-run require cold water temperatures in the summer that simulate their upper basin habitat and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek is currently the most feasible opportunity for the ESU to expand its spatial structure but restoration is not scheduled to be completed until 2020. The Central Valley Salmon and Steelhead Recovery Plan includes criteria for recovering the winter-run Chinook salmon ESU, including re-establishing a population into historical habitats upstream of Shasta Dam (NMFS 2014).

Winter-run Chinook salmon embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, so this run is particularly at risk from climate warming. The only remaining population of winter-run Chinook salmon relies on the cold water pool in Shasta Reservoir, which buffers the effects of warm temperatures in most years. The exception occurs during drought years, which are predicted to occur more often with climate change (Yates *et al.* 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Beechie *et al.* 2013, Dimacali 2013). These factors will compromise the quantity and/or quality of winter-run Chinook salmon habitat available downstream of Keswick Dam. It is imperative for additional populations of winter-run Chinook salmon to be re-established into historical habitat in Battle Creek and above Shasta Dam for long-term viability of the ESU (NMFS 2014).

In summary, the extinction risk for the winter-run ESU has increased over the last 5 years, and several listing factors have contributed to the recent decline, including drought, poor ocean conditions and hatchery influence (NMFS 2016c). Large-scale fish passage and habitat restoration actions are necessary for improving the winter-run ESU viability (NMFS 2016c).

### 2.2.2. Central Valley Spring-run Chinook salmon

- Listed as threatened (September 16, 1999, 64 FR 50394), reaffirmed (June 28, 2005, 70 FR 37160).
- Designated critical habitat (September 2, 2005, 70 FR 52488)

Historically, spring-run Chinook salmon were the second most abundant salmon run in the Central Valley and one of the largest on the west coast (CDFG 1990). These fish occupied the middle and upper elevation reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults. The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The San Joaquin River historically supported a large run of spring-run Chinook salmon, suggested to be one of the largest runs of any Chinook salmon on the West Coast with estimates averaging 200,000-500,000 adults returning annually (CDFG 1990).

Of the historic 18 or 19 historic independent populations all within four distinct geographic regions, only three independent populations currently exist (Mill, Deer, and Butte creeks tributary to the upper Sacramento River) and they represent only the northern Sierra Nevada diversity group (Lindley *et al.* 2004). Additionally, smaller populations are currently persisting in Antelope and Big Chico creeks, and the Feather and Yuba rivers in the northern Sierra Nevada diversity group (CDFG 1998). In the San Joaquin River basin, observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014).

Adult CV spring-run Chinook salmon leave the ocean to begin their upstream migration in late January and early February and enter the Sacramento River between March and September, primarily in May and June (CDFG 1998, Yoshiyama *et al.* 1998, Lindley *et al.* 2004). Spring-run

Chinook salmon generally enter rivers as sexually immature fish and must hold in freshwater for up to several months before spawning (Moyle 2002). While maturing, adults hold in deep pools with cold water. Spawning normally occurs between mid-August and early October, peaking in September (Moyle 2002).

Eggs incubate for 40-60 days and embryos develop and hatch into alevins, a larval stage reliant on yolk for nutrition, and remain in redds until the yolk is completely consumed for an additional 30-40 days before emerging as fry. In Butte and Big Chico creeks, fry emergence occurs from November through January, and in the colder waters of Mill and Deer creeks, emergence typically occurs from January through March (Moyle 2002). The majority of juveniles migrate to the ocean as young-of-the-year in the winter or spring months within eight months of hatching, but some juveniles may reside in freshwater for 12 to 16 months and migrate as yearlings. Mill and Deer creek juveniles typically exhibit a later young-of-the-year migration and an earlier yearling migration than Butte Creek juveniles (Lindley *et al.* 200)4. By contrast, data collected on the Feather River suggests that the bulk of juvenile emigration occurs during November and December (Seesholtz *et al.* 2003).

Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU. Generally, these streams have shown a positive escapement trend since 1991, displaying broad fluctuations in adult abundance. The Feather River Fish Hatchery (FRFH) spring-run Chinook salmon population represents an evolutionary legacy of populations that once spawned above Oroville Dam. The FRFH population is included in the ESU based on its genetic linkage to the natural spawning population, and the potential for development of a conservation strategy (June 28, 2005, 70 FR 37160). Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates some spawning occurs in the river. Genetic introgression has likely occurred here due to lack of physical separation between spring-run and fall-run Chinook salmon populations (CDFG 1998).

Because the populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, these watersheds are used to evaluate risk of extinction based on viable salmonid population (VSP) parameters. Over the long term, these three remaining populations are considered to be vulnerable to both anthropomorphic and naturally occurring catastrophic events. The viability assessment of CV spring-run Chinook salmon conducted during NMFS' 2010 status review found that the biological status of the ESU had worsened since the 2005 status review and recommended that the species status be reassessed in two to three years as opposed to waiting another 5 years, if the decreasing trend continued (Good *et al*. 2005, NMFS 2011b). In 2012 and 2013, most tributary populations increased in returning adults, averaging over 13,000. However, 2014 returns were lower again, just over 5,000 fish, indicating the ESU remains highly fluctuating. The most recent status review was conducted in 2015, which looked at promising increasing populations in 2012-2014; however, the 2015 returning fish were extremely low (1,488), with additional pre-spawn mortality reaching record lows (NMFS 2016b). Since the effects of the 2012-2016 drought have not been fully realized, NMFS anticipates at least several more years of very low returns, which may result in severe rates of decline (NMFS 2016b).

Spring-run Chinook salmon adults are particularly vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson *et al*. 2012). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in the natal stream for one to two summers prior to emigrating, and would be susceptible to warming water temperatures. In Butte Creek, fish are limited to low elevation habitat that is currently thermally marginal, as demonstrated by high summer mortality of adults in 2002 and 2003, and will become intolerable within decades if the climate warms as expected. Ceasing water diversion for power production from the summer holding reach in Butte Creek resulted in cooler water temperatures, more adults surviving to spawn, and extended population survival time (Mosser *et al*. 2013).

In summary, the CV spring-run Chinook salmon ESU is likely to become endangered within the foreseeable future throughout all or significant portion of its range (NMFS 2016b). Based on the severity of the drought and the low escapements as well as increased pre-spawn mortality in Butte, Mill, and Deer creeks in 2015, there is concern that these CV spring-run Chinook salmon strongholds will deteriorate into high extinction risk in the coming years based on the population size or rate of decline criteria (NMFS 2016b).

### 2.2.3. Central Valley Spring-run Chinook Salmon Critical Habitat and Physical or Biological Features

The critical habitat designation for CV spring-run Chinook salmon (June 28, 2005, 70 FR 37160) lists the PBFs, which include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine habitat. The geographical range of designated critical habitat includes stream reaches of the Feather, Yuba, and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, and the Sacramento River, as well as portions of the northern Delta (June 28, 2005, 70 FR 37160).

Currently, many of the PBFs of CV spring-run Chinook salmon critical habitat are degraded, and provide limited high quality habitat. Features that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, scarcity of complex in-river cover, and the lack of floodplain habitat. Although the current conditions of CV spring-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species. In the future, climate change impacts are likely to exacerbate human caused reductions in the value of critical habitat for the conservation of the species.

### 2.2.4. California Central Valley steelhead

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

Prior to dam construction, water development, and watershed perturbations, CCV steelhead were distributed throughout the Sacramento and San Joaquin rivers (McEwan 2001). Steelhead were found from the upper Sacramento and Pit rivers (now inaccessible due to Shasta and Keswick dams) south to the Kings and possibly the Kern River systems, and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1998). Lindley *et al.* (2006) estimated that historically there were at least 81 independent CCV steelhead populations distributed primarily throughout the eastern tributaries of the Sacramento and San Joaquin rivers. Presently, impassable dams block access to 80 percent of historically available habitat, and block access to all historical spawning habitat for about 38 percent of historical populations (Lindley *et al.* 2006).

Existing wild steelhead populations in the Sacramento River basin occur in the upper Sacramento River and its tributaries, including Battle, Clear, Cottonwood, Antelope, Deer, and Mill creeks and the Yuba River. Other Sacramento River basin populations may exist in Big Chico and Butte creeks, and a few wild steelhead are produced in the American and Feather rivers (McEwan 2001). A hatchery supported population of steelhead also occurs in the Mokelumne River. CCV steelhead were thought to be extirpated from the San Joaquin River system, until recent monitoring detected small populations of *O. mykiss* in the Merced, Tuolumne, Stanislaus, Mokelumne, and Calaveras rivers previously thought to be devoid of steelhead (McEwan 2001). It is uncertain whether the *O. mykiss* in those rivers are predominantly resident or anadromous *O. mykiss*; presumably, both the anadromous and resident life history form of *O. mykiss* are present.

