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

Refer to NMFS No: WCR-2018-9970

June 25, 2018

Ms. Sue Bauer
Branch Chief
North Region Environmental Planning M-1
District 3
California Department of Transportation
703 B Street
Marysville, California 95907

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the Sacramento River I Street Bridge Replacement Project in Sacramento and Yolo Counties (03-3F090)

Dear Ms. Bauer:

Thank you for your letter of August 8, 2016, and biological assessment (BA), requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Sacramento River I Street Bridge Replacement Project (Project) in Sacramento and Yolo counties.

This biological opinion (BO) is based on the final BA for the Sacramento River I Street Bridge Replacement Project in Sacramento and Yolo counties. Based on the best available scientific and commercial information, the BO concludes that the Project is not likely to jeopardize the continued existence of the Federally listed threatened California Central Valley steelhead (*Oncorhynchus mykiss*), Central Valley spring-run Chinook Salmon (*Oncorhynchus tshawytscha*), Sacramento River winter-run Chinook Salmon (*Oncorhynchus tshawytscha*), or the Southern distinct population segment of North American green sturgeon (*Acipencer medirostris*) and is not likely to destroy or adversely modify their designated critical habitats. NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the Project.

This letter also transmits NMFS's review of potential effects of the Project on essential fish habitat (EFH) for Pacific Coast Salmon, designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. The analysis concludes that the project will adversely affect the EFH of Pacific Coast Salmon in the action area. The EFH consultation concludes with conservation recommendations.

The California Department of Transportation (Caltrans) has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed written response to NMFS within 30 days of receipt of these conservation recommendations, and 10 days in advance of any action, that includes a description of measures adopted by Caltrans for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR § 600.920(j)). If unable to complete a final response within 30 days, Caltrans should provide an interim written response within 30 days before submitting its final response. In the case of a response that is inconsistent with our recommendations, Caltrans must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the I Street Bridge Repair Project and the measures needed to avoid, minimize, or mitigate (also referred to as compensate by NMFS) such effects.

Please contact LTJG Caroline Wilkinson at the California Central Valley Office of NMFS at (916) 930-3731 or via email at caroline.wilkinson@noaa.gov if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

Maria Rea
for Barry A. Thom
Regional Administrator

Enclosure

cc: To the file: 151422-WCR2017-SA00319

UNITED STATES DEPARTMENT OF COMMERCE
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act (MSA) Essential Fish Habitat (EFH) Consultation, and Fish and Wildlife Coordination Act Recommendations

Sacramento River I Street Bridge Replacement Project in Sacramento and Yolo Counties
Project Number 03-3F090

NMFS Consultation Number: WCR-2018-9970

Action Agency: California Department of Transportation (Caltrans)

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	Yes	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
Southern distinct population segment of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No

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

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

Issued By: Maria Rea

for Barry A. Thom
Regional Administrator

Date: June 25, 2018

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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

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

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

Because the proposed action would modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources, and enabling the Federal agency to give equal consideration with other project purposes, as required under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

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

1.2 Consultation History

- On August 28, 2015, NMFS issued a species list to California Department of Transportation (Caltrans).
- On November 17, 2015, LTJG Sean Luis participated in a site visit to the proposed I Street Bridge site.
- On August 8, 2016, the NMFS West Coast Region – California Central Valley Office (CCVO) received a consultation initiation request and Biological Assessment (BA) from Caltrans for the I Street Bridge Replacement Project (Project). This Project is a cooperation between Caltrans and the Cities of Sacramento and West Sacramento, California.
- On January 10, 2017, NMFS CCVO received an email update from Caltrans that less rock slope protection (RSP) would be required than initially expected, thus reducing the permanent impacts for this Project.
- On April 4, 2017, NMFS requested more information about the use and movement of the barge in the waterway during times outside of the in-water work window.

- On June 5, 2017, NMFS received via email a memorandum dated May 19, 2017, with updated information about the use of the barge, a further update to the amount of RSP to be used, and a document that addressed errata in the original BA.
- On May 22, 2018, the consultation was initiated based on Caltrans' timeline.

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). "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). No interrelated actions or interdependent actions were identified.

Under the MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

Under the FWCA, an action occurs whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license" (16 USC 662(a)).

NMFS recognizes that Caltrans has assumed the Federal Highway Administration's (FHWA) responsibilities under Federal environmental laws for ESA section 7 consultation on this project as allowed by a Memorandum of Understanding (NEPA Assignment) with the FHWA effective December 23, 2016.

The City of Sacramento, in cooperation with the City of West Sacramento and Caltrans, propose to replace the existing I Street Bridge between the cities of Sacramento and West Sacramento, California with a new bridge. The Project will replace the existing functionally obsolete and structurally deficient bridge, and replace it with a larger, safer bridge approximately 1,000 feet north of the existing bridge. The existing bridge will be left in place to remain in use as a railroad bridge. Work on this project is expected to begin in spring 2019 and complete construction by mid-summer 2021. In-water work will be conducted over two seasons from May 1 through November 30. The new bridge will consist of two vehicle lanes, on-street Class II bike lanes, and sidewalks along both sides. The proposed bridge will be approximately 860 feet long, composed of five spans, with an approximately 330-foot long movable center span to meet United States Coast Guard (USCG) requirements.

1.3.1 Construction of New Bridge

The new bridge will consist of two fixed-span approach structures that tie into the Sacramento and West Sacramento banks of the river. The two fixed-span approaches will be 72 feet wide and approximately 200 feet and 270 feet in length on the Sacramento and West Sacramento banks, respectively. The center span of the bridge will consist of a movable span that meets USCG requirements. The movable span will be approximately 330 feet in length. The bridge soffit elevation will be set 3 feet above the 200-year water surface elevation to comply with the Central

Valley Flood Protection Board (CVFPB) freeboard requirements. Each of the fixed-span approaches will consist of two spans. Each approach structure will consist of an abutment on the bank of the river, a center pier within the river located around the existing bank toe of slope, and the another set of piers that also supports the movable center span. The movable center span will provide a 278-foot clear channel opening centered near the middle of the river. The moveable span will likely be a vertical lift bridge that will raise the center span to a minimum vertical clearance of 59 feet over the maximum river elevation of 31 feet.

Due to the existing soil conditions, the bridge will be constructed on deep pile foundations. Table 1 summarizes the type and size of piles that will be used during construction of the new bridge, and the depth to which the piles will be installed. The abutments for the fixed-span approach structures at the river bank will consist of approximately 50 piles per abutment that are driven or cast-in-drill-hole (CIDH), to a depth of approximately 70 feet below the original ground elevation. The center piers for the two fixed-span approach structures (located approximately at the bank toe of slope in the river, below the Ordinary High Water Mark (OHWM)) will consist of 50 driven or CIDH piles per pier that are approximately 70 feet below the original ground elevation. If driven piles are selected for either the abutments or piers, the piles will be precast concrete or steel. The foundations for the movable span will consist of four large-diameter cast-in-steel-shell (CISS) piles per pier. Each pile will be 108 inches in diameter, extending approximately 140 feet below the original ground elevation, and will be driven with a vibratory hammer and/or with a hydraulic oscillator/rotator system.

Table 1. Piles Proposed to Construct I Street Bridge

Pile Location	Pile Diameter/ Type	Total Number of Piles to be Installed	Depth of Installation below ordinary ground elevation (feet)	Temporary or Permanent Installation
Abutments 1 and 6	16-in diameter steel	100	70	Permanent
	16-in square precast concrete (alternative to 16-in diameter steel			
Piers 2 and 5	16-in diameter steel	100	70	Permanent
	16-in square precast concrete (alternative to 16-in diameter steel			
Piers 3 and 4	108-in steel casings	8	140	Permanent
Bridge Fender System	16-in diameter concrete	60	30	Permanent
Temporary trestle	16-in diameter steel	160	70	Temporary
	16-in H pile (alternative to 16-in diameter steel pile above)			
Spud piles	16-in diameter steel	8	40	Temporary
Cofferdams	Sheet piles	180	25	Temporary

The proposed Project would include the placement of temporary and permanent fill (bridge piers and RSP) below the OHWM and would result in the temporary and permanent loss of aquatic habitat area and volume, rearing and migration habitat for anadromous fish. A total of up to 0.07 acre of permanent impacts on perennial stream and anadromous fish habitat in the Sacramento River would result from the following bridge components and RSP to be placed below the OHWM. The two fixed-span approach structures for the new bridge would be constructed on center piers (Piers 2 and 5) with foundations each consisting of 50 driven or CIDH piles. The piles would be covered by pile caps. The footprint for Piers 2 and 5 on the river bottom would total 2,500 square feet (0.06 acre). The movable span section of the bridge would be constructed on a foundation of four 108-inch diameter CISS piles in the riverbed. The CISS piles, consisting of hollow steel shells, would be driven into the channel bottom using drivers and cranes on the temporary trestle or mounted on barges to temporarily place the steel shells at the desired location for each pile. Once the steel shells are in place, the soil inside the shell would be drilled out, and concrete would be poured into the dewatered hollow shells. The piles would be covered by pile caps. The footprint for Piers 3 and 4 on the river bottom would total 464 square feet (0.001 acre). A bridge fender system would be constructed around the movable span piers that would include approximately 30 driven piles around each pier. The footprint of the bridge fender system on the river bottom would total 85 square feet (0.002 acre). RSP (1/4-ton, Method B) would be installed along 120 linear feet of shoreline (approximately 60 linear feet on City of Sacramento shoreline and 60 linear feet on City of West Sacramento shoreline). This would include covering approximately 300 square feet (0.007 acre) of the bank below the OHWM on the City of Sacramento shoreline. A total of up to 37 cubic yards of RSP would be placed below the OHWM and a total of up to 574 cubic yards of RSP would be placed above the OHWM.

Overall, a total of 0.07 acres of critical habitat below the OHWM will be lost to hardscape by the repair of the levee and the placement of bridge piers and RSP. An additional 1.26 acres will be affected by shade created by the new bridge structure. A total of 1.44 acres of cottonwood riparian habitat will be permanently lost to hardscape by the levee and bridge structures, 0.44 of which is below the OHWM.

The new bridge will include a fender system around the moveable span piers to protect the piers from watercraft in the river. The fender system will consist of approximately 30 driven concrete piles around each of the movable span piers (Table 1). The piles will be driven to a depth of about 30 feet below the river bottom.

Construction of the new bridge foundations and approach structures will require the use of temporary work trestles. The trestles will be constructed during the first construction season using temporary piles within the river. Each trestle will include approximately 80 driven steel piles. Either 16-inch diameter hollow piles or 16-inch H piles (Table 1).

1.3.2 Roadway, Bikeway, and Levee Modifications

The new bridge alignment will require several roadway modifications. In Sacramento, Railyards Boulevard will be extended west onto the new bridge over the Sacramento River. East of Bercut Drive, Railyards Boulevard will consist of two westbound lanes and one eastbound lane. Between Jibboom Street and Bercut Drive, Railyards Boulevard will consist of two westbound lanes and three eastbound lanes. The intersection of Railyards Boulevard with Jibboom Street and Bercut Drive will consist of either a signalized intersection or a roundabout with two lanes in each direction. West of the Jibboom Street intersection, Railyards Boulevard will consist of one lane in each direction.

Bercut Drive will be modified from Railyards Boulevard north approximately 500 feet. Bercut Drive will have two northbound lanes at the Railyards Boulevard intersection, tapering down to one northbound and one southbound lane at the northern project limits. Any improvements to Bercut Drive south of Railyards Boulevard are not part of this Project.