Steelhead typically migrate to marine waters after spending two years in fresh water. They reside in marine waters for typically 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year olds. Unlike Pacific salmon, steelhead are capable of spawning more than once before they die. However, it is rare for steelhead to spawn more than twice before dying, and most that do so are females (Moyle 2002). CCV steelhead are considered “ocean-maturing” (also known as winter) steelhead, although summer steelhead may have been present prior to construction of large dams (Moyle 2002). Ocean maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. CCV steelhead enter fresh water from August through April. They hold until flows are high enough in tributaries to enter for spawning (Moyle 2002). Steelhead adults typically spawn from December through April, with peaks from January through March in small streams and tributaries where cool, well oxygenated water is available year-round (McEwan 2001). Depending on water temperature, steelhead eggs may incubate in redds for over 1 month before hatching as alevins. Following yolk sac absorption, alevins emerge from the gravel as young juveniles or fry and begin actively feeding (Moyle 2002).

Historic 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 is 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 (NFH) have increased in recent years, 2011 to 2014. 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 200–300 fish each year. Numbers of wild adults returning each year have ranged from 252 to 610 from 2010 to 2014. The returns of CCV steelhead to the FRFH experienced a sharp decrease from 2003 to 2010, down to as low as 86 fish returning in 2010. In recent years, however, returns have experienced an increase with 1797 fish returning in 2013. Almost all of these fish are hatchery fish and stocking levels have remained fairly constant, suggesting that smolt and/or ocean survival was poor for age classes that showed poor returns in the late 2000's. Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2015 that no clear trend is present.

Redd counts are conducted in the American River and in Clear Creek. An average of 143 redds have been counted on the American River from 2002–2015 (Reclamation unpublished data 2016). 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 (USFWS unpublished data 2016). The Clear Creek redd count data ranges from 100-1,023 and indicates an upward trend in abundance since 2006. The East Bay Municipal Utilities District has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season, and the overall trend is a slight increase. However, it is generally believed that most of the *O. mykiss* spawning in the Mokelumne River are resident fish, which are not part of the CCV steelhead DPS (Satterthwaite *et al.* 2010).

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the Central Valley 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 Central Valley. 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. 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.

California Central Valley steelhead abundance and 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 and 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 Central Valley 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 Central Valley historically consisted of both summer-run and winter-run migratory forms. Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams as summer-run have been extirpated (McEwan and Jackson 1996, Moyle 2002).

Although CCV steelhead will experience similar effects of climate change to Chinook salmon in the Central Valley, as they are also blocked from the vast majority of their historic 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 Central Valley, 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 salmon and recommend an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F) (McCullough *et al*. 2001). Successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (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.

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). 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. The CCV steelhead DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range (NMFS 2016a).

### 2.2.5. California Central Valley Steelhead Critical Habitat and Physical or Biological Features

The critical habitat designation for CCV steelhead (June 28, 2005, 70 FR 37160) lists the PBFs, which include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas. The geographical extent of designated critical habitat includes: the Sacramento, Feather, and Yuba rivers, and Deer, Mill, Battle and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries but excluding the mainstem San Joaquin River above the Merced River confluence; and the waterways of the Delta.

Many of the PBFs of CCV steelhead critical habitat are currently degraded and provide limited high quality habitat. Passage to historical spawning and juvenile rearing habitat has been largely reduced due to construction of dams throughout the Central Valley. Levee construction has also degraded the value for the conservation of the species of freshwater rearing and migration habitat and estuarine areas as riparian vegetation has been removed, reducing habitat complexity, food resources, and resulting in many other ecological effects. Contaminant loading and poor water quality in Central California waterways poses threats to lotic fish, their habitat and food resources. Additionally, due to reduced access to historical habitats, genetic introgression is occurring because naturally-produced fish are interacting with hatchery-produced fish which has the potential to reduce the long-term fitness and survival of this species.

Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento/San Joaquin River watersheds and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery efforts. In the future, climate change impacts are likely to exacerbate human caused reductions in the value of critical habitat for the conservation of the species.

### 2.2.6. Southern DPS of North American Green Sturgeon

- Listed as threatened (April 7, 2006, 71 FR 17757).
- Critical habitat designated (October 9, 2009, 74 FR 52300).

The sDPS is composed of a single, independent population, which principally spawns in the mainstem Sacramento River and also breeds opportunistically in the Feather River and the Yuba River (Israel *et al.* 2009, Lindley *et al.* 2011, Seesholtz *et al.* 2014). There is no known modern usage of the upper San Joaquin River by green sturgeon, and adult spawning has not been documented there (Jackson and Eenennaam 2012). During late summer and early fall, subadults and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast, including the Delta, and along the North American continental shelf (Emmett *et al*. 1991, Moser and Lindley 2007).

Adult sDPS green sturgeon reach sexual maturity at 15 years of age, and spawn every two to six years (NMFS 2015). They leave the ocean and enter San Francisco Bay between January and early May (Heublein *et al.* 2009). Spawning occurs primarily from April through early July in cool sections of the upper Sacramento in deep pools containing small to medium sized gravel, cobble, or boulder substrate (Poytress *et al.* 2015). Post-spawn fish may hold for several months in the Sacramento River and out-migrate in the fall or winter, or move out of the river quickly during the spring and summer months, with the holding behavior most commonly observed (Heublein *et al.* 2009). Post-spawn out-migration through the San Francisco Bay Delta Estuary is also variable, with individuals migrating to the Pacific Ocean in either a couple of days or remaining in the estuary for a number of months (Heublein *et al.* 2009).

Green sturgeon eggs hatch in approximately 8 days (Deng *et al.* 2002). Larvae utilize benthic structures and exhibit nocturnal feeding and migration activity. Metamorphosis to the juvenile stage is complete within 45 days of hatching. Although little information is known about the juvenile life stage, young green sturgeon appear to rear for the first 1-2 months in the upper Sacramento River and then migrate downstream and into the Delta and Estuary and rear until 1.5 years of age, feeding on benthic invertebrates (NMFS 2015). Salvage of green sturgeon at the the

Skinner Delta Fish Protection Facility, and the Tracy Fish Collection Facility indicate that they are present in the Delta year-round. At 1.5-4 years of age, juveniles migrate to sea and thereby enter the sub-adult phase (NMFS 2015).

Preliminary results of adult acoustic telemetry surveys estimate an average annual spawning run of 223 (DIDSON) and 236 (telemetry) fish (Mora *et al*. 2015). This estimate does not include the number of spawning adults in the lower Feather or Yuba rivers, where green sturgeon spawning was recently confirmed (Seesholtz *et al*. 2014). Trends in abundance of sDPS green sturgeon have been estimated from salvage numbers at the Skinner Delta Fish Protection Facility, and the Tracy Fish Collection Facility, and by incidental catch of green sturgeon by the CDFW's white sturgeon sampling/tagging program. Historical estimates from these sources are likely unreliable because the sDPS was likely not taken into account in incidental catch data, and salvage does not capture range-wide abundance in all water year types. A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the Skinner Delta Fish Protection Facility and the Tracy Fish Collection Facility. These data should be interpreted with some caution. Operations and practices at the facilities have changed over the decades, which may affect salvage data. These data likely indicate a high production year versus a low production year qualitatively, but cannot be used to rigorously quantify abundance.

The parameters of green sturgeon population growth rate and carrying capacity in the Sacramento River Basin are poorly understood. Larval count data show enormous variance among sampling years. In general, sDPS green sturgeon year class strength appears to be highly variable with overall abundance dependent upon a few successful spawning events (NMFS 2015). Other indicators of productivity such as data for cohort replacement ratios are not currently available for sDPS green sturgeon.

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. Recent research indicates that concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. The apparent, but unconfirmed,

extirpation of spawning populations from the San Joaquin River narrows the available habitat within their range, offering fewer habitat alternatives. Whether sDPS green sturgeon display diverse phenotypic traits such as ocean behavior, age at maturity, and fecundity, or if there is sufficient diversity to buffer against long-term extinction risk is not well understood.
Threats due to habitat alteration continue to occur and indirect evidence suggests a decline in abundance (NMFS 2015). Lindley *et al*. (2007), in discussing winter-run Chinook salmon, states that an ESU (or DPS) represented by a single population at moderate risk of extinction is at high risk of extinction over a large timescale; this would apply to the sDPS for green sturgeon. The most recent 5 year status review for sDPS green sturgeon found that some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers (NMFS 2015). Since many of the threats cited in the original listing still exist, the threatened status of the DPS is still applicable (NMFS 2015).

### 2.2.7. sDPS Green Sturgeon Critical Habitat and Physical or Biological Features

The critical habitat designation for sDPS green sturgeon (October 9, 2009, 74 FR 52300) lists the PBFs. In summary, the PBFs include the following for both freshwater riverine systems and estuarine habitats: food resources, water flow, water quality, migratory corridor, depth, and sediment quality. Additionally, for riverine systems, the designation includes substrate type or size. Substrate type or size is also a PBF for freshwater riverine systems. In addition, the PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. The geographical range of designated critical habitat includes the following.

In freshwater, the geographical range includes the Sacramento River from the Sacramento I-Street Bridge to Keswick Dam, including the Sutter and Yolo bypasses and the lower American River from the confluence with the mainstem Sacramento River upstream to the Highway 160 bridge; the Feather River from its confluence with the Sacramento River upstream to Fish Barrier Dam; the Yuba River from its confluence with the Feather River upstream to Daguerre Point Dam; and the Sacramento-San Joaquin Delta (as defined by California Water Code section 12220, except for listed excluded areas). In coastal bays and estuaries, the geographical range includes San Francisco, San Pablo, Suisun, and Humboldt bays in California; Coos, Winchester, Yaquina, and Nehalem bays in Oregon; Willapa Bay and Grays Harbor in Washington; and the lower Columbia River estuary from the mouth to river kilometer 74. In coastal marine waters, the geographical range includes all U.S. coastal marine waters out to the 60 fathom depth bathymetry line from Monterey Bay north and east to include waters in the Strait of Juan de Fuca, Washington.

Currently, many of the PBFs of sDPS green sturgeon are degraded and provide limited high quality habitat. Additional features that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, and presence of contaminants in sediment. Although the current conditions of green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in both the Sacramento/San Joaquin River watersheds, the Delta, and nearshore coastal areas are considered to have high intrinsic value for the conservation of the species. In the future, climate change impacts are likely to exacerbate human caused reductions in the value of critical habitat for the conservation of the species.

## 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 proposed FWAFM Project is located in the northern half of the Yolo Bypass, in Yolo County, California. The action area includes the Fremont Weir, a portion of the Fremont Weir Wildlife Area, two downstream agricultural road crossings in the Tule Canal, and an area within the northern Elkhorn Basin (referred to as the Elkhorn Area). The northern boundary of the action area is the Sacramento River bank immediately north of the existing Fremont Weir fish ladder, but does not include the Sacramento River. The Fremont Weir fish ladder is located between river mile (RM) 82 and RM 84 and is approximately 0.62 mile west of the Yolo Bypass east levee. The southern boundary of the action area includes the 200-foot buffer beyond an existing agricultural crossing located in the Tule Canal, approximately 1 mile south of the Fremont Weir Wildlife Area. The action area includes: the construction limits in which the new fish passage facility would be constructed and agricultural road crossings would be modified, spoil sites, spoil haul routes, and staging areas; and a 200-foot buffer from these locations.

## 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. Status of the Species in the Action Area

The Sacramento River adjacent to the action area is a principal migration corridor for adult and juvenile Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and southern DPS green sturgeon, and provides rearing habitat for these species. Adults of all of these species may enter the Yolo Bypass through the Tule Canal and migrate through the Fremont Weir when passage conditions permit. Juveniles may enter the Yolo Bypass from the south via tidal exchange or become entrained onto the bypass when the Sacramento River reaches a stage when it overtops the Fremont Weir and the Yolo Bypass becomes flooded.

#### 2.4.1.1. Sacramento Winter-run Chinook Salmon

Upstream migrating adult Sacramento River winter-run Chinook salmon occur in the Sacramento River near the action area from December through July, peaking in March, based on the generalized adult migrating timing from the literature (Yoshiyama *et al.* 1998). However adult winter-run Chinook salmon have only been detected in the lower Yolo Bypass or the Colusa Basin Drain/Wallace Weir fish rescue operation from February through April (CDFW 2015, 2016b; DWR 2016a).

Downstream migrating winter-run juveniles occur from November through February based on rotary screw trap catches at Knights Landing (CDFW unpublished data 1999–2015). Peak numbers generally occur following the onset of major fall or winter storm events and resulting high flows and turbidity (Williams 2006). In addition, juvenile winter-run Chinook salmon have been observed in the Toe Drain of the Yolo Bypass from December to June, with peak presence in January and February (DWR 2016a). While they can enter the bypass from the south via tidal exchange, their abundance on the Yolo Bypass is highest when the floodplain is inundated from November through May as a result of the Sacramento River overtopping the Fremont Weir. During the dry season, juveniles are unlikely to be present in the action area during construction as they are rarely observed upstream of the Lisbon Weir, which is downstream of the action area.

#### 2.4.1.2. Central Valley Spring-run Chinook Salmon

Based on the literature, CV spring-run Chinook salmon upstream adult migration generally occurs in the Sacramento River near the action area from March through September, peaking in May and June (Yoshiyama *et al*. 1998). Four adult spring-run Chinook salmon have been collected in March and April from Colusa Basin Drain/Wallace Weir fish rescue operations by CDFW from 2013 to 2015 (CDFW 2015, 2016b).

Downstream migrating spring-run juveniles in the Sacramento River occur from December through May based on rotary screw trap catches at Knights Landing (CDFW unpublished data 1999–2015). Juvenile spring-run Chinook salmon have been observed in the Toe Drain of the Yolo Bypass from December to June, with peak presence occurring between March and April (DWR 2016a). While they can enter the bypass from the south via tidal exchange, their abundance on the Yolo Bypass is highest when the floodplain is inundated as a result of the Sacramento River overtopping the Fremont Weir. During the dry season, juveniles are unlikely to be present in the action area during construction as they are rarely observed upstream of the Lisbon Weir, which is downstream of the action area.

#### 2.4.1.3. California Central Valley Steelhead

The highly variable and complex life history allows for both juvenile and adult CCV steelhead to be present in the action area year-round, though presence often coincides with high flow events from fall through spring. Historical records indicate that CCV steelhead adults migrate into the Sacramento River from August through March with a peak in September and October (Hallock *et al*. 1957, Moyle 2002). A single adult steelhead was captured in February at the Wallace Weir during the November through June 2013-2014 period that a fyke trap was run just below the weir structure (CDFW 2016b).

Rotary screw trap catches of juvenile steelhead in the Sacramento River at Knights Landing indicate that juveniles generally migrate downstream from November through May, with a peak in March and April (CDFW unpublished data 1999–2015). Juveniles have been observed in the Yolo Bypass from January to June, peaking in March (DWR 2016a).

#### 2.4.1.4. sDPS North American Green Sturgeon

Adult green sturgeon may arrive in the northern Yolo Bypass during Fremont Weir overtopping events in the winter and early spring. When the Sacramento River stage is not high enough to provide adequate passage over the weir, these fish have been trapped in the stilling basin of the Fremont Weir and in nearby scour channels and ponds (CDFW 2016b). While adult white sturgeon presence in the Yolo Bypass has been well documented as a result of DWR fyke trap efforts in the Toe Drain of the Yolo Bypass, green sturgeon have never been observed in the 18-year history of DWR fyke trap operation (DWR 2016a).

Outmigrating juvenile green sturgeon may enter the Yolo Bypass if their migration down the Sacramento River coincides with a Fremont Weir overtopping event. During non-overtopping events, juvenile green sturgeon could migrate up the Yolo Bypass from the southern tidally-influenced zone. However, the likelihood of this occurring is low. From past monitoring efforts by DWR, only one juvenile green sturgeon has been observed in the lower Yolo Bypass (DWR 2016a).

### 2.4.2. Factors Affecting Listed Fish Species and Critical Habitat in the Action Area

#### 2.4.2.1. Yolo Bypass, Fremont Weir, and Tule Pond

The Yolo Bypass is a 59,000-acre, a leveed floodplain engineered to convey floodwaters of the greater Sacramento Valley. It is the largest contiguous floodplain of the lower Sacramento River. Between floods, the Bypass primarily supports agriculture and managed habitat for waterfowl. At the northern end of the Yolo Bypass, Fremont Weir conveys floodwaters from the Sacramento and Feather Rivers into the Bypass. Flow also enters the Yolo Bypass from several small west side streams: Knights Landing Ridge Cut, Cache Creek, Willow Slough Bypass and Putah Creek. After floodwaters recede, the basin empties through the Toe Drain, a perennial riparian channel on the eastern edge of the Bypass. During drier months the tidally-influenced Toe Drain channel is the primary source of perennial water in the Yolo Bypass, feeding a complex network of canals and ditches.

The Fremont Weir, completed in 1924 by the USACE, is an ungated, fixed-crest, concrete weir measuring 1.8 miles long, 6 feet high, and 35 feet wide. The Fremont Weir was designed to allow flow into the Yolo Bypass during high-flow events when the Sacramento River is higher than the Fremont Weir 32-foot weir crest elevation (North American Vertical Datum of 1988 [NAVD88]). The weir has a concrete stilling basin to minimize scouring during overtopping events at the weir. The stilling basin lies just downstream of the crest of the weir and spans the full length of the weir

Historical records indicate that the Sacramento River overtops the Fremont Weir roughly once every 3 years, with flood flows generally occurring November through April, creating vital shallow water habitat for native fish and migratory and wintering shorebird populations (DWR and Reclamation 2012). Because much of the historical floodplain in the Sacramento Valley has been lost to development, river channelization and levee construction, the remnant floodplain habitat of the Yolo Bypass has exceptional biological value for many native aquatic and wildlife species. However, the value of this habitat is compromised in below-normal to critically dry years, when there is little or no floodplain inundation and poor connectivity between the Yolo Bypass and the Sacramento River.