Improvements to Jibboom Street will extend 550 feet north of Railyards Boulevard. Jibboom Street will consist of one travel lane in each direction, on-street Class II bike lanes, a sidewalk along the west side of the roadway, and retaining walls of various heights along both sides of the road. Improvements to or extension of Jibboom Street south of Railyards Boulevard are not part of this Project.

This Project includes raising the roadway profile for Railyards Boulevard to approximately 6 feet higher than the original ground elevation at the Jibboom Street intersection. The profile adjustment will satisfy the Central Valley Flood Protection Board requirements to provide 3 feet of clearance between the 200-year floodwater surface elevation and the bridge soffit, or low chord of the bridge.

In West Sacramento, modifications to the alignment of C Street will cut off access to four residential parcels and one multifamily parcel located along 2nd Street north of C Street. The new alignment will connect to C Street approximately 150 feet east of the 3rd Street intersection and continue north approximately 300 feet. The new alignment will then make a 90-degree left turn and connect to 3rd Street approximately 300 feet north of C Street. The new alignment will require right-of-way acquisition from seven individual parcels and removal of three structures, two individual residences and one apartment building.

Between the bridge touchdown location along C Street in West Sacramento and the 4th Street/C Street intersection, the roadway will consist of one westbound travel lane, two eastbound travel lanes, a center left-turn lane, on-street Class II bike lanes, on-street parking along the north side of the roadway, and sidewalks along both sides of the roadway. As the roadway through this section currently consist of the proposed number of travel lanes, the widening to occur in this area will support the Class II bike lanes and wider sidewalks.

Along C Street between 4th Street and 5th Street, the roadway will consist of one travel lane in each direction, left-turn lanes, on-street Class II bike lanes, and sidewalks along both sides of the road. All of the improvements through this section will be accommodated within the existing roadway limits.

Reconstruction of the existing Class I bikeway, the Sacramento River Parkway, along Jibboom Street, will occur approximately 500 feet north and 300 feet south of Railyards Boulevard. Grade-separation of the path under the proposed bridge structure will accommodate a continuous off-street Class I path along this section. Cyclists and pedestrians approaching Railyards Boulevard in either direction will have the option to continue along the path under the new bridge, avoiding the need to cross the roadway. Cyclists and pedestrians traveling along the path will have the option to connect to Railyards Boulevard and cross over the new bridge into West Sacramento or turn east into Sacramento. Due to the limited horizontal clearance between the Sacramento River and the Interstate 5 (I-5) viaduct structure, retaining walls will be constructed along the path to account for the vertical elevation difference between Jibboom Street and that pat that will continue under the new bridge. Retaining walls will be 16 feet or less in height.

In West Sacramento, improvements to the levee will occur 300 feet north and 300 feet south of the proposed C Street alignment in order to bring the levee into current standards required by Title 23 of the California Code of Regulations. Modifications will require 3:1 side slopes on both the landside and waterside of the levee and a 20-foot wide crown at the top of the levee. Levee improvements will also include a slurry cutoff wall, which will extend to a depth of 110 feet below the original ground elevation. The proposed roadway profile will cross over the levee at approximately 6 feet higher than the original ground elevation. To maintain access to the levee for inspection and maintenance, access roads will be constructed from the new roadway to the top of the improved levee section. The proposed grading for the levee will require relocation of a water tower located along 2nd Street just north of the proposed C Street alignment. Relocation of the water tower will be approximately 43 feet to the northwest of the existing location.

The proposed levee maintenance road will serve as the future Class I River Walk Park Trail extension in West Sacramento. Similar to the trail improvements proposed above for Sacramento, grade-separation of the trail will occur under the proposed bridge structure. Cyclists and pedestrians approaching C Street in either direction will have the option to continue along the trail under the new structure, avoiding the need to cross the roadway. Cyclists and pedestrians who are traveling along the trail also will have the option to connect to C Street to cross over the proposed bridge into Sacramento or head west on C Street.

1.3.3 Over-water Construction Site Access

This Project will require the usage of temporary trestles and barges in order to provide contractor access to the river portion of the Project area. Trestles and barges will provide staging areas for construction materials, a working platform for cranes, and general construction support. The temporary trestles will consist of 160 16-inch diameter steel piles or 16-inch H-piles that will be driven into place with an impact hammer. A temporary work platform will be built around the steel piles. The platform will be removed at the end of the first construction season, but the piles will remain in place for the duration of the entire Project.

Barges will also be used to provide access to the Project location. Each barge will be anchored to the river bottom with four 16-inch diameter steel spud piles that will be driven into place with an impact hammer. Up to two barges will be anchored in the river at one time. Barges will be repositioned in the channel throughout construction only as needed to complete the work. The barges will be removed after the completion of bridge construction.

1.3.4 In-water Construction Activities

In-water construction activities consist of construction activities that occur below the OHWM. In-water work will occur only within the period of May 1 to November 30 during each of the construction seasons. The work window will allow most of the in-water construction work to be completed during the first construction season. Other construction activities above the OHWM may continue to occur outside of the in-water work window.

In-water construction activities will include the following:

- Installation and removal of 160 steel piles with a vibratory hammer and an impact hammer for the temporary falsework platforms (trestles). The piles will be embedded approximately 70 feet below the original ground elevation, based on preliminary engineering and site analysis.
- Installation and removal of eight steel spud piles with an impact hammer for anchoring barges. The piles will be embedded approximately 40 feet into the substrate, based on preliminary engineering and site analysis.
- Installation of steel sheet piles with a vibratory driver for temporary cofferdams.
- Installation of 100 steel piles for piers 2 and 5 with an impact hammer for the new bridge (although work will occur within dewatered cofferdams, underwater sound will propagate beyond the dewatered cofferdams). The piles will be embedded approximately 70 feet into the substrate, based on preliminary engineering and site analysis.
- Installation of eight 108-inch-diameter steel casings for piers 3 and 4 with a vibratory hammer and/or hydraulic oscillator/rotator system for the new bridge. The piles will be embedded approximately 140 feet into the substrate, based on preliminary engineering and site analysis.
- Installation of 30 concrete piles with an impact hammer for the new bridge fender system. The piles will be embedded approximately 30 feet into the substrate, based on preliminary engineering and site analysis.
- Installation of RSP along the shorelines of Sacramento and West Sacramento to prevent erosion. Approximately 120 linear feet of shoreline will be lined with rock, 60 linear feet on each city's shoreline. A total of up to 37 cubic yards of RSP will be placed below the OHWM.

1.3.5 Avoidance and Minimization Measures

- Bubble curtains will be installed around piles during impact driving and proofing operations to dampen underwater sound shockwaves.
- The construction contractor will conduct several dry or dead blows with the hammer initially to frighten fish away from the pile before the pile is driven or proofed with an impact pile driver. Implementation of several dry or dead blows with the hammer to initially frighten fish away is being proposed because the use of a cushioning block or similar feature would result in more strikes being needed to drive the piles, thereby resulting in a greater chance of exceeding the cumulative sound exposure levels (SELs) without significantly reducing peak SELs.
- Install orange construction fencing between the construction area and adjacent sensitive biological resources
    - The Project proponent and/or their contractor will install orange construction fencing between the construction area and adjacent sensitive biological resource areas including protected trees to be avoided.
- Conduct environmental awareness training for construction employees
    - A qualified biologist will conduct the training, which will inform the construction crews on the need to avoid effects to listed anadromous fish

species and their habitats, identify where these species and habitats are most likely to occur, and cover the reporting protocol, restrictions, and guidelines that must be followed to reduce or avoid effects to species and habitats during the Project.

- Conduct periodic biological monitoring
    - A qualified biological monitor will visit the site a minimum of once per week to ensure the fencing has remained in place and that activities are being conducted in accordance with the agreed upon Project schedule and agency conditions of approval.
    - Certain construction activities will require a biological monitor for the duration of the activity or during the initial disturbance of an area. These activities include impact pile driving, turbidity monitoring, and fish capture and relocation.
- Conduct all in-water construction activities between May 1 and November 30 and during daylight hours only
    - All in-water construction work, including pile driving (in-water and on shore within 250 feet of the Sacramento River), installation of cofferdams, removal of temporary sheet piles, and placement of RSP will occur within the in-water work window.
    - In-water work will only occur during daylight to allow fish to use nighttime hours for feeding and unobstructed passage.
- Implement measures to minimize sound levels during pile driving
    - The contractor will vibrate all piles to the maximum depth possible before using an impact hammer.
    - No more than 20 piles will be driven per day.
    - Pile driving will occur on no more than 75 total days during construction.
    - For the piles for the bridge piers and for temporary trestle piles, the number of strikes per day will be limited to 16,000 (i.e. 800 hammer strikes per pile, per day).
    - For the bridge fender piles, the number of strikes per day will be limited to 20,000 (i.e. 1,000 hammer strikes per pile per day).
    - The smallest pile driver and minimum force necessary will be used to complete the work.
    - Sound attenuation devices such as a bubble curtain or similar will be used in order to minimize the extent to which the interim peak and cumulative SEL thresholds are exceeded.
    - No pile driving will occur at night.
- Develop and implement a hydroacoustic monitoring plan. The plan will be submitted to NMFS and other resource agencies for approval at least 60 days before the start of project activities. The plan will include the following requirements:
    - The project proponent and/or the contractor will monitor underwater noise levels during all impact pile driving activities on land and in water to ensure the peak and cumulative SELs do not exceed estimated values.
    - The monitoring plan will describe the methods and equipment that will be used to document the extent of underwater sounds produced by pile driving, including the

number, location, distances, and depths of hydrophones and associated monitoring equipment.
    - The monitoring plan will include a reporting schedule for daily summaries of the hydroacoustic monitoring results and for more comprehensive reports to be provided to the resource agencies on a monthly basis during the pile-driving season.
    - The daily reports will include the number of piles installed per day; the number of strikes per pile; the interval between strikes; the peak Sound Pressure Level, SEL, and RMS per strike; and the accumulated SEL per day at each monitoring station.
    - The Project proponent or its contractors will ensure that a qualified fish biologist is on site during impact pile driving to document any occurrences of stressed, injured, or dead fish. If stressed, injured, or dead fish are observed during pile driving, the Project proponent and/or its construction contractor will reduce the number of strikes per day to ensure that fish are no longer showing signs of stress, injury, or mortality.
- Protect water quality and prevent erosion and sedimentation in drainages and wetlands by producing a storm water pollution prevention plan (SWPPP) and using best management practices (BMPs). BMPs will include:
    - All earthwork or foundation activities involving wetlands or the intermittent vegetated stream will occur in the dry season (between May 1 and October 31). All in-water work within the Sacramento River will be conducted between May 1 and November 30 to minimize or avoid potential impacts on sensitive life stages (migration and rearing) of listed fish species.
    - Equipment used in and around drainages and wetlands will be in good working order and free of dripping or leaking engine fluids. All vehicle maintenance will be performed at least 300 feet from all streams. Any necessary equipment washing will be carried out where the water cannot flow into drainages or wetlands.
    - Develop a hazardous material spill prevention control and countermeasure plan before construction begins. The plan will include strict onsite handling rules to keep construction and maintenance materials from entering the river, including procedures related to refueling, operating, storing, and staging construction equipment and to preventing and responding to spills. The plan also will identify the parties responsible for monitoring a spill response. During construction, any spills will be cleaned up immediately according to the spill prevention control and countermeasure plan. The Project proponent will review and approve the contractors' spill prevention control and countermeasure plan before allowing construction to begin.
    - Prohibit the following types of materials from being rinsed or washed into the streets, shoulder areas, or gutters: concrete, solvents and adhesives, thinners, paints, fuels, sawdust, dirt, gasoline, asphalt and concrete saw slurry, and heavily chlorinated water.
    - Take any surplus concrete rubble, asphalt, or other rubble from construction to a local landfill.
    - Prepare and implement an erosion and sediment control plan for the proposed Project that will include the following provisions and protocols. The SWPPP for

the Project will detail the applications and type of measures and the allowable exposure of unprotected soils.