When the Sacramento River stage is 2 to 3 feet higher than the Fremont weir, passage is possible for salmonids and, to a lesser extent, sturgeon. When the river stage is just barely above the crest of the Fremont Weir, the lack of suitable water depth makes it difficult for salmonids to reach the Sacramento River and likely creates a complete barrier for sturgeon. Once the Sacramento River recedes below the crest of Fremont Weir, fish are likely to become stranded in the stilling basin, the old river channel (commonly referred to as "the oxbow"), the deep pond south of the existing fish ladder, the downstream scour channels, Tule Pond, or Tule Canal between the agricultural road crossings. The deep pond south of the existing fish ladder and Tule Pond are deep enough to hold fish year-round, but water quality conditions become unfavorable for native fishes to survive during the summer months. Under existing conditions, for fish to volitionally reconnect with the Sacramento River, the Sacramento River stage must be high enough to allow fish to swim directly over the crest of Fremont Weir or there must be water flowing through the Fremont Weir fish ladder deep enough to allow fish to reconnect with the river.

Along the middle of the Fremont Weir is the Fremont Weir fish ladder, a 4-foot-wide and 6-foot-deep concrete modified Denil-type fish ladder with a crest elevation of 31.8 feet. The fish ladder is manually opened when the Sacramento River stage recedes below the crest of Fremont Weir. The fish ladder is opened by removing wood stoplogs from the inlet of the fish ladder, which allows some adult migratory fish near this area to pass through the ladder and follow an earthen channel (Upstream Channel) to the Sacramento River. When the Sacramento River recedes below the bottom elevation of the ladder (an approximate elevation of 26 feet), the ladder is closed by replacing the stoplogs. The fish ladder is considered ineffective for a number of reasons. First, it is the only fish ladder located along the 1.8-mile span of Fremont Weir, which makes it difficult for all migratory fish to find during or following an overtopping event. Second, the bottom elevation of the ladder is too high to maintain a deep enough connection for sturgeon and salmonids for a sufficient duration. Third, Denil-type fish ladders are designed to provide passage specifically for salmonids and are considered inadequate for sturgeon. Although this Denil-type fish ladder has been widened by removing interior baffles, the 4-foot-wide entrance is still too narrow for sturgeon passage.

As Fremont Weir begins to overtop, flows are initially contained within the prominent scour channels that extend from Tule Pond, an approximately 15-acre perennial pond in the Yolo Bypass, to Fremont Weir. During this time, flow and migratory fish are contained within the scour channels. If sufficient flows overtop Fremont Weir, there is enough depth to allow fish to move out of the scour channels and onto the floodplain. Yet, it is more likely that, because of increased depth and flow, fish will follow the prominent scour channels that extend from Tule Pond to Fremont Weir. Specifically, many fish are expected to follow the 1,300-meter-long scour channel that runs from Tule Pond to the deep pond located just downstream of the existing fish ladder. That scour channel provides the most viable migratory pathway during Fremont Weir overtopping and as floodwaters begin to recede, because it conveys significant flow and is deeper and wider than other channels. A poorly defined channel connects the deep pond to the stilling basin (Reach 1) at an area just southeast of the fish ladder. This channel is steep and shallow and does not provide favorable conditions for adult fish to swim from the deep pond to the Fremont Weir, unless the area is inundated during an overtopping event.

Following overtopping events, salmonids and green sturgeon trapped in the shallow waters of the stilling basin and scour channels are vulnerable to poaching, poor water quality, and falling water levels (CDFW 2016b). As floodwaters begin to recede, fish that do not successfully reach the Sacramento River either retreat into the Tule Canal or become stranded on the Yolo Bypass, particularly around man-made features (Sommer *et al*. 2005). Between 1955 and the summer of 2016, CDFW documented 28 fish rescues efforts within the Fremont Weir vicinity, including the stilling basin and adjacent ponds and swales. CDFW recorded rescuing 26 sDPS green sturgeon, 351 juvenile CCV steelhead, over 4,500 juvenile Chinook salmon, and over 1,900 adult Chinook salmon.

#### 2.4.2.2. Tule Canal

South of the Tule Pond is the Tule Canal, a man-made channel along the east side of the Yolo Bypass, which receives water from westside tributaries (including Knights Landing Ridge Cut, Cache Creek, Willow Slough, and Putah Creek) and agricultural diversions almost year-round and drains the initial flows from the Sacramento River when the river rises above the crest of Fremont Weir.

Adults stray into the Yolo Bypass from the Sacramento River near the Cache Slough Complex and through the Tule Canal. The water level in the Tule Canal varies throughout the year and is influenced by agricultural irrigation practices and rainfall. The abundance of ESA-listed anadromous fishes in the Yolo Bypass is often positively correlated to flow. Even modest flow increases, natural or from agricultural discharge, can provide attraction flows sufficient enough to cause fish to stray. Fremont Weir overtopping conditions aside, water stage in the northern Tule Canal during the dry season is controlled primarily by input from the Knights Landing Ridge Cut to the west. This water can enter the Tule Canal either through inputs from Agricultural Road Crossing 1 via an irrigation cross-canal that terminates north of the crossing, or at the confluence of the Wallace Weir drainage canal south of Agricultural Road Crossing 3. During higher flow periods, drainage from the Yolo Bypass contributes to Tule Canal stage, as does input from the more tidally influenced Toe Drain to the south.

There are multiple earthen agricultural road crossings/impoundments in the Tule Canal that control water and provide access for vehicles and farming equipment from the Yolo Bypass east levee road to the agricultural fields. Adult salmonids and sturgeon may experience delays if they encounter these agricultural road crossings at lower flows, when the agricultural crossings may not be submerged. The agricultural road crossings become submerged during higher flow conditions, such as when Fremont Weir overtops, eventually allowing salmonids or sturgeon to move beyond them. Adult or juvenile migratory fish, including salmonids and sturgeon, may become trapped in between these crossings as higher flows recede. Prior to an overtopping event, fish are able to move as far north as Agricultural Road Crossing 3. These fish are unable to move further upstream, unless the Sacramento River overtops Fremont Weir.

During the winter and spring, water temperature and general water quality are favorable for salmonids and sturgeon. Under these conditions, fish can successfully hold in the Tule Canal for extended periods of time. From early summer through late fall, decreases in flow and increases in water temperature cause water quality to diminish to the point that the Tule Canal may no longer be suitable for salmonids and sturgeon to hold for prolonged periods.

#### 2.4.2.3. Agricultural Road Crossings 2 and 3

Agricultural Road Crossing 2 serves as an earthen road and as an irrigation flow-control structure for adjoining fields. This road crossing is the primary means of transporting heavy equipment across the Tule Canal. The road crossing contains a 30-inch-diameter culvert placed north to south, and a 36-inch-diameter culvert located immediately downstream of and parallel to the road that drains water from the adjacent agricultural fields into the Tule Canal. The culvert within the earthen road crossing is undersized for reliable fish passage and is prone to clogging with vegetation and debris. For adult fish to pass over Agricultural Road Crossing 2, Tule Canal must convey flows of approximately 1,000 cfs. Some fish passage may occur through the culverts at lower flows, but the culverts are more prone to clogging with debris at low flows. This road crossing is often partially washed out by high-flow events and must be rebuilt. Agricultural Road Crossing 3 is located 0.7 miles south of Agricultural Road Crossing 2. Being comparable in design to Agricultural Road Crossing 2, Agricultural Road Crossing 3 functions similarly to Agricultural Road Crossing 2 and creates similar fish passage obstructions.

Agricultural Road Crossings 2 and 3 are earthen crossings that are frequently washed out during high flow events and require regular maintenance by the landowner. This maintenance includes installing the culverts and building up the earthen crossings and thus disturbs both upland and aquatic habitat. Under most non-overtopping conditions, these crossings present significant passage obstacles for adult salmonids and sturgeon. Fremont Weir poses a similar fish passage barrier under all but the highest river stage overtopping events, particularly for sturgeon.

#### 2.4.2.4. Recreational Boating

The Sacramento River near the Fremont Weir experiences recreational boat traffic. Based on reported ambient underwater sound levels recorded at various open water locations in the western United States, the expected underwater ambient sound level could range from 114 to 135 decibels root mean square.

#### 2.4.2.5. Recreational Fishing

The Fremont Weir receives varying recreational use throughout the year from hunters, fishermen, and other recreationists, but fishing is not allowed within the action area as fishing is not permitted within 250 feet of a weir (California Code of Regulations, T-14, Section 2.35). Lisbon Weir is the northernmost point that a boat could travel in the Toe Drain/Tule Canal, therefore there is no boating access in the action area. Much of the Tule Canal is located on private property where public recreational use does not occur. In 2016, new regulations prohibited fishermen from taking sturgeon in the Yolo Bypass, Toe Drain Canal, and the Tule Canal upstream of the Lisbon Weir at any time (California Code of Regulations, T-14, Section 5.80).