  - Discharge from dewatering operations, if needed, and runoff from disturbed areas will be made to conform to the water quality requirements of the waste discharge permit issued by the Recreational Water Quality Criteria.
  - Apply temporary erosion control measures, such as sandbagged silt fences, throughout construction of the proposed Project and remove them after the working area is stabilized or as directed by the engineer. Soil exposure will be minimized through use of temporary BMPs, groundcover, and stabilization measures. Exposed dust-producing surfaces will be sprinkled daily, if necessary, until wet. This measure will be controlled to avoid producing runoff. Paved roads will be swept daily following construction activities.
  - The contractor will conduct periodic maintenance of erosion and sediment control measures.
  - Plant an appropriate seed mix of native species on disturbed areas upon completion of construction.
  - Cover or apply nontoxic soil stabilizers to inactive construction areas (previously graded areas inactive for 10 days or more) that could contribute sediment to waterways.
  - Enclose and cover exposed stockpiles of dirt or other loose, granular construction materials that could contribute sediment to waterways. Material stockpiles will be located in non-traffic areas only. Side slopes will not be steeper than 2:1. A filter fabric fence and interceptor dike will surround all stockpile areas.
    - Contain soil and filter runoff from disturbed areas by berms, vegetated filters, silt fencing, straw wattle, plastic sheeting, catch basins, or other means necessary to prevent the escape of sediment from the disturbed area.
    - Use other temporary erosion control measures (such as silt fences, staked straw bales/wattles, silt/sediment basins and traps, check dams, geofabric, sandbag dikes, and temporary revegetation or other ground cover) to control erosion from disturbed areas as necessary.
    - Avoid earth or organic material from being deposited or placed where it may be directly carried into the channel.
- Monitor turbidity in the Sacramento River
  - The Project proponent will require the construction contractor to monitor turbidity levels in the Sacramento River during in-water construction activities (e.g., pile driving, extraction of temporary sheet piles used for cofferdams, placement of RSP). Turbidity will be measured using standard techniques upstream and downstream of the construction area to determine whether changes in ambient turbidity levels exceed 20%, the threshold derived from the Sacramento and San Joaquin Rivers Basins Plan (Central Valley Regional Water Quality Control Board 2011). If it is determined that turbidity levels exceed the 20% threshold, then the Project proponent and/or its contractors will adjust work to ensure that turbidity levels do not exceed the 20% threshold.
- Implement cofferdam restrictions
  - The extent of cofferdam footprints will be limited to the minimum necessary to support construction activities.

- Sheet piles used for cofferdams will be installed and removed using a vibratory 0pile driver.
- Cofferdams will not be left in place over winter where they could be overtopped by winter/spring flows and when juveniles of listed species are most likely to be present in the construction area.
- All pumps used during dewatering of cofferdams will be screened according to California Department of Fish and Wildlife (CDFW) and NMFS guidelines for screens.
- Cofferdam dewatering and fish rescue/relocation from within cofferdams will commence immediately following cofferdam closure.

- Prepare and implement a fish rescue and relocation plan. The fish rescue and relocation plan will be submitted to the resource agencies [CDFW, NMFS, and U.S. Fish and Wildlife Service (USFWS)] for approval at least 60 days before initiating activities to install cofferdams. At a minimum, the plan will include the following:
  - A requirement that fish rescue and relocation activities will commence immediately after cofferdam closure and that dewatering has sufficiently lowered water levels inside cofferdams to make it feasible to rescue fish.
  - A description of the methods and equipment proposed to collect, transfer, and release all fish trapped within cofferdams. Capture methods may include seining, dip netting, and/or electrofishing as approved by CDFW, NMFS, and USFWS. CDFW, NMFS, USFWS, and the Project proponent and/or contractor will cooperatively develop the precise methods and equipment.
  - A requirement that only CDFW-, NMFS-, and USFWS-approved fish biologists will conduct the fish rescue and relocation.
  - A requirement that fish biologists will contact CDFW, NMFS, and USFWS immediately if any listed species are found dead or injured.
  - A requirement that a fish rescue and relocation report be prepared and submitted to CDFW, NMFS, and USFWS within 5 business days following completion of the fish relocation. Data will be provided in tabular form and at a minimum will include the species and number rescued and relocated, approximate size of each fish (or alternatively, approximate size range if large number of individuals are encountered), date and time of their capture, and general condition of all live fish (e.g., good–active with no injuries; fair–reduced activity with some superficial injuries; poor–difficulty swimming/orienting with major injuries). For dead fish, additional data will include fork length and description of injuries and/or possible cause of mortality if it can be determined.
- Prevent the spread or introduction of aquatic invasive species (AIS) including invasive mussels and aquatic plants and hydrilla. The Project proponent or its contractors will implement the following actions to prevent the potential spread or introduction of AIS associated with barges and other construction activities:
  - The Project proponent or its contractors will coordinate with the CDFW’s Invasive Species Program to ensure that the appropriate BMPs are implemented to prevent the spread or introduction of AIS.
  - Educate construction supervisors and managers about the importance of controlling and preventing the spread of AIS.

- Train vessel and equipment operators and maintenance personnel in the recognition and proper prevention, treatment, and disposal of AIS.
- To the extent feasible, prior to departure of vessels from their place of origin and before in-water construction equipment is allowed to operate within the waters of the Sacramento River, thoroughly inspect and remove and dispose of all dirt, mud, plant matter, and animals from all surfaces that are submerged or may become submerged, or places where water can be held and transferred to the surrounding water.

- Minimize or avoid temporary construction lighting and permanent bridge lighting from directly radiating on water surfaces of the Sacramento River. The effects of nighttime lighting on special-status fish species will be minimized or avoided by implementing the following actions:
  - *Temporary Construction Lighting*
    - Avoiding construction activities at night, to the maximum extent practicable.
    - Using the minimal amount of lighting necessary to safely and effectively illuminate the work areas.
    - Shielding and focusing lights on work areas and away from the water surface of the Sacramento River, to the maximum extent practicable.
  - *Permanent Bridge Lighting*
    - Minimizing nighttime lighting of the bridge structure for aesthetic purposes.
    - Using the minimal amount of lighting necessary to safely and effectively illuminate vehicular, bicycle, and pedestrian areas on the bridge.
    - Shielding and focusing lights on vehicular, bicycle, and pedestrian areas and away from the water surface of the Sacramento River, to the maximum extent practicable.
- Onsite mitigation
  - Disturbed areas will be reseeded with an appropriate seed mix of native species on disturbed areas upon completion of construction.
  - To mitigate for the loss of 1.44 acres of riparian forest, onsite mitigation will be used to the greatest extent practicable. Planted species will be similar to those removed and all plants will be fitted with exclusion cages or other protection from herbivory. Plants will be monitored and irrigated for 3 years or as required in the project permits. If 75 percent of the plants survive at the end of the monitoring period, the re-vegetation will be considered successful. If the survival criterion is not met at the end of the monitoring period, planting and monitoring will be repeated after mortality causes have been identified and corrected.
  - The 0.44 acres of affected shaded riverine aquatic habitat (SRA) below the OHWM will be replaced at a 3:1 ratio by planting native riparian trees in temporary impact areas and along existing onsite or offsite unshaded banks along the Sacramento River.
  - Plant riparian trees that are intended to provide SRA cover along the water's edge at summer low flows up to the OHWM and at sufficient densities to provide shade along at least 85% of the bank's length when the trees reach maturity.

1.3.6 Mitigation Banking

Caltrans plans to mitigate for the impacts of the I Street Bridge Replacement Project by purchasing credits from a NMFS approved mitigation bank at a 3:1 ratio for permanent impacts on critical habitat below the OHWM and in water column habitat, totaling 1.33 acres from the new bridge piers and RSP (0.07 acre) and from the bridge shading of aquatic habitat (1.26 acre). Caltrans proposes to mitigate the permanent loss of critical habitat through the purchase of 3.99 acres of mitigation credits at a NMFS-approved fish conservation bank.

Caltrans will compensate for the permanent fill of 1.85 acres of other waters of the United States in the Sacramento River by purchasing mitigation bank credits at either (1) a minimum of 2:1, for a total of up to 3.7 acres, if credits are for preservation of habitat; or (2) a minimum of 1:1, for a total of 1.85 acres, if the credits are for creation of habitat.

Additionally, Caltrans plans to mitigate for the loss of 1.44 acres of riparian forest by mitigating onsite to the maximum extent practicable. Offsite compensation will be used to achieve no net loss of existing in-kind riparian cover habitat values. Caltrans will compensate for the loss of 1.44 acres of riparian forest by purchasing mitigation bank credits at either (1) a minimum of 2:1, for a total of up to 2.88 acres, if credits are for preservation of habitat; or (2) a minimum of 1:1, for a total of 1.44 acres, if the credits are for creation of habitat.

In addition to the mitigation for the loss of riparian forest habitat, specific measures will be included onsite to compensate for the loss of SRA cover. The 0.44 acres of affected SRA below the OHWM will be mitigated onsite at a 3:1 ratio. However, the acreage will not be duplicated; such that the acreage of riparian forest habitat restored for SRA cover mitigation will apply towards riparian forest habitat mitigation requirements.

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

This BO 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; February 11, 2016).

The designations of critical habitat for CV spring-run Chinook, CCV steelhead, winter-run Chinook, and sDPS green sturgeon use 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 BO, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an “exposure-response-risk” approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.1.1 Conservation Banking in the Context of the ESA Environmental Baseline

Conservation (or mitigation) banks present a unique situation in terms of how they are used in the context of the Effects Analysis and the Environmental Baseline in ESA section 7 consultations. When NMFS is consulting on a proposed action that includes conservation bank credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that a section 7 consultation occurred at the time of bank establishment. A traditional interpretation of “environmental baseline” might suggest that the overall ecological benefits of the conservation bank actions belong in the Environmental Baseline. However, under this interpretation, all proposed actions, whether or not they included proposed credit purchases, would benefit from the environmental 'lift' of the entire conservation bank because it would be factored into the environmental baseline. In addition, where proposed actions did include credit purchases, it would not be possible to attribute their benefits to the proposed action, without double-counting. These consequences undermine the purposes of conservation banks and also do not reflect their unique circumstances. Specifically, conservation banks are established based on the expectation of future credit purchases. In addition, credit purchases as part of a proposed action will also be the subject of a future section 7 consultation.

It is therefore appropriate to treat the beneficial effects of the bank as accruing incrementally at the time of specific credit purchases, not at the time of bank establishment or at the time of bank restoration work. Thus, for all projects within the service area of a conservation bank, only the benefits attributable to credits sold are relevant to the environmental baseline. Where a proposed action includes credit purchases, the benefits attributable to those credit purchases are considered effects of the action.

That approach is taken in this BO.

2.2 Rangewide Status of the Species and Critical Habitat

This BO examines the status of each species that will 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. This BO also examines the condition of critical habitat throughout the designated area, evaluates the value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that value for the conservation of the species.