### 2.4.2.6. Water Quality

Juvenile salmonids rearing on the Yolo Bypass floodplain are known to be vulnerable to methylmercury accumulation (Henery *et al.* 2010). It is likely that juvenile green sturgeon rearing on the floodplain would experience similar methylmercury accumulation. These juvenile fish may also be exposed to various herbicides, fertilizers, and pesticides that have been broadcast onto agricultural fields in the Yolo Bypass or fields that have drained into the Yolo Bypass via the Colusa Basin Drain (McCarthy *et al.* 2008).

### 2.4.2.7. Levee Construction and Bank Stabilization

The Tule Canal has some limited riparian cover on the east side levee and in the channel, but generally lacks significant riparian or instream woody cover. Levee construction and bank protection can reduce floodplain connectivity, change substrate size, and decrease riparian habitat and shaded riverine aquatic cover. The armoring and revetment of river banks with riprap significantly diminishes the natural geomorphic processes of a river that create and enhance critical habitat, such as floodplain creation, riparian vegetation recruitment, and river meander migration (Buer *et al.* 1989, Florsheim and Mount 2002, Gergel *et al.* 2002, Larsen *et al.* 2006, Fremier *et al.* 2014).

### 2.4.2.8. Summary of Climate Change Impacts

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change. The Central Valley has been modeled to have an increase in air temperature of between 2°C and 7°C by 2100, with a drier hydrology predominated by precipitation rather than snowfall (Dettinger and Cayan 1995, Hayhoe *et al.* 2004, Van Rheenen *et al.* 2004, Cloern *et al.* 2011). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt dominated system to a winter rain dominated system. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff (Georgakakos *et al.* 2012, Hanak and Lund 2012). Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids and green sturgeon that must hold below the dam over the summer and fall periods.

Within the context of the brief period over which the proposed project is scheduled to be constructed, near term effects of global climate change are unlikely to result in any perceptible declines to the overall health or distribution of the listed populations of anadromous fish within the action area that are the subject of this consultation. Over the long term, global climate change may have an effect on the water quality of the Sacramento River near the action area and beyond, with reduced flows or increased water temperatures - the likely outcome of increasing global temperatures.

## 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 of the proposed FWAFPM Project include those from two distinct phases of the proposed action: (1) construction and (2) operations. Construction activities at the existing fish ladder and stilling basin consists of demolition and removal of a portion of the Fremont Weir and stilling basin, removal of vegetation for construction access, and excavation to replace the fish ladder and portion of the stilling basin with a deeper and wider fish passage structure. Construction activities at the Upstream Channel and Reach 1 consists of the removal of vegetation for construction access, channel excavation, and installation of engineered streambed material for channel protection. The construction activities at Agricultural Road Crossing 2 consists of vegetation removal for construction access, replacing the existing road crossing with a bridge, and installation of engineered streambed material for channel protection. Construction activities at Agricultural Road Crossing 3 consists of permanent removal of the crossing and grading to create a consistent channel bottom and width in Tule Canal. The phase of operations includes the operations of the Fremont Weir Passage Structure and maintenance of the Fremont Weir Fish Passage Structure, Fremont Weir Stilling Basin, Upstream Channel, Reach 1, and Agricultural Crossing 2. Described below are the effects of both construction and operations on listed species and critical habitat.

### 2.5.1. Effects of Construction on Listed Species

#### 2.5.1.1. Likelihood of Presence of Listed Species in the Action Area

The work window of the proposed action, May 1 to October 31, is outside of the flood season, November 1 through April 15, when the Yolo Bypass would be inundated and also avoids the primary migration windows of adult and juvenile winter-run Chinook salmon, spring-run, and green sturgeon. Juvenile spring-run and winter-run Chinook Salmon have been observed in the Toe Drain of the Yolo Bypass from December to June, with peak presence occurring between February and April (CDWR 2016a). While they can enter the bypass from the south via tidal exchange, their abundance on the Yolo Bypass is highest when the floodplain is inundated as a result of the Sacramento River overtopping the Fremont Weir. During the dry season, juveniles are unlikely to be present in the action area during construction as they are rarely observed upstream of the Lisbon Weir, which is downstream of the action area. Although juvenile spring-run, adult and juvenile steelhead, and juvenile green sturgeon might occur in the Sacramento River, they would likely not be present in the action area due to the shallow water, poor water quality, and high water temperatures found in the Tule Canal during summer and early fall. Furthermore, fish would move away from noisy environments under ongoing activities, adding another mechanism to eliminate the potential for their exposure to the proposed action, if there were any fish present in the action area (Hempen *et al*. 2014). As discussed in section 2.5.1.3, the noise levels from the proposed action would not cause impairment to listed fish species.

### 2.5.1.2. Effects of Dewatering on Listed Species

In an effort to further minimize construction-related effects to fish, as many activities as possible would be performed when the action area is dry. The Upstream Reach, Fremont Weir Fish Passage Structure, Reach 1 will all be performed when Fremont Weir is dry, therefore dewatering at this location is not anticipated. For Agricultural Crossings 2 and 3, the Tule Canal is often dry in the summer, and this site may not receive water until late-September or early-October when agricultural drainage reaches the site. Thirty days prior to beginning construction, Reclamation and DWR would request that landowners of adjacent parcels re-route their irrigation water into other canals in an effort to bypass the site. This action would facilitate in drying the sites, which are kept wet largely by agricultural drainage in the summer months. Bypassing drainage to downstream of the road crossings would allow the area to slowly draw down, which would allow fish to naturally vacate the region and reduce the risk of harming fish during fish rescues and dewatering efforts.

If water is still present at these sites after 30 days of natural drainage, the remaining water would be removed via pumps. Agricultural Road Crossing 3 would be removed first in an attempt to improve natural drainage at Agricultural Road Crossing 2. Sandbags would be placed upstream, and downstream if necessary, of Agricultural Road Crossing 3 to prevent additional water from entering the site. Once the site is isolated hydraulically, it will be dewatered and all excavation and grading would occur on dry land. Upon completion of removing Agricultural Road Crossing 3, the sandbags would be removed and Agricultural Road Crossing 2 would be allowed to naturally drain. If dewatering is needed at Agricultural Road Crossing 2, the same dewatering approach would be used, only earthen berms would be used in place of sandbags. Upon draining Agricultural Road Crossing 2, all work would be performed on dry land.

Fish present in the dewatered area would be subject to stranding and probable mortality resulting from suffocation, desiccation, or physical injury. To minimize this potential impact, fish will be relocated prior to complete dewatering of the work site. Once the site is hydraulically isolated, a qualified biologist and trained field crew would be onsite to inspect the area and begin fish rescue and relocation activities as needed. Fish relocation at these sites will be done downstream of the agricultural road crossings within suitable habitat in the Tule Canal. Fish will be collected using a fine-mesh beach seine to reduce the risk of gills becoming entangled in the beach seine. Small fish will be held temporary in aerated coolers with clean, locally-sourced water. Efforts will be made to keep densities low enough to reduce stress and to maintain suitable DO levels and water quality in the cooler. Fish will be shuttled to the nearest suitable habitat and released using water-to-water transfers. Large fish will be moved immediately after collection and transferred to suitable habitat via fish cradles.

After efforts have been made to remove as many fish as possible, pumps fitted with NMFS-approved fish screens will be used to further dewater the site (NMFS 2011). The field crew will continue to monitor for and rescue fish as the water levels decrease and relocate fish to suitable habitat. In the event that groundwater infiltration continues to occur following a fish rescue and dewatering effort, pumps will remain operational to keep the project area dry. All ESA-listed fish species observed will be logged into a project database and reported to NMFS and CDFW.

Relocation of fish can cause stress, physical injury, and mortality from handling and crowding (including potential stress associated with crowding in the receiving area). To minimize this impact, handling and holding of fish would be minimized to the extent possible. Furthermore, water temperatures, DO, and fish densities in the buckets would be maintained within safe limits at all times, and relocated fish would be released in suitable habitat at least 1,000 feet from the construction site. The fish biologist on site would contact NMFS and CDFW immediately if any steelhead, Chinook salmon, or green sturgeon were found dead or injured. However, listed fish are not likely to be present during the dewatering of the construction site, since the Fremont Weir would be dry and summer water quality in the Tule Canal is typically extremely poor, with very high temperatures. For these reasons, effects due to dewatering are discountable, as they are unlikely to occur.

#### 2.5.1.3. Effects of Noise on Listed Species

The effects of noise on fish include: (1) mortality if the noise level is greater than 228.9 dB relative to 1 micropascal reference for water (re 1 μPa), which was the peak pressure from underwater explosions; (2) damage to sensory hair cells if the noise level is greater than 180 dB (re 1 μPa); and (3) increased stress hormone levels if the noise level is greater than 153 dB (re 1 μPa) (Hempen *et al*. 2014).