In 2016, NMFS completed a status review of 28 species of Pacific salmon, steelhead and eulachon, including Sacramento River winter-run Chinook salmon (winter-run Chinook), Central Valley spring-run Chinook salmon (CV spring-run Chinook), and California Central Valley (CCV) steelhead, and concluded that the species' status should remain as previously listed (81 FR 33468). The 2016 status reviews for winter-run Chinook, CV spring-run Chinook, and CCV steelhead found that, although the listings should remain unchanged, the status of these populations have suffered in 2014 and 2015 from the unprecedented California drought. An updated status review for sDPS green sturgeon was issued recently, concluding that the status of sDPS green sturgeon should remain as threatened (NMFS 2015).

The descriptions of the status of species and conditions of the designated critical habitats in this BO are a synopsis of the detailed information available on NMFS' West Coast Region website. The following federally listed species ESUs or 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)

Sacramento River winter-run Chinook salmon designated critical habitat
(58 FR 33212, June 16, 1993)

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

Central Valley spring-run Chinook salmon ESU (*O. tshawytscha*)
Listed as threatened (70 FR 37160, June 28, 2005)

Central Valley spring-run Chinook salmon designated critical habitat
(70 FR 52488, September 2, 2005)

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

California Central Valley steelhead DPS (*O. mykiss*)
Listed as threatened (71 FR 834, January 5, 2006)

California Central Valley steelhead designated critical habitat
(70 FR 52488, September 2, 2005)

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)

Southern DPS of North American green sturgeon designated critical habitat
(74 FR 52300, October 9, 2009)

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

Table 2. ESA listing history.

Species	Scientific Name	Original Final Listing Status	Current Final Listing Status	Critical Habitat Designated
Sacramento River winter-run Chinook salmon ESU	*Oncorhynchus tshawytscha*	1/4/1994 59 FR 440 Endangered	6/28/2005 70 FR 37160 Endangered	6/16/1993 58 FR 33212
Central Valley spring-run Chinook salmon ESU	*Oncorhynchus tshawytscha*	9/16/1999 64 FR 50394 Threatened	6/28/2005 70 FR 37160 Threatened	9/2/2005 70 FR 52488
California Central Valley steelhead DPS	*Oncorhynchus mykiss*	3/19/1998 63 FR 13347 Threatened	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488
Southern DPS of North American green sturgeon	*Acipenser medirostris*	4/7/2006 71 FR 17757 Threatened	4/7/2006 71 FR 17757 Threatened	10/9/2009 74 FR 52300

2.2.1 Sacramento River Winter-run Chinook Salmon

2.2.1.1 Summary of Sacramento River Chinook Salmon ESU Viability

There are several criteria (only one is required) that would qualify winter-run Chinook at moderate risk of extinction, and since there is still only one population that spawns downstream of Keswick Dam, that population will be at high risk of extinction in the long-term according to the criteria in Lindley *et al.* (2007). Recent trends in those criteria are: (1) continued low abundance; (2) a negative growth rate over 6 years (2006–2012), which is two complete generations; (3) a significant rate of decline since 2006; and (4) increased risk of catastrophe from oil spills, wildfires, or extended drought (climate change). The most recent 5-year status review (NMFS 2016) on winter-run Chinook concluded that the ESU had increased to a high risk of extinction. In summary, the most recent biological information suggests that the extinction risk for winter-run Chinook has increased from moderate risk to high risk of extinction since 2005, and that several listing factors have contributed to the recent decline, including drought and poor ocean conditions (NMFS 2011b).

2.2.1.2 Critical Habitat: Physical and Biological Features for Sacramento River Winter-run Chinook Salmon

NMFS designated critical habitat for winter-run Chinook on June 16, 1993 (58 FR 33212). Critical habitat was delineated as the Sacramento River from Keswick Dam at RM 302 to Chipps Island, RM 0, at the westward margin of the Sacramento-San Joaquin Delta (Delta), including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the Golden Gate

Bridge. In the Sacramento River, critical habitat includes the river water, river bottom, and the adjacent riparian zone.

Critical habitat for winter-run Chinook is defined as specific areas (listed below) that contain the PBFs considered essential to the conservation of the species. This designation includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing (June 16, 1993, 58 FR 33212). NMFS limits "adjacent riparian zones" to only those areas above a stream bank that provide cover and shade to the nearshore aquatic areas. Although the bypasses (*e.g.,* Yolo, Sutter, and Colusa) are not currently designated critical habitat for winter-run Chinook, NMFS recognizes that they may be utilized when inundated with Sacramento River flood flows and are important rearing habitats for juvenile winter-run Chinook. Also, juvenile winter-run Chinook may use tributaries of the Sacramento River for non-natal rearing. Critical habitat also includes the estuarine water column and essential foraging habitat and food resources used by winter-run Chinook as part of their juvenile outmigration or adult spawning migration.

The following is the status of the PBFs that are considered to be essential for the conservation of winter-run Chinook (June 16, 1993, 58 FR 33212):

1. <u>Access from the Pacific Ocean to Appropriate Spawning Areas</u>

Adult migration corridors should provide satisfactory water quality, water quantity, water temperature, water velocity, cover, shelter and safe passage conditions in order for adults to reach spawning areas. Adult winter-run Chinook generally migrate to spawning areas during the winter and spring. At that time of year, the migration route is accessible to the appropriate spawning grounds on the upper 60 miles of the Sacramento River, however much of this migratory habitat is degraded and they must pass through a fish ladder at the Anderson-Cottonwood Irrigation District Dam (ACID). In addition, the many flood bypasses are known to strand adults in agricultural drains due to inadequate screening (Vincik and Johnson 2013). Since the primary migration corridors are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic conservation value to the species.

2. <u>The Availability of Clean Gravel for Spawning Substrate</u>

Suitable spawning habitat for winter-run Chinook exists in the upper 60 miles of the Sacramento River between Keswick Dam and Red Bluff Diversion Dam (RBDD). However, the majority of spawning habitat currently being used occurs in the first 10 miles downstream of Keswick Dam. The available spawning habit is completely outside the historical range utilized by winter-run Chinook upstream of Keswick Dam. Because Shasta and Keswick dams block gravel recruitment, the U.S. Bureau of Reclamation (Reclamation) annually injects spawning gravel into various areas of the upper Sacramento River. With the supplemented gravel injections, the upper Sacramento River reach continues to support a small naturally-spawning winter-run Chinook population. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

3. Adequate River Flows for Successful Spawning, Incubation of Eggs, Fry Development and Emergence, and Downstream Transport of Juveniles

An April 5, 1960, Memorandum of Agreement between Reclamation and the CDFW originally established flow objectives in the Sacramento River for the protection and preservation of fish and wildlife resources. In addition, Reclamation complies with the 1990 flow releases required in State Water Resource Control Board (SWRCB) Water Rights Order (WRO) 90-05 for the protection of Chinook salmon. This order includes a minimum flow release of 3,250 cubic feet per second (cfs) from Keswick Dam from September through February during all water year types, except critically dry. NMFS issued a 2009 BO on the long-term operations of the CV Project and State Water Project (CVP/SWP) that requires a minimum flow release of 3,250 cubic feet per second (cfs) from Keswick Dam from September through February during all water year types (NMFS 2009a).

4. Water Temperatures at 5.8–14.1°C (42.5–57.5°F) for Successful Spawning, Egg Incubation, and Fry Development

Summer flow releases from Shasta Reservoir for agriculture and other consumptive uses drive operations of Shasta and Keswick dam water releases during the period of winter-run Chinook spawning, egg incubation, fry development, and emergence. This pattern, the opposite of the pre-dam hydrograph, benefits winter-run by providing cold water for miles downstream during the hottest part of the year. The extent to which winter-run Chinook habitat needs are met depends on Reclamation's other operational commitments, including those to water contractors, Delta requirements pursuant to State Water Rights Decision 1641 (D-1641), and Shasta Reservoir end of September storage levels required in the NMFS 2009 BO (NMFS 2009a) WRO 90-05 requires Reclamation to operate Shasta, Keswick, and Spring Creek Powerhouse to meet a daily average water temperature of 13.3°C (56°F) at RBDD. They also provide the exception that the water temperature compliance point (TCP) may be modified when the objective cannot be met at RBDD. Based on these requirements, Reclamation models monthly forecasts and determines how far downstream 13.3°C (56°F) can be maintained throughout the winter-run Chinook spawning, egg incubation, and fry development stages.

The TCP changes and moves upstream each year to meet this objective. As the TCP moves upstream, the value of that habitat is degraded by reducing the spawning area in size and imprinting upon the next generation to return further upstream.

5. Habitat and Adequate Prey Free of Contaminants

Water quality conditions have improved since the 1980s due to stricter standards and Environmental Protection Agency (EPA) Superfund site cleanups. No longer are there fish kills in the Sacramento River caused by the heavy metals (*e.g.,* lead, zinc and copper) found in the Spring Creek runoff. However, legacy contaminants such as mercury (and methyl mercury), polychlorinated biphenyls (PCBs), heavy metals and persistent organochlorine pesticides continue to be found in watersheds throughout the CV. In 2010, the EPA, listed the Sacramento River as impaired under the Clean Water Act, section 303(d), due to high levels of pesticides, herbicides, and heavy metals (http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml). Although most of these contaminants are at low concentrations in the food chain, they continue to work their way into the base of the food web, particularly when sediments are disturbed and previously entombed compounds are released into the water column.

Adequate prey for juvenile salmon to survive and grow consists of abundant aquatic and terrestrial invertebrates that make up the majority of their diet before entering the ocean. Exposure to these contaminated food sources such as invertebrates may create delayed sublethal effects that reduce fitness and survival (Laetz *et al.* 2009). Contaminants are typically associated with areas of urban development, agriculture, or other anthropogenic activities (*e.g.*, mercury contamination as a result of gold mining or processing). Areas with low human impacts frequently have low contaminant burdens, and therefore lower levels of potentially harmful toxicants in the aquatic system. Freshwater rearing habitat has a high intrinsic conservation value even if the current conditions are significantly degraded from their natural state.

6. Riparian and Floodplain Habitat that Provides for Successful Juvenile Development and Survival

The channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento River system typically have low habitat complexity, low abundance of food organisms, and offer little protection from predators. Juvenile life stages of salmonids are dependent on the natural functioning of this habitat for successful survival and recruitment. Ideal habitat contains natural cover, such as riparian canopy structure, submerged and overhanging large woody material (LWM), aquatic vegetation, large rocks and boulders, side channels, and undercut banks that augment juvenile and adult mobility, survival, and food supply. Riparian recruitment is prevented from becoming established due to the reversed hydrology (*i.e.*, high summer time flows and low winter flows prevent tree seedlings from establishing). However, there are some complex, productive habitats within historical floodplains [*e.g.*, Sacramento River reaches with setback levees (*i.e.*, primarily located upstream of the City of Colusa)] and flood bypasses (*i.e.*, fish in Yolo and Sutter bypasses experience rapid growth and higher survival due to abundant food resources) seasonally available that remain in the system. Nevertheless, the current condition of degraded riparian habitat along the mainstem Sacramento River restricts juvenile growth and survival (Michel 2010, Michel *et al.* 2013).

7. Access Downstream so that Juveniles can Migrate from the Spawning Grounds to San Francisco Bay and the Pacific Ocean

Freshwater emigration corridors should be free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. Migratory corridors are downstream of the Keswick Dam spawning areas and include the mainstem of the Sacramento River to the Delta, as well as non-natal rearing areas near the confluence of some tributary streams.

Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. Unscreened diversions that entrain juvenile salmonids are prevalent throughout the mainstem Sacramento River and in the Delta. Predators such as striped bass (*Morone saxatilis*) and Sacramento pikeminnow (*Ptychocheilus grandis*) tend to concentrate immediately downstream of diversions, resulting in increased mortality of juvenile Chinook salmon.

Water pumping at the CVP/SWP export facilities in the South Delta at times causes the flow in the river to move back upstream (reverse flow), further disrupting the emigration of juvenile winter-run Chinook by attracting and diverting them to the interior Delta, where they are exposed to increased rates of predation, other stressors in the Delta, and entrainment at pumping stations. NMFS' BO on the long-term operations of the CVP/SWP (NMFS 2009a) sets limits to the strength of reverse flows in the Old and Middle rivers, thereby keeping salmon away from areas of highest mortality. Regardless of the condition, the remaining estuarine areas are of high conservation value because they provide factors that function as rearing habitat and as an area of transition to the ocean environment.

2.2.2 Central Valley Spring-run Chinook salmon

2.2.2.1 Summary of CV Spring-run Chinook salmon DPS Viability

Since the independent populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, NMFS can evaluate risk of extinction based on Viable Salmonid Population (VSP) parameters in these watersheds. Lindley *et al.* (2007) indicated that the CV spring-run Chinook populations in the Central Valley had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis (PVA) model and other population viability criteria (*i.e.*, population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of CV spring-run Chinook was at moderate extinction risk according to the PVA model, but appeared to satisfy the other viability criteria for low-risk status. However, CV spring-run Chinook failed to meet the "representation and redundancy rule" since there are only demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them, or out of the four diversity groups as described in the NMFS Central Valley Salmon and Steelhead Recovery Plan. Over the long term, these three remaining populations are considered vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the CV spring-run Chinook populations in these three watersheds due to their close proximity to each other. One large event could eliminate all three populations.

In the 2011 status review of CV spring-run Chinook, the authors concluded that the ESU status had likely deteriorated on balance since the 2005 status review and the Lindley *et al.* (2007) assessment, with two of the three extant independent populations (Deer and Mill creeks) of CV spring-run Chinook slipping from low or moderate extinction risk to high extinction risk. Additionally, Butte Creek remained at low risk, although it was on the verge of moving towards high risk, due to the rate of population decline. In contrast, CV spring-run Chinook in Battle and

Clear creeks had increased in abundance since 1998, reaching levels of abundance that place these populations at moderate extinction risk. Both of these populations have likely increased at least in part due to extensive habitat restoration. The Southwest Fisheries Science Center concluded in their viability report (Williams *et al.* 2011) that the status of CV spring-run Chinook has probably deteriorated since the 2005 status review and that its extinction risk has increased. The degradation in status of the three formerly low- or moderate-risk independent populations is cause for concern.

In the 2016 status review, NMFS found, with a few exceptions, CV spring-run Chinook salmon populations have increased through 2014 returns since the last status review (2010/2011), which moved the Mill and Deer creek populations from the high extinction risk category to moderate, and Butte Creek remaining in the low risk of extinction category. Additionally, the Battle Creek and Clear Creek populations continued to show stable or increasing numbers in that period, putting them at moderate risk of extinction based on abundance. Overall, the Southwest Fisheries Science Center concluded in their viability report that the status of CV spring-run Chinook salmon (through 2014) had probably improved since the 2010/2011 status review and that the ESU's extinction risk may have decreased. However, the 2015 returning fish were extremely low (1,488), with additional pre-spawn mortality reaching record lows. Since the effects of the 2012 to 2015 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).

2.2.2.2 Critical Habitat: Physical and Biological Features for CV Spring-Run Chinook Salmon

Critical habitat was designated for CV spring-run Chinook on September 2, 2005 (70 FR 52488). Critical habitat for CV spring-run Chinook includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the OHWM. In areas where the OHWM has not been defined, the lateral extent will be defined by the bankfull elevation which is the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of one to two years on the annual flood series (Bain and Stevenson 1999) (70 FR 52488). Critical habitat for CV spring-run Chinook is defined as specific areas that contain the PBFs essential to the conservation of the species. Following are the inland habitat types used as PBFs for CV spring-run Chinook.

1. <u>Spawning Habitat</u>

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most spawning habitat in the CV for Chinook salmon is located in areas directly downstream of dams containing suitable environmental conditions for spawning and incubation. Spawning habitat for CV spring-run Chinook occurs on the mainstem Sacramento River between RBDD and Keswick Dam and in tributaries such as Mill, Deer, and Butte creeks; as well as the Feather and Yuba rivers, Big Chico, Battle, Antelope, and Clear creeks. However, little spawning activity has been recorded in recent years on the Sacramento River mainstem for CV spring-run Chinook. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

2. Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile salmonid development; and natural cover such as shade, submerged and overhanging LWM, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from piscivorous fish and birds. Freshwater rearing habitat also has a high intrinsic conservation value even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

3. Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream passage of adults and the downstream emigration of juveniles. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For adults, upstream passage through the Delta and much of the Sacramento River is not a problem, yet a number of challenges exist on many tributary streams. For juveniles, unscreened or inadequately screened water diversions throughout their migration corridors and a scarcity of complex in-river cover have degraded this PBF. However, since the primary migration corridors are used by numerous populations and are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic conservation value to the species.

4. Estuarine Areas

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PBF. Natural cover such as submerged and overhanging LWM, aquatic vegetation, and side channels are suitable for juvenile and adult foraging.

The remaining estuarine habitat for these species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species. Regardless of the condition, the remaining estuarine areas are of high conservation value because they provide factors that function to provide predator avoidance, as rearing habitat and as an area of transition to the ocean environment.

2.2.3 California Central Valley steelhead

Summary of CCV Steelhead DPS Viability

All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion of naturally spawned fish to hatchery produced fish over the past 25 years (Good *et al.* 2005, NMFS 2011a, NMFS 2016a); the long-term abundance trend remains negative. Hatchery production and returns are dominant over natural fish, and one of the four hatcheries is dominated by Eel/Mad River origin steelhead stock. Continued decline in the ratio between naturally-produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin-clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts captured in monitoring studies has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin continue to show an overall very low abundance, and fluctuating return rates. Lindley *et al.* (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley *et al.* (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

The widespread distribution of wild CCV steelhead in the Central Valley provides the spatial structure necessary for the DPS to survive and avoid localized catastrophes. However, most wild CCV steelhead populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change (NMFS 2011a). 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 life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

The 2016 status review (NMFS 2016a) concluded that overall, the status of CCV steelhead appears to have changed little since the 2011 status review when the Technical Recovery Team concluded that the DPS was in danger of extinction. Further, there is still a general lack of data on the status of wild populations. There are some encouraging signs, as several hatcheries in the Central Valley have experienced increased returns of steelhead over the last few years. There has also been a slight increase in the percentage of wild steelhead in salvage at the south Delta fish facilities, and the percentage of wild fish in those data remains much higher than at Chipps Island. The new video counts at Ward Dam show that Mill Creek likely supports one of the best wild steelhead populations in the Central Valley, though at much reduced levels from the 1950s and 60s. Restoration and dam removal efforts in Clear Creek continue to benefit CCV steelhead. However, the catch of unmarked (wild) steelhead at Chipps Island is still less than 5 percent of the total smolt catch, which indicates that natural production of steelhead throughout the Central Valley remains at very low levels.

2.2.3.1 Critical Habitat: Physical and Biological Features for CCV Steelhead

Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488). Critical habitat for CCV steelhead includes stream reaches such as those of 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, and the waterways of the Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the OHWM. In areas where the OHWM has not been defined, the lateral extent will be defined by the bankfull elevation which is the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series (Bain and Stevenson 1999) (70 FR 52488). Critical habitat for CCV steelhead is defined as specific areas that contain the PBFs and physical habitat elements essential to the conservation of the species. Following are the inland habitat types used as PBFs for CCV steelhead.

1. <u>Freshwater Spawning Habitat</u>

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most of the available spawning habitat for steelhead in the CV is located in areas directly downstream of dams due to inaccessibility to historical spawning areas upstream and the fact that dams are typically built at high gradient locations. These reaches are often impacted by the upstream impoundments, particularly over the summer months, when high temperatures can have adverse effects upon salmonids spawning and rearing downstream of the dams. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

2. <u>Freshwater Rearing Habitat</u>

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and survival; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging LWM, log jams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Freshwater rearing habitat also has a high conservation value even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

3. <u>Freshwater Migration Corridors</u>

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream and downstream passage of adults, and the emigration of smolts. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For this reason, freshwater migration corridors are considered to have a high conservation value even if the migration corridors are significantly degraded compared to their natural state.

4. <u>Estuarine Areas</u>

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PBF. Natural cover such as submerged and overhanging LWM, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging. Estuarine areas are considered to have a high conservation value as they provide factors which function to provide predator avoidance and as a transitional zone to the ocean environment.

2.2.4 Southern DPS of North American Green Sturgeon

2.2.4.1 Summary of sDPS Green Sturgeon Viability

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 2011c). Viability is defined as an independent population having a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year timeframe (McElhany *et al.* 2000). The best available scientific information does not indicate that the extinction risk facing sDPS green sturgeon is negligible over a long-term (~100 year) time horizon; therefore, the sDPS is not believed to be viable. To support this statement, the PVA that was done for sDPS green sturgeon in relation to stranding events (Thomas *et al.* 2013) may provide some insight. While this PVA model made many assumptions that need to be verified as new information becomes available, it was alarming to note that over a 50-year time period the DPS declined under all scenarios where stranding events were recurrent over the lifespan of a green sturgeon.

Although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley *et al.* (2007), in discussing winter-run Chinook, states that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, the position of NMFS, upon weighing all available information (and lack of information) has stated the extinction risk to be moderate (NMFS 2011c).

There is a strong need for additional information about sDPS green sturgeon, especially with regard to a robust abundance estimate, a greater understanding of their biology, and further information about their habitat needs.

2.2.4.2 Southern DPS of North American Green Sturgeon Critical Habitat

Critical habitat was designated for the sDPS green sturgeon on October 9, 2009 (74 FR 52300). A full and exact description of all sDPS green sturgeon critical habitat, including excluded areas, can be found at 50 CFR 226.219. Critical habitat includes the stream channels and waterways in the Delta to the OHWM. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are also included as critical habitat for sDPS green sturgeon.

Critical habitat for sDPS green sturgeon includes PBFs within the defined area that are essential to the conservation of the species. PBFs for sDPS green sturgeon have been designated for freshwater riverine systems, estuarine habitats, and nearshore coastal areas. In keeping with the focus on the California CV, we will limit our discussion to freshwater riverine systems and estuarine habitats.

2.2.4.2.1 Freshwater Riverine Systems

1. Food Resources

Abundant food items for larval, juvenile, sub-adult, and adult life stages for sDPS green sturgeon should be present in sufficient amounts to sustain growth, development, and support basic metabolism. Although specific information on food resources for green sturgeon within freshwater riverine systems is lacking, they are presumed to be generalists and opportunists that feed on similar prey as other sturgeons (Israel and Klimley 2008). Seasonally abundant drifting and benthic invertebrates have been shown to be the major food items of shovelnose and pallid sturgeon in the Missouri River (Wanner *et al.* 2007), lake sturgeon in the St. Lawrence River (Nilo *et al.* 2006), and white sturgeon in the lower Columbia River (Muir *et al.* 2000). As sturgeons grow, they begin to feed on oligochaetes, amphipods, smaller fish, and fish eggs as represented in the diets of lake sturgeon (Nilo *et al.* 2006), pallid sturgeon (Gerrity *et al.* 2006), and white sturgeon (Muir *et al.* 2000).