Construction at the Fremont Weir will occur entirely on dry land, so in-water work will not be required. However, demolition of the existing concrete structures and the installation of the sheet pile wall upstream of the modified fish passage structure are anticipated to be the noisiest activities in the action area. These activities would occur 360 feet away from the Sacramento River and 425 feet away from the deep pond.

The *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish* estimates the peak pressure impact driving of steel sheet piles to be 205 decibels measured 33 feet from the pile [California Department of Transportation (CalTrans) 2015]. The root mean square is anticipated to be 190 decibels 33 feet from the site. The sound exposure level is estimated to be 180 decibels 33 feet from the site. These values exceed the threshold that affects fish behavior; however, sound pulses will be highly attenuated as they propagate through bottom sediments towards open water. In addition, the location of the pile driving will occur outside the 200-foot distance in the technical guidance that CalTrans provides for evaluating the hydroacoustics of pile driving on fish (CalTrans 2015). Building on this guidance, because the affected area of the pile driving is not expected to extend beyond 200 feet, there will be no need to further attenuate the sound in the Sacramento River or deep pond, which are located 360 feet and 425 feet away, respectively, to avoid adverse effects to fish.

In addition, noise may be induced from operating heavy equipment, placing of engineered streambed material, and installing and removing in-water silt fences and the temporary water barrier. Noise levels from these activities are expected to be well below levels responsible for mortality or noise induced hearing damage. Also, the Yolo Bypass and Tule Canal are dry during the construction period and construction activities would be done in a dry channel, further reducing noise-related impacts to fish. Considering the localized impact zone and noise production during construction, listed species would not be present; or if present, they would either avoid or move out of the impact zone (Hempen *et al*. 2014). Therefore, the effect is discountable as it is extremely unlikely to occur.

#### 2.5.1.4. Effects of Suspended Sediment on Listed Species

The severity of effect of suspended sediment pollution on fish increases as a function of suspended sediment concentration (SSC) and duration of exposure. For example, juvenile and adult salmonids, when exposed to 20 mg/L SSC for up to 1 week, would experience sublethal effects including short-term reduction in feeding rates and minor to moderate physiological stress (*e.g.*, increase in rate of coughing and increased respiration rate). Exposure to 150 mg/L SSC would have the following sublethal effects: moderate habitat degradation, impaired homing, major physiological stress, and long-term reduction in feeding rate and feeding success (Newcombe and Jensen 1996).

In-water construction activities that may increase SSC include berm construction and removal at each of the Agricultural Road Crossings. However the effects of these activities are insignificant due to: (1) The lack of flow in the northern Tule Canal during the dry season and the use of sediment curtains would prevent turbidity plumes from broadcasting beyond the action area. (2) Silt fencing and sediment curtains would be installed to reduce sudden increases in turbidity and suspended sediments. These areas would be confined to the project area by the sediment curtains and are unlikely to have a significant effect to ESA-listed fish species that may be present in the action area. (3) Due to the May 1 to October 31 work window, juvenile and adult ESA-listed fish species are least likely to be present in the action area. Not only is this period outside of peak migration seasons, but high temperatures and low DO levels are common in the Tule Canal during the low-flow summer months making the region unsuitable for ESA-listed fish species.

#### 2.5.1.5. Effects of Other Pollutants from Spills or Leakage on Listed Species

Pollutants that may result from accidental spills or leakage from machinery or storage containers include gasoline, diesel fuel, lubricants, and hydraulic fluid. These substances can cause physiological stress and increased susceptibility of aquatic organisms to other sources of mortality such as predation through exposure to non-lethal levels, and kill aquatic organisms through exposure to lethal concentrations. Petroleum products also tend to form oily films on the water surface that can reduce DO levels available to aquatic organisms. However, these effects will be minimized through implementation of a spill prevention, control, and counter-measure plan. Adherence to all preventative, contingency, and reporting measures in the approved plan will reduce the potential effects to listed fish species to discountable levels. In addition, as many activities as possible would be performed in a dry setting. Working in the dry greatly reduces direct impacts to fish and lessens the potential for a contaminant spill to impact the downstream aquatic environment. Therefore, the effect is discountable as it is extremely unlikely to occur.

### 2.5.2. Effects of Construction on Designated Critical Habitat

In-water construction activities in the Tule Canal at Agricultural Road Crossings 2 and 3 have the potential to temporarily negatively affect critical habitat. Constructing earthen dams, placement of rock, and excavation could result in temporary increases in noise, turbidity, and suspended sediments. However, these effects on critical habitat would be minimized by implementing various BMPs and conservation measures such as implementing spill and stormwater prevention plans, implementing a turbidity monitoring plan, complying with the Regional Water Board turbidity objectives, and not doing work during a Fremont Weir overtopping event. Construction-related increases in turbidity and suspended sediments at the agricultural road crossings would be brief (only during berm construction and removal) and confined to the project area by the sediment curtains, and are likely to have insignificant effects on critical habitat.

#### 2.5.2.1. Effects of Loss of Riparian Habitat on Listed Species and Critical Habitat

The action area of the proposed FWAFPM Project is designated as critical habitat for rearing and migration of spring-run, steelhead, and green sturgeon. Small amounts of rearing habitat would be negatively affected by the FWAFPM Project. However, the migratory pathways for upstream migrating adult salmonids and sturgeon and emigrating juvenile salmonids would be greatly improved as a result of the proposed FWAFPM Project.

The Upstream Channel and Reach 1 would be excavated wider and deeper to allow for improved fish passage. This habitat is only activated during an overtopping event and as the Yolo Bypass drains following an overtopping event. Modifications to these channels would facilitate fish passage and remove isolated pools that are known to strand both adult and juvenile ESA-listed fish species.

The improvements proposed for Agricultural Road Crossings 2 and 3 would eliminate two principal migratory barriers in the Tule Canal. At Agricultural Road Crossing 3, 0.24 acres of upland habitat (including the earthen berm with a single small culvert) would be converted into aquatic habitat, allowing fish to freely navigate from bank to bank. At Agricultural Road Crossing 2, 0.18 acres of upland habitat would be converted to aquatic habitat. A similarly sized earthen berm with a small, 30-inch culvert would be replaced with a bridge, also allowing fish bank to bank passage. Under existing conditions, passage would only be possible through the undersized culverts or during a high flow event with sufficient stage for fish to swim over the road crossings. The proposed FWAFPM Project would allow unimpeded fish passage at both locations.

Engineered streambed material would be added to the Upstream Channel, Reach 1, and at Agricultural Road Crossing 2. In general, replacement of natural substrate with riprap reduces the quality of channel habitat for juvenile salmonids and other fishes by reducing habitat diversity and altering several important attributes of natural perennial drainage. These attributes include natural substrates, riparian vegetation, woody material, and variable water depths and velocities, including shallow, low velocity areas used by juveniles as refuge from fast currents and predators. Simple riprapped banks and bottoms generally create more uniform physical and hydraulic conditions characterized by deeper, faster water, and lack of cover. These conditions reduce utilization by juvenile fishes and also inhibit the establishment of vegetation and retention of sediment, organic material, and large woody material, which provide important sources of cover and food for juvenile fishes and other aquatic organisms. In addition to cover and shelter for fish, perennial drainage provides other important stream ecosystem functions, including channel stability; and inputs of organic matter, and nutrients (Murphy and Meehan 1991).

The impacts of replacing natural substrate with engineered streambed material are expected to be minimal, particularly at Agricultural Road Crossing 2, because of the low quality of existing habitat. The Tule Canal is an agriculture drain with simple leveed slopes that are characterized by steep banks. Further, the improvements made at Agricultural Road Crossings 2 and 3 would convert 0.42 acres of upland habitat (in the form of earthen berms) to open water, aquatic habitat. However, 0.24 acres of critical habitat would be permanently modified at Agricultural Road Crossings 2 and 3 as the Tule Canal would be graded and filled with engineered streambed material. At the Fremont Weir, 1.57 acres of critical habitat would be permanently modified, as channels are graded and filled with engineered streambed material, the fish passage structure is enlarged, and the elevated platform is erected. In total, 1.81 acres of critical habitat would be permanently modified. To mitigate for this lost natural substrate, Reclamation and DWR will purchase 5.43 acres (3:1 ratio) of floodplain riparian habitat credits at a NMFS-approved mitigation bank.

### 2.5.3. Effects of Operation and Maintenance on Listed Species

Operation of the proposed Fremont Weir fish passage structure would provide improved connectivity for ESA-listed fish species to enter the Sacramento River from the Yolo Bypass. This enhanced connectivity should increase individual survival as well as potentially increase spawning success outside of the Yolo Bypass. While the FWAFPM Project is not likely to completely remedy the existing stranding issues along the Fremont Weir, it is expected to considerably improve conditions and greatly reduce stranding at Fremont Weir. As such, fish rescues are anticipated to be less of a need as a result of the FWAFPM Project. Under an existing ESA Section 10(a)(1)(A) research permit (permit #18181-3A), CDFW will continue to perform fish rescues after an overtopping event at the Fremont Weir. The modified portion of the stilling basin would be 4 feet deeper than the adjacent 1.4-mile long eastern segment. This deeper holding pool may better congregate fish than the current design, making it easier for CDFW fish rescue crews to efficiently rescue stranded fish. Additionally, fish in this deeper section would be less susceptible to poaching than fish in the shallower portions of the stilling basin.