2. Substrate Type or Size

Critical habitat in the freshwater riverine system should include substrate suitable for egg deposition and development, larval development, sub-adults, and adult life stages. For example, spawning is believed to occur over substrates ranging from clean sand to bedrock, with preferences for cobble (Emmett *et al.* 1991, Moyle *et al.* 1995). Eggs are likely to adhere to substrates, or settle into crevices between substrates (Van Eenennaam *et al.* 2001, Deng *et al.* 2002). Larvae exhibited a preference for benthic structure during laboratory studies (Van Eenennaam *et al.* 2001, Deng *et al.* 2002, Kynard *et al.* 2005), and may seek refuge within crevices, but use flat-surfaced substrates for foraging (Nguyen and Crocker 2007).

3. Water Flow

An adequate flow regime is necessary for normal behavior, growth, and survival of all life stages in the upper Sacramento River. Such a flow regime should include stable and sufficient water flow rates in spawning and rearing reaches to maintain water temperatures within the optimal range for egg, larval, and juvenile survival and development (11°C - 19°C or 51.8°F - 66.2°F) (Mayfield and Cech 2004, Van Eenennaam *et al.* 2005, Allen *et al.* 2006). Sufficient flow is also needed to reduce the incidence of fungal infestations of the eggs, and to flush silt and debris from cobble, gravel, and other substrate surfaces to prevent crevices from being filled in and to maintain surfaces for feeding. Successful migration of adult green sturgeon to and from spawning grounds is also dependent on sufficient water flow. Spawning in the Sacramento River is believed to be triggered by increases in water flow to about 14,000 cfs [average daily water flow during spawning months: 6,900 – 10,800 cfs; (Brown 2007)]. In Oregon's Rogue River, nDPS green sturgeon have been shown to emigrate to sea during the autumn and winter when water temperatures dropped below 10°C (50°F) and flows increased (Erickson *et al.* 2002). On the Klamath River, the fall outmigration of nDPS green sturgeon has been shown to coincide with a significant increase in discharge resulting from the onset of the rainy season (Benson *et al.* 2007). On the Sacramento River, flow regimes are largely dependent on releases from Shasta Dam, thus the operation of this dam could have profound effects upon sDPS green sturgeon habitat.

4. Water Quality

Adequate water quality, including temperature, salinity, oxygen content, and other chemical characteristics are necessary for normal behavior, growth, and viability of all life stages. Suitable water temperatures include: stable water temperatures within spawning reaches, temperatures within 11°C - 17°C (51.8°F – 62.6°F) (optimal range is 14°C - 16°C (57.2°F – 60.8°F)) in spawning reaches for egg incubation (March-August) (Van Eenennaam *et al.* 2005), temperatures below 20°C (68°F) for larval development (Werner *et al.* 2007), and temperatures below 24°C (75.2°F) for juveniles (Mayfield and Cech 2004, Allen *et al.* 2006). Suitable salinity levels range from fresh water [< 3 parts per thousand (ppt)] for larvae and early juveniles to brackish water (10 ppt) for juveniles prior to their transition to salt water. Prolonged exposure to higher salinities may result in decreased growth and activity levels and even mortality (Allen and Cech 2007) . Adequate levels of dissolved oxygen (DO) are needed to support oxygen consumption by early life stages, ranging from 61.78 to 76.06 mg O_2 hr^{-1} kg^{-1} for juveniles (Allen and Cech 2007). Suitable water quality also includes water with acceptably low levels of contaminants (*i.e*., pesticides, organochlorines, selenium, elevated levels of heavy metals, *etc*.) that may disrupt normal development of embryonic, larval, and juvenile stages of green sturgeon. Poor water quality can have adverse effects on growth, reproductive development, and reproductive success. Studies on the effects of water contaminants upon green sturgeon are needed; studies performed upon white sturgeon have clearly demonstrated the negative impacts contaminants can have upon white sturgeon biology (Fairey *et al.* 1997, Foster *et al.* 2001a, Foster *et al.* 2001b, Kruse and Scarnecchia 2002, Feist *et al.* 2005). Legacy contaminants such as mercury persist in the watershed and pulses of pesticides have been identified in winter storm discharges throughout the Sacramento River basin, the Central Valley, and the Delta.

5. Migratory Corridor

Safe and unobstructed migratory pathways are necessary for adult green sturgeon to migrate to and from spawning habitats, and for larval and juvenile green sturgeon to migrate downstream from spawning and rearing habitats within freshwater rivers to rearing habitats within the estuaries. Unobstructed passage throughout the Sacramento River up to Keswick Dam (RM 302) is important, because optimal spawning habitats for green sturgeon are believed to be located upstream of the RBDD (RM 242).

6. Depth

Deep pools of ≥ 5 m (16 ft) depth are critical for adult green sturgeon spawning and for summer holding within the Sacramento River. Summer aggregations of green sturgeon are observed in these pools in the upper Sacramento River upstream of Glenn-Colusa Irrigation District (GCID). The significance and purpose of these aggregations are unknown at the present time, but may be a behavioral characteristic of green sturgeon. Adult green sturgeon in the Klamath and Rogue rivers also occupy deep holding pools for extended periods, presumably for feeding, energy conservation, and/or refuge from high water temperatures (Erickson *et al.* 2002, Benson *et al.* 2007). As described above approximately 54 pools with adequate depth have been identified in the Sacramento River upstream of the GCID location.

7. Sediment Quality

Sediment should be of the appropriate quality and characteristics necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of contaminants [*e.g*., elevated levels of heavy metals such as mercury, copper, zinc, cadmium, and chromium, polycyclic aromatic hydrocarbons (PAHs), and organochlorine pesticides] that can result in negative effects on any life stage of green sturgeon or their prey. Based on studies of white sturgeon, bioaccumulation of contaminants from feeding on benthic species may negatively affect the growth, reproductive development, and reproductive success of green sturgeon. The Sacramento River and its tributaries have a long history of contaminant exposure from abandoned mines, separation of gold ore from mine tailings using mercury, and agricultural practices with pesticides and fertilizers that result in deposition of these materials in the sediment horizons in the river channel. The San Joaquin River is a source for many of these same contaminants, although pollution and runoff from agriculture are the predominant driving force. Disturbance of these sediment horizons by natural or anthropogenic actions can liberate sequestered contaminants into the river. This is a continuing concern throughout the watershed.

2.2.4.2.2 Estuarine Habitats

1. Food Resources

Abundant food items within estuarine habitats and substrates for juvenile, sub-adult, and adult life stages are required for the proper functioning of this PBF for green sturgeon. Green sturgeon feed primarily on worms, mollusks, and crustaceans (Moyle 2002). Radtke (1966) studied the diet of juvenile sDPS green sturgeon and found their stomach contents to include a mysid shrimp, amphipods, and other unidentified shrimp. These prey species are critical for the rearing, foraging, growth, and development of juvenile, sub-adult, and adult green sturgeon within the bays and estuaries. Currently, the estuary provides these food resources, although annual fluctuations in the population levels of these food resources may diminish the contribution of one group to the diet of green sturgeon relative to another food source.

Invasive species are a concern because they may replace the natural food items consumed by green sturgeon. The Asian overbite clam (*Corbula amurensis*) is one example of a prolific invasive clam species in the Delta. It has been observed to pass through white sturgeon undigested (Kogut 2008).

2. Water Flow

Within bays and estuaries adjacent to the Sacramento River (*i.e.*, the Delta and the Suisun, San Pablo, and San Francisco Bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds is required. Sufficient flows are needed to attract adult green sturgeon to the Sacramento River from the bay and to initiate the upstream spawning migration into the upper river. The specific quantity of flow required is a topic of ongoing research.

3. Water Quality

Adequate water quality, including temperature, salinity, oxygen content, and other chemical characteristics, is necessary for normal behavior, growth and viability of all life stages. Suitable water temperatures for juvenile green sturgeon should be below 24°C (75°F). At temperatures above 24°C, juvenile green sturgeon exhibit decreased swimming performance (Mayfield and Cech 2004) and increased cellular stress (Allen *et al.* 2006). Suitable salinities in the estuary range from brackish water (10 ppt) to salt water (33 ppt). Juveniles transitioning from brackish to salt water can tolerate prolonged exposure to salt water salinities, but may exhibit decreased growth and activity levels (Allen and Cech 2007), whereas sub-adults and adults tolerate a wide range of salinities (Kelly *et al.* 2007). Sub-adult and adult green sturgeon occupy a wide range of DO levels, but may need a minimum DO level of at least 6.54 mg O_2/l (Kelly *et al.* 2007, Moser and Lindley 2007).

Suitable water quality also includes water free of contaminants (*e.g.*, pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal development of juvenile life stages, or the growth, survival, or reproduction of sub-adult or adult stages. In general, water quality in the Delta and estuary meets these criteria, but local areas of the Delta and downstream bays have been identified as having deficiencies. Discharges of agricultural drain water have also been implicated in local elevations of pesticides and other related agricultural compounds within the Delta and the tributaries and sloughs feeding into the Delta. Discharges from petroleum refineries in Suisun and San Pablo bay have been identified as sources of selenium to the local aquatic ecosystem (Linville *et al.* 2002).

4. Migratory Corridor

Safe and unobstructed migratory pathways are necessary for timely passage of adult, sub-adult, and juvenile fish within the region's different estuarine habitats and between the upstream riverine habitat and the marine habitats. Within the waterways comprising the Delta and bays downstream of the Sacramento River, safe and unobstructed passage is needed for juvenile green sturgeon during the rearing phase of their life cycle. Passage within the bays and the Delta is also critical for adults and sub-adults for feeding and summer holding, as well as to access the Sacramento River for their upstream spawning migrations and to make their outmigration back into the ocean. Within bays and estuaries outside of the Delta and the areas comprised by Suisun, San Pablo, and San Francisco bays, safe and unobstructed passage is necessary for adult and sub-adult green sturgeon to access feeding areas, holding areas, and thermal refugia, and to ensure passage back out into the ocean. Currently, safe and unobstructed passage has been diminished by human actions in the Delta and bays. The CVP and SWP, responsible for large volumes of water diversions, alter flow patterns in the Delta due to export pumping and create entrainment issues in the Delta at the pumping and fish facilities. Power generation facilities in Suisun Bay create risks of entrainment and thermal barriers through their operations of cooling water diversions and discharges. Installation of seasonal barriers in the South Delta and operations of the radial gates in the Delta Cross Channel facilities alter migration corridors available to green sturgeon. Actions such as the hydraulic dredging of ship channels and operations of large ocean going vessels create additional sources of risk to green sturgeon within the estuary. Commercial shipping traffic can result in the loss of fish, particularly adult fish, through ship and propeller strikes.

5. Water Depth

A diversity of depths is necessary for shelter, foraging, and migration of juvenile, sub-adult, and adult life stages. Sub-adult and adult green sturgeon occupy deep (≥ 5 m) holding pools within bays, estuaries, and freshwater rivers. These deep holding pools may be important for feeding and energy conservation, or may serve as thermal refugia (Benson *et al.* 2007). Tagged adults and sub-adults within the San Francisco Bay estuary primarily occupied waters with depths of less than 10 meters, either swimming near the surface or foraging along the bottom (Kelly *et al.* 2007). In a study of juvenile green sturgeon in the Delta, relatively large numbers of juveniles were captured primarily in shallow waters from 3 – 8 feet deep, indicating juveniles may require shallower depths for rearing and foraging (Radtke 1966).

Currently, there is a diversity of water depths found throughout the San Francisco Bay estuary and Delta waterways. Most of the deeper waters, however, are composed of artificially maintained shipping channels, which do not migrate or fluctuate in response to the hydrology in the estuary in a natural manner. Shallow waters occur throughout the Delta and San Francisco Bay. Extensive "flats" occur in the lower reaches of the Sacramento and San Joaquin river systems as they leave the Delta region and are even more extensive in Suisun and San Pablo bays. In most of the region, variations in water depth in these shallow water areas occur due to natural processes, with only localized navigation channels being dredged (*e.g.*, the Napa River and Petaluma River channels in San Pablo Bay).

6. Sediment Quality

Sediment quality (*i.e.*, chemical characteristics) is necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of contaminants (*e.g.*, elevated levels of selenium, PAHs, and organochlorine pesticides) that can cause negative effects on all life stages of green sturgeon (see description of *sediment quality* for riverine habitats above).

2.2.5 Global Climate Change

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the CCV and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger *et al.* 2004). Projected warming is expected to affect Central Valley Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006).

For winter-run Chinook, the 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. CV Spring-run Chinook adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson *et al.* 2011). CV Spring-run Chinook 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. Although steelhead will experience similar effects of climate change to Chinook salmon, 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). ACID is considered the upriver extent of green sturgeon passage in the Sacramento River. The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher than ACID during late spring and summer. Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected.

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011, Wade *et al.* 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure *et al.* 2013).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area is not the same as the Project area because the action area must delineate all areas where federally-listed salmon, steelhead, and green sturgeon may be effected by the implementation of the proposed action.

The Project area is located along the Sacramento River in Sacramento and Yolo counties. The current and proposed I Street Bridges adjoin the cities of Sacramento and West Sacramento in the Sacramento West U.S. Geological Survey (USGS) Quadrangle, Range 4 East Township 9 North. The center of the existing bridge lies approximately at position 38.58627°, -121.50640°. The center of the proposed new bridge will lie approximately 1,000 feet north of the existing bridge approximately at position 38.58928°, -121.50635°.

The bridge crosses a portion of the lower Sacramento River. The action area encompasses 4,325 linear meters (14,190 feet) of the Sacramento River, to include 1,410 meters (4,626 feet) upstream and 2,915 meters (9,564 feet) downstream from the bridge which will effectively stop acoustic propagation. The action area encompasses the full lateral extent of the river. The action area includes the portion of the river determined to likely experience potential adverse effects resulting from the Project, including sedimentation, turbidity, and hydroacoustic impacts. Since the proposed action includes the purchase of mitigation credits from a conservation bank, the Action Area also includes the areas affected by the four conservation or mitigation banks that have service areas relevant to the project. These include the Fremont Landing Conservation Bank, a 100-acre floodplain site along the Sacramento River (Sacramento River Mile 106), Bullock Bend Mitigation Bank, a 119.65-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80), Cosumnes Floodplain Mitigation Bank, a 493-acre site located at the confluence of the Cosumnes and Mokelumne Rivers in Sacramento County, and the Liberty Island Conservation Bank, a 147.91-acre floodplain site at the lower end of the Yolo Bypass.

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).

The action area encompasses 4,325 linear meters (14,190 feet) of the Sacramento River. The action area includes the portion of the river determined to likely experience potential adverse effects resulting from the project including sedimentation, turbidity, and hydroacoustic impacts.

2.4.1 Mitigation Banking and Environmental Baseline

There are several conservation or mitigation banks approved by NMFS with service areas that include the action area considered in this BO. These banks occur within critical habitat for sDPS green sturgeon, winter-run Chinook, CV spring-run Chinook, and CCV steelhead. These include:

Cosumnes Floodplain Mitigation Bank: Established in September 2009, the Cosumnes Floodplain mitigation bank is a 493-acre site located at the confluence of the Cosumnes and Mokelumne Rivers in Sacramento County. This bank is authorized by NMFS to provide credits for Floorplain Mosaic Wetlands, Floodplain Riparian Habitat, and Shaded Riverine Aquatic

Habitat. There are floodplain mosaic wetlands, floodplain riparian habitat, and shaded riverine aquatic habitat credits available. To date, there have been 17,407.3 of 78,172.4 credits sold and the ecological value (increased rearing habitat for juveniles) of the sold credits are part of the environmental baseline. All features of this bank are designated critical habitat for the species analyzed in this BO.

Fremont Landing Conservation Bank: Established in 2006, the Fremont Landing Conservation Bank is a 100-acre floodplain site along the Sacramento River (Sacramento River Mile 106) and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook, CV spring-run Chinook and CCV steelhead. There are off-channel shaded aquatic habitat credits, riverine shaded aquatic habitat credits and floodplain credits available. To date, there have been 28.2 of 100 credits sold and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. All features of this bank are designated critical habitat for the species analyzed in this BO.

Bullock Bend Mitigation Bank: Established in 2016, the Bullock Bend Mitigation Bank is a 116.15-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80) and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook, CV spring-run Chinook and CCV steelhead. There are salmonid floodplain restoration, salmonid floodplain enhancement and salmonid riparian forest credits available. To date, there have been 56.52 of 116.15 credits sold and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. All features of this bank are designated critical habitat for the species analyzed in this BO.

Liberty Island Conservation Bank: Established in 2010, the Liberty Island Conservation Bank is a 147.91-acre floodplain site at the lower end of the Yolo Bypass and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook, CV spring-run Chinook, sDPS Green Sturgeon, and CCV steelhead. There are salmonid riparian and salmonid marsh credits available. To date, there have been 139.11 credits sold and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. All features of this bank are designated critical habitat for the species analyzed in this BO.

2.4.2 Status of Listed Species in the Action Area

The action area functions primarily as rearing habitat and as a migration corridor for winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS green sturgeon. Various life stages of these species may be found within the action area throughout the year. Due to Project timing and location, fish in the action area are expected to be over 2g. This larger size means that they have different susceptibilities to effects from sound caused by pile driving.

Sacramento River winter-run Chinook Salmon

Of the four anadromous fish species addressed in this BO, winter-run Chinook faces the greatest risk of extinction. This is due to a severe reduction in historical spawning habitat in the

Sacramento River watershed. Listed as federally endangered, winter-run Chinook geographical distribution is confined to the mainstem Sacramento River, extending as far north as Keswick Dam. Spawning occurs below Keswick Dam and the mainstem Sacramento River serves as a migratory corridor. Figure 1 includes temporal occurrence and relative abundances for adults and juveniles in the mainstem Sacramento River and at Knights Landing, respectively. The Knights Landing data is indicative of juvenile presence and run timing in the action area, but the adult data is more indicative of upstream presence.

Based on salvage records at the CVP and SWP fish collection facilities, juvenile winter-run Chinook are expected in the action area starting in December. Based on these data, their presence in the action area is expected to peak in March and then rapidly decline from April through June. The majority of winter-run juveniles will enter the action area during February through June. Presence of adult Chinook salmon is interpolated from historical data. Adult winter-run Chinook are expected to enter the action area starting in January, with the majority of adults passing through the action area from February to April. As such, adult winter-run Chinook are not expected to be in the action area during the in-water work window, although juvenile winter-run Chinook may be present during this time.

Based on the temporal presence of winter-run Chinook in the lower Sacramento River, the timing of the Proposed project, and the location of the action area, it is likely that adult and juvenile Sacramento River winter-run Chinook salmon will be using the action area during the in-water work window.

Winter run relative abundance												
a) Adults freshwater												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River basin[a,b]												
Upper Sacramento River spawning[c]												
b) Juvenile emigration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River at Red Bluff[d]												
Sacramento River at Knights Landing[e]												
Sacramento trawl at Sherwood Harbor[f]												
Midwater trawl at Chipps Island[g]												

Sources: [a]Yoshiyama *et al.* (1998); Moyle (2002); [b]Myers *et al.* (1998) ; [c] Williams (2006) ; [d] Martin *et al.* (2001); [e] Knights Landing Rotary Screw Trap Data, CDFW (1999-2011); [f,g] Delta Juvenile Fish Monitoring Program, USFWS (1995-2012)

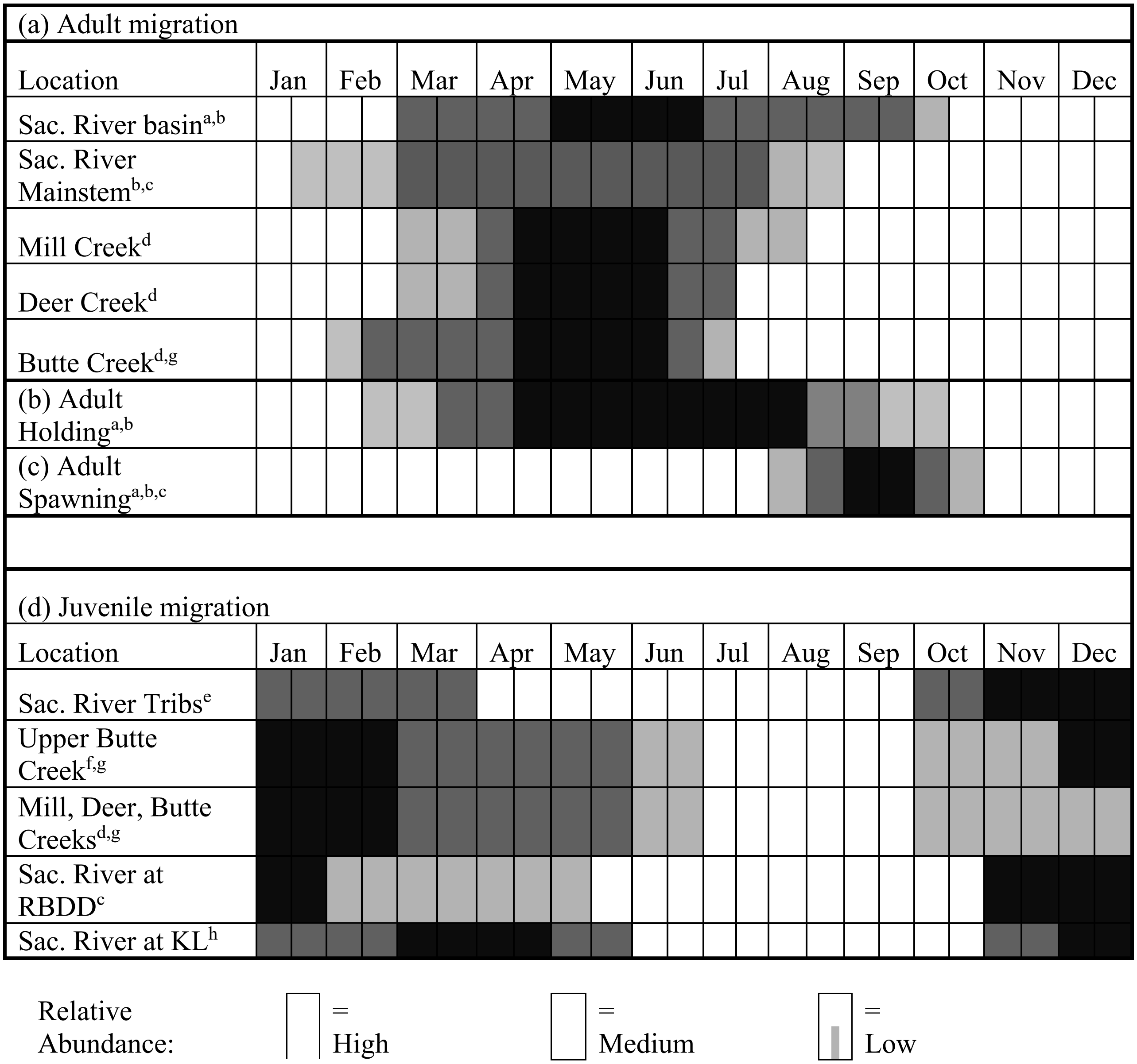
Figure 1. The temporal occurrence of adult (a) and juvenile (b) winter-run in the Sacramento River. Darker shades indicate months of greatest relative abundance.