Operation of the fish passage structure would coincide with Fremont Weir overtopping events between November 1 and May 31. Upstream migrating adults have the potential to become injured or killed as a result of operating the bottom-hinged gate in the passage structure. However, the bottom-hinged gates are designed with an inflatable bladder located directly beneath the gate to raise and lower the gate. Compared to a traditional hydraulic bottom-hinged gate, these gates are less likely to directly injure fish because the bladder prevents fish from positioning themselves under the gate. Further, the gate takes roughly 60 minutes to fully close providing fish with ample time to get out of the gate’s path of travel. Due to the high unlikely hood of occurring, effects of the operation of the fish passage structure are discountable.

The removal of Agricultural Road Crossing 3 and the modifications at Agricultural Road Crossing 2 would open the channel to match the upstream and downstream channel margins, and would not require any operations. Improvements at these crossings would provide ESA-listed fish species that migrate into the Yolo Bypass with an enhanced opportunity to return to the Sacramento River.

Maintenance in the Upstream Channel and Reach 1, including debris, vegetation, and sediment removal, and maintenance to the fish passage structure would be conducted between April 16 and October 31, during the non-flood season when listed species would not be present on the Yolo Bypass floodplain. Therefore, the Upstream Channel, Reach 1, and fish passage structure maintenance activities are discountable as they are unlikely to occur.

The curtailment of the annual removal and replacement of Agricultural Road Crossings 2 and 3 would reduce upland ground disturbance, in-channel disturbances, and associated sedimentation and turbidity. In addition, the increased channel capacity of the new structure would be more efficient at passing debris, thereby reducing maintenance required at this site. However, maintenance at Agricultural Road Crossing 2 would still include vegetation and debris removal. To maintain fish passage through the structure, maintenance activities would occur in the non-flood season. Maintenance timing is also outside of peak ESA-listed species migration seasons when high temperatures and low DO levels are common in the Tule Canal. Effects to ESA-listed species are discountable because listed fish are not expected to be present.

### 2.5.4. Effects of Operation and Maintenance on Critical Habitat

Operation and maintenance of the Fremont Weir Passage Structure, Fremont Weir Stilling Basin, Upstream Channel, Reach 1, and Agricultural Crossing 2 will benefit designated critical habitat for spring-run Chinook, steelhead, or green sturgeon by improving the PBFs of freshwater migration corridors for adults and juveniles.

### 2.5.5. Effects of Monitoring and Adaptive Management on Listed Species

Upon completion of construction, Reclamation and DWR will monitor the fish passage efficacy of the structure for a period of no less than 5 years. Biological monitoring includes ARIS sonar-imaging observations, acoustic telemetry, and analysis of ongoing CDFW fish rescue efforts. Using an adaptive management framework, the results of these monitoring efforts will allow Reclamation and DWR to shift operations to improve the ability of the structure to pass fish.

The ARIS sonar-imaging camera will be installed in the structure to allow for direct observation of fish behavior. The unit would be flush-mounted into the structure, keeping it out of the flow path, negating the risk of added turbulence or direct injury to fish as a result of collision with the unit. Effects from the ARIS are discountable.

### 2.5.6. Effects of Monitoring and Adaptive Management on Critical Habitat

Monitoring and adaptive management of the Fremont Weir Passage Structure, Fremont Weir Stilling Basin, Upstream Channel, Reach 1, and Agricultural Crossing 2 will benefit designated critical habitat for spring-run Chinook, steelhead, or green sturgeon by improving the PBFs of freshwater migration corridors for adults and juveniles.

## 2.6. Cumulative Effects

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

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

### 2.6.1. Water Quality

Juvenile salmonids rearing on the Yolo Bypass floodplain are known to be vulnerable to methylmercury accumulation (Henery *et al.* 2010). It is likely that juvenile green sturgeon rearing on the floodplain would experience similar methylmercury accumulation. Agricultural practices in the Yolo Bypass may contribute to the degradation of water quality in the action area. Stormwater and irrigation runoff related to agricultural activities contain pesticides, sediments, and other contaminants that may negatively affect salmonid reproductive success and survival rates (McCarthy *et al.* 2008).

## 2.7. Integration and Synthesis

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

### 2.7.1. Status of the Species

Populations of winter-run and spring-run Chinook salmon and steelhead in California have declined drastically over the last century, and some populations have been extirpated. The current status of listed salmonids within the action area, based upon their risk of extinction, has not significantly improved since the species were listed (NMFS 2015, 2016a, 2016b, 2016c). This severe decline in populations over many years, and in consideration of the degraded environmental baseline, demonstrates the need for actions which will assist in the recovery of all of the ESA-listed species in the action area, and that if measures are not taken to reverse these trends, the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead could be at risk.

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2015).

### 2.7.2. Environmental Baseline and Cumulative Effects

The FWAFPM Project action area encompasses the northern portion of the Yolo Bypass including the Fremont Weir, a portion of the Fremont Weir Wildlife Area, two downstream agricultural road crossings in the Tule Canal, an area within the northern Elkhorn Basin, and 200 foot buffers from these locations. The action area is considered an important rearing and migratory corridor for all ESA-listed anadromous fish species. Upstream migrating adult green sturgeon and salmonids may arrive in the northern Yolo Bypass during Fremont Weir overtopping events where the Sacramento River stage is not high enough to provide adequate passage over the weir. Juvenile salmonids and green sturgeon may enter the Yolo Bypass if their migration down the Sacramento River coincides with a Fremont Weir overtopping event. Both adults and juveniles have the potential to be stranded in the stilling basin of the Fremont Weir and in nearby scour channels and ponds as floodwaters recede following overtopping events. Listed fish trapped in the shallow waters of the stilling basin and scour channels are vulnerable to poaching, poor water quality, and falling water levels.

It is also likely that adult salmonids are susceptible to straying into the Yolo Bypass as agricultural drainage increases through the Yolo Bypass during periods of low flow in the Sacramento River. These agricultural releases act as attraction flows that cause upstream migrating adults to stray into the Yolo Bypass while in the Cache Slough Complex south of the Yolo Bypass. During low flow periods, fish passage connectivity to the Sacramento River at Fremont Weir is compromised, which contributes to stranding in this area.

In addition, adult salmonids and sturgeon may experience delays if they encounter agricultural road crossings in Tule Canal at lower flows, when the agricultural crossings may not be submerged. The agricultural road crossings become submerged during higher flow conditions, such as when Fremont Weir overtops, eventually allowing salmonids or sturgeon to move beyond them. Adult or juvenile migratory fish, including salmonids and sturgeon, may become trapped in between these crossings as higher flows recede.

Baseline and cumulative effects from activities such as continued agricultural practices, bank stabilization projects, and recreational boating and fishing will continue to negatively affect the federally listed species in the action area. Runoff from agricultural activities may contain contaminants such as pesticides, sediments, and nutrients that may affect listed species through lethal and sublethal impacts. Levee construction and bank protection can reduce floodplain connectivity, change substrate size, and decrease riparian habitat and shaded riverine aquatic cover. However, NMFS expects the species and their designated critical habitats to improve with the implementation of CVP/SWP long-term operations biological opinion RPA actions I.6 and I.7 and recovery actions identified in NMFS (2014).

### 2.7.3. Effects on Listed Species

The potential negative effects of construction activities on listed species include elevated levels of noise, turbidity, or contaminants, and injury/morality related to fish relocation. However, it is unlikely that these construction activities will result in adverse effects to the listed species for the following reasons: (1) the potential negative impacts on listed species have been addressed and will be minimized through best management practices and conservation measures; (2) the work window avoids the primary migration windows of adult and juvenile winter-run Chinook salmon, adult spring-run, and adult green sturgeon; (3) although juvenile spring-run, adult and juvenile steelhead, and juvenile green sturgeon might occur in the Sacramento River, they would likely not be present in the action area due to the shallow water, poor water quality, and high water temperatures that occur in the action area during summer and early fall; (4) the work site would be dewatered during construction, preventing fish from migrating past the construction site; and (5) fish would move away from noisy environments with ongoing construction activities.

Operation of the proposed Fremont Weir fish passage structure would provide improved connectivity for ESA-listed fish species to enter the Sacramento River from the Yolo Bypass. This enhanced connectivity should increase individual survival as well as potentially increase spawning success outside of the Yolo Bypass. While this project is not likely to completely remedy the existing stranding issues along the Fremont Weir, it is expected to drastically improve conditions and greatly reduce stranding at Fremont Weir. In addition, the inflatable bladder bottom-hinged gate of the fish passage structure prevents fish from positioning themselves under the gate, and the gate takes roughly 60 minutes to fully close, providing fish with ample time to get out of the gate’s path of travel. In addition all maintenance activities would be conducted during the non-flood season when listed species would not likely be present on the Yolo Bypass floodplain.