CV spring-run Chinook Salmon

The mainstem of the Sacramento River serves as a primary migratory corridor for both upstream and downstream migration of CV spring-run Chinook, connecting spawning habitat within the Sacramento River basin to the San Francisco Bay estuary and the Pacific Ocean. CV spring-run Chinook share a similar geographical distribution as well as many life history characteristics with CCV steelhead and the PBFs of their critical habitat are concurrently defined (see "*Status of Critical Habitat in the Action Area*" section). Figure 2 includes temporal occurrence and relative abundances for adults and juveniles in the mainstem Sacramento River and at Knights Landing, respectively. Similar to winter-run Chinook, the Knights Landing data are indicative of juvenile presence and run timing in the action area, but the adult data are more indicative of upstream presence.

CVP and SWP salvage records and the northern and Central Delta fish monitoring data indicate that juvenile CV spring-run Chinook first begin to appear in the action area in December and January, but that a significant presence does not occur until March and peaks in April. By May, the salvage of juvenile CV spring-run Chinook declines sharply and essentially ends by the end of June. The data from the northern and central Delta fish monitoring programs indicate that a small proportion of the annual juvenile CV spring-run Chinook emigration occurs in January and is considered to be mainly composed of yearling CV spring-run Chinook juveniles based on their size at date. Adult CV spring-run Chinook are expected to start entering the action area in approximately January. Low levels of adult migration are expected through early March. The peak of adult spring-run Chinook movement through the action area is expected to occur from April through June with adults continuing to enter the system through the summer.

Based on the temporal presence of CV spring-run Chinook in the lower Sacramento River, the timing of the in-water work associated with the proposed Project, and the location of the action area, it is likely that adult and juvenile CV spring-run Chinook will be using the action area during the proposed in-water work.



Sources: [a]Yoshiyama *et al.* (1998); [b]Moyle (2002); [c]Myers *et al.* (1998); [d]Lindley *et al.* (2004); [e]CDFG (1998); [f]McReynolds *et al.* (2007); [g]Ward *et al.* (2003); [h]Snider and Titus (2000)
Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after they hatch.

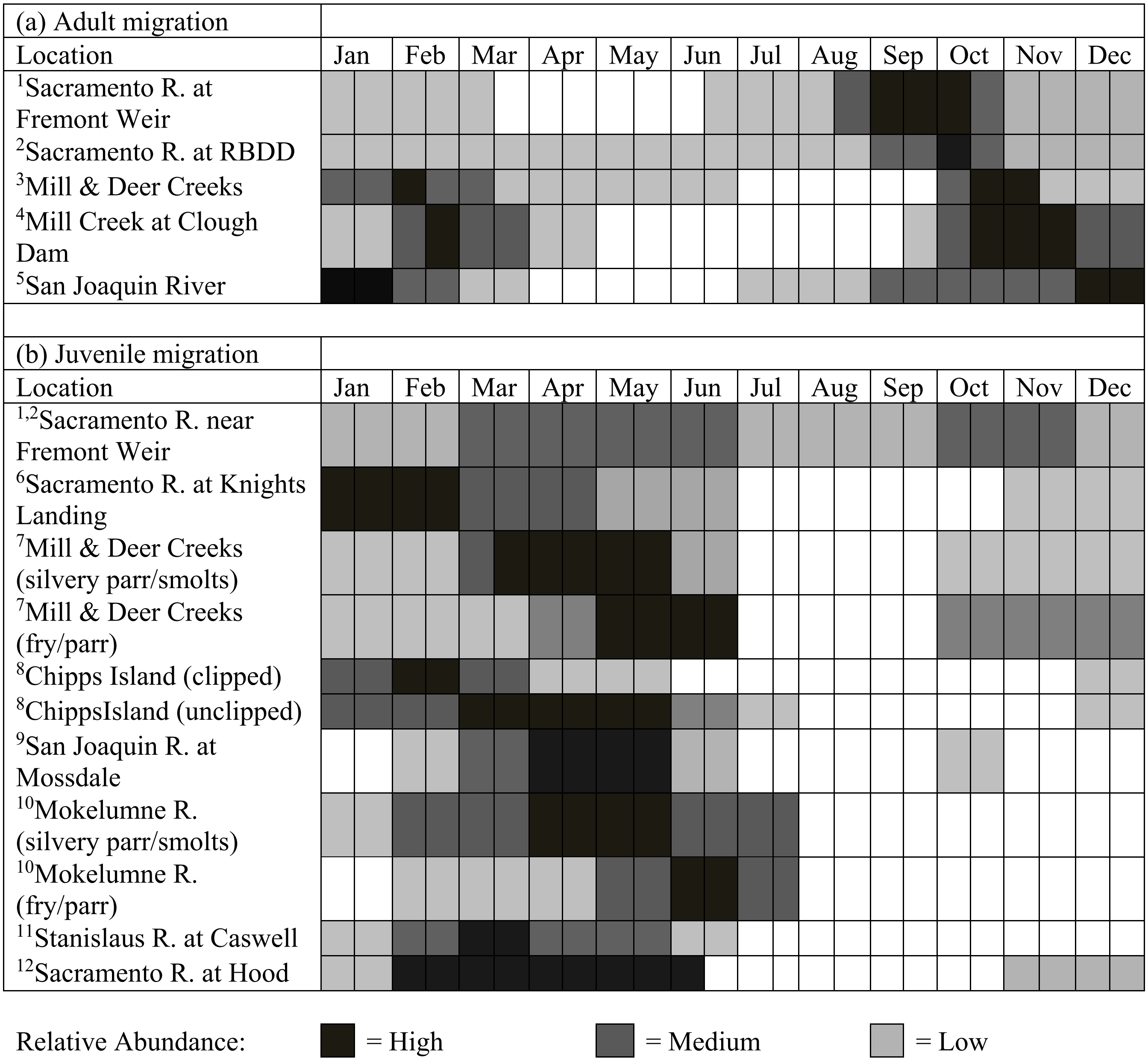
Figure 2. The temporal occurrence of adult (a) and juvenile (b) Central Valley spring-run Chinook salmon in the Sacramento River. Darker shades indicate months of greatest relative abundance.

CCV steelhead

Steelhead are well-distributed throughout the Central Valley below the major rim dams (Good *et al.* 2005, NMFS 2011a, NMFS 2016a). The mainstem of the Sacramento River serves as a primary migratory corridor for both upstream and downstream migration, connecting spawning habitat within the Sacramento River basin to the San Francisco Bay estuary and the Pacific Ocean. All adult CCV steelhead originating in the Sacramento River watershed will have to migrate through the action area in order to reach their spawning grounds and to return to the ocean following spawning. Likewise, all CCV steelhead smolts originating in the Sacramento River watershed will also have to pass through the action area during their emigration to the ocean. The Sacramento River may provide some rearing benefit to emigrating steelhead smolts. Figure 3 includes temporal occurrence and relative abundances for adults and juveniles in the mainstem Sacramento River and at Knights Landing, respectively. Similar to winter-run and CV spring-run Chinook, the Knights Landing data are indicative of juvenile presence and run timing in the action area, but the adult data are more indicative of upstream presence.

CCV steelhead smolts will first start to appear in the action area in November. This is based on the records from the CVP and SWP fish salvage facilities, as well as the fish-monitoring program in the northern and central Delta. Their presence increases through December and January, peaks in February and March, and declines in April. By June, the emigration has essentially ended, with only a small number of fish being salvaged through the summer at the CVP and SWP. Adult steelhead are expected to move through the action area throughout the year with the peak of upriver immigration expected to occur August through November. There is potential exposure to adult steelhead moving back downstream in a post-spawn condition (kelts) through the action area during the February to May period. It is expected that more kelts will be observed earlier in the period (February) due to the timing of spawning in the Sacramento River basin.

Based on the temporal presence of adult and juvenile steelhead in the lower Sacramento River, the timing of the proposed project, and the location of the action area, it is likely that adult steelhead will be using the action area as a migration corridor during construction. Additionally, it is likely that juvenile steelhead may be emigrating through the action area during construction.



Sources: [1]Hallock *et al.* (1957); [2]McEwan (2001); [3]Harvey (1995); [4]CDFW unpublished data; [5]CDFG Steelhead Report Card Data 2007; [6]NMFS analysis of 1998-2011 CDFW data; [7]Johnson and Merrick (2012); [8]NMFS analysis of 1998-2011 USFWS data; [9]NMFS analysis of 2003-2011 USFWS data; [10]unpublished EBMUD RST data for 2008-2013; [11]Oakdale RST data (collected by FishBio) summarized by John Hannon (Reclamation) ; [12]Schaffter (1980).

Figure 3. The temporal occurrence of (a) adult and (b) juvenile California Central Valley steelhead at locations in the Central Valley. Darker shades indicate months of greatest relative abundance.

sDPS green sturgeon

The upper mainstem Sacramento River is the only area where consistent annual spawning by sDPS green sturgeon has been confirmed via the presence of eggs and larvae (Poytress *et al.* 2015). The action area is located on the main migratory route for adults moving upstream to spawn, post spawn adults migrating back to the ocean, juvenile outmigrants, and rearing sub-adults. Juvenile green sturgeon from the sDPS are routinely collected at the SWP and CVP salvage facilities throughout the year. Based on the salvage records, green sturgeon may be present during any month of the year, and have been particularly prevalent during July and August. Adult green sturgeon begin to enter the Delta in late February and early March during the initiation of their upstream spawning run. The peak of adult entrance into the Delta appears to occur in late February through early April with fish arriving upstream in April and May. Adults continue to enter the Delta until early summer (June-July) as they move upriver to spawn. It is also possible that some adult green sturgeon will be moving back downstream in April and May through the action area, either as early post spawners or as unsuccessful spawners. Some adult green sturgeon have been observed to rapidly move back downstream following spawning, while others linger in the upper river until the following fall.

2.4.3 Status of Critical Habitat in the Action Area

Sacramento River winter-run Chinook Salmon

Critical habitat for Sacramento River winter-run Chinook occurs in the action area. As defined in the federal register notice designating winter-run Chinook critical habitat, the essential physical and biological habitat features of winter-run Chinook are: (1) migratory corridors for both upstream and downstream migration; (2) clean gravel for spawning; (3) adequate flow conditions for spawning, eggs, and larvae; (4) adequate temperature conditions for spawning, eggs, and larvae; (5) habitat and prey items that are free of contaminants; and (6) rearing habitat for juveniles. The features that occur within the action area are migratory corridors, habitat and prey items, and rearing habitat for juveniles. Each of these features has been degraded from historical conditions. Naturally-occurring floodplain habitat has been largely removed near the action area due to bank revetment and other levee repair actions, limiting habitat value for juvenile rearing. Habitat complexity has been reduced due to revetment activities and removal of vegetation, reducing macroinvertebrate production, shelter from predators, and thermal refugia. The mainstem Sacramento River also contains inorganic nutrients and contaminants from agriculture and industrial practices throughout the Sacramento River watershed. These contaminants can greatly degrade water quality, especially in summer months.

CCV steelhead and CV spring-run Chinook Salmon

The action area includes critical habitat