NMFS has considered these potential effects of the proposed action on listed winter-run, spring-run, steelhead, and green sturgeon, combined with other ongoing activities within the action area, and determined that the proposed action is not expected to appreciably reduce the likelihood of survival and recovery of winter-run, spring-run, steelhead, and green sturgeon in the wild by reducing their spatial structure, diversity, abundance, and productivity. This conclusion is also due to the fact that the overall project effect will be beneficial to the listed species by improving fish passage in the Yolo Bypass.

### 2.7.4. Effects on Critical Habitat

The critical habitat for spring-run, steelhead, and green sturgeon in the action area is considered to have a high value necessary for the conservation of the listed species. The placement of engineered streambed material will permanently modify the area from the current physical habitat to an artificial substrate. The physical habitat area that will be modified is estimated to be 1.81 acres. As a conservation measure, the project proponent will purchase 5.43 acres through a NMFS-approved conservation bank. This conservation measure is a mitigation measure for offsetting the loss of critical habitat and essential fish habitat (see section 3.2).

Adult salmonids and sturgeon are not expected to be negatively impacted by replacing naturally occurring substrate with engineered streambed material, as they use the Yolo Bypass primarily as a migratory corridor. Juvenile salmonids may be impacted by the loss of natural substrate, though these impacts are expected to be minimal, as it is less than 2 acres of up to 59,000 acres of available floodplain rearing habitat when the Yolo Bypass is inundated from an overtopping event at Fremont Weir.

Based on the analysis of available evidence, the proposed action is likely to adversely affect the critical habitat, but is not likely to appreciably diminish the value of designated critical habitat for the conservation of spring-run, steelhead, and green sturgeon. In fact, overall the FWAFPM Project will not diminish, but will improve and increase the function of the migratory corridor to listed fish species by improving fish passage conditions in the Yolo Bypass.

### 2.7.5. Summary

Improving fish passage in the Yolo Bypass was identified as a high priority recovery action in the Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). Some potential effects of the implementation of the FWAFPM Project are expected to result in incidental take of listed anadromous fish in the action area, although negative effects are expected to be minimal. Most significant immediate and long-term effects of the FWAFPM Project will be to improve overall conditions for listed salmonids and green sturgeon by increasing fish passage from the Yolo Bypass into the Sacramento River.

The adverse effects that are anticipated to result from the implementation are not the magnitude that will be expected to appreciably reduce the likelihood of survival and recovery of the affected species in the action area, or at the ESU/DPS level. Nor are any temporary adverse effects to critical habitat expected to reduce the value of designated or proposed critical habitat for the conservation of the species. VSP parameters of spatial structure, diversity, abundance, and productivity are not expected to be appreciably reduced; in contrast, implementing this Project is expected to improve diversity, abundance, and productivity, which will be necessary for the Sacramento River Basin populations to reach a viable status, or as it functions as a major migratory corridor for all ESA-listed anadromous species. NMFS expects that any adverse effects of the FWAFPM Project will be outweighed by the immediate and long-term benefits to species survival, and increasing abundance, produced by the improvement in rearing and migratory habitat.

## 2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run, California Central Valley steelhead, sDPS North American green sturgeon or destroy or adversely modify their designated critical habitats.

## 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 incidental take statement.

### 2.9.1. Amount or Extent of Take

It is impossible to quantify and track the amount or number of individuals that are expected to be incidentally taken per species as a result of the proposed action due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of migration and rearing, and individual habitat use within the action area.

However, it is possible to designate as ecological surrogates those elements of the proposed action that are expected to result in incidental take, that are also somewhat predictable and/or measurable, with the ability to monitor those surrogates to determine the level of incidental take that is occurring. The most appropriate thresholds for incidental take is the ecological surrogate of habitat modification due to the permanent loss of 1.81 acres of rearing habitat. The behavioral modifications or fish responses that are likely to result from the habitat loss are described below. There is not a stronger ecological surrogate based on the information available.

(1) Incidental take in the form of reduce growth, increase predation, leading to reduced fitness and survival of juvenile salmonids and green sturgeon is expected to occur due to the loss of rearing habitat.

It is assumed that a very low proportion of the population will be affected due to the 59,000 acres of adjacent rearing habitat that is available. If the amount of habitat disturbance described in the surrogate is exceeded, the proposed action will be considered to have exceeded anticipated take levels.

### 2.9.2. Effect of the Take

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

### 2.9.3. Reasonable and Prudent Measures

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

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize the take of winter-run, spring-run, steelhead, and green sturgeon.

(1) Reclamation and DWR shall minimize impacts to listed species and their critical habitats

(2) Reclamation and DWR shall take measures to ensure implementation of the monitoring and adaptive management as detailed in the BA and this biological opinion.

### 2.9.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and Reclamation and DWR must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). Reclamation and DWR have 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 incidental take statement (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 term and condition implement reasonable and prudent measure 1:

Reclamation and DWR shall implement BMPs and conservation measures as detailed in the BA and this biological opinion, ensure that the contractors and operators of the equipment comply with those BMPs and conservation measures, and educate and inform personnel involved in the implementation of the FWAFPM Project as to the BMPs and conservation measures.

(2) The following term and condition implement reasonable and prudent measure 2:

Reclamation and DWR shall continue to coordinate with NMFS during the implementation and monitoring of the FWAFPM Project as necessary by providing updates on progress and status. Annual technical memoranda that summarize the results of the study plan as part of the Post-Construction Monitoring, Evaluation, and Adaptive Management Plan shall be submitted to NMFS no later than December 31 of each year:

Attn: Assistant Regional Administrator
California Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, California 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).

(1) Reclamation and DWR should support and promote aquatic and riparian habitat restoration in the Sacramento River and other watersheds of the CVP and SWP with listed aquatic species. Practices that avoid or minimize negative impacts to listed species should be encouraged.

(2) Reclamation and DWR should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects.

(3) Reclamation and DWR should use species recovery plans to help ensure that their actions will address the underlying processes that limit fish recovery, and to identify key actions in the action area when prioritizing project sites each year. The final recovery plan for Central Valley listed salmonids is available at:

http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/california_central_valley/california_central_valley_recovery_plan_documents.html

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

### 2.11. Reinitiation of Consultation

This concludes formal consultation for the Fremont Weir Adult Fish Passage Modification 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 incidental take statement 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 biological opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

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

### 3.1. Essential Fish Habitat Affected by the Project

Reclamation and DWR have determined that the proposed action may adversely affect essential fish habitat for Pacific coast salmon, including winter-, spring-, fall-, and late fall-run Chinook salmon. EFH in the action area consists of adult migration habitat and juvenile rearing and migration habitat for the four salmon runs. There are no habitat areas of particular concern in the action area.

### 3.2. Adverse Effects on Essential Fish Habitat

The effects of the proposed action on Pacific Coast salmon EFH would be similar to the effects of this action on the designated critical habitat of listed salmonids. The proposed action may result in short-term and long-term adverse effects on Pacific coast salmon EFH that would be minimized by implementing various BMPs and Conservation Measures. Potential short-term effects include construction-related increases in noise, turbidity, and suspended sediment in the Yolo Bypass. Construction of new channels upstream and downstream of the new fish ladder structure, and construction of Agricultural Crossing 2, would result in effects on Pacific coast salmon EFH due to loss of 1.81 acres of riparian habitat and natural substrate. The impacts of replacing natural substrate with engineered streambed material are expected to be minimal, particularly at the agricultural road crossings because of the low quality of existing habitat. The Tule Canal is an agriculture drain with simple leveed slopes that are characterized by steep banks. Additionally, most of the engineered streambed material placed at Agricultural Road Crossing 2 would be placed at the site of the existing earthen berm, and would therefore be new aquatic habitat. At the Fremont Weir, the affected EFH comes in the form of modified channels and fish passage structures. The improvements made at Agricultural Road Crossings 2 and 3 would convert 0.42 acres of upland habitat (in the form of earthen berms) to open water, aquatic habitat.

### 3.3. Essential Fish Habitat Conservation Recommendations

The proposed action includes adequate measures described in the ESA section 7 consultation above to avoid, minimize, or otherwise offset the adverse effects to EFH. Therefore, EFH Conservation Recommendations are not being provided at this time. However, if there are revisions to the project description that may result in adverse effects to EFH, Reclamation will need to re-initiate EFH consultation.

## 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 biological 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 user of this biological opinion is Reclamation. Other interested users could include the applicant (Department of Water Resources), California Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. An individual copy of this biological opinion was provided to Reclamation. This biological opinion will be posted on the Public Consultation Tracking System web site (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 biological 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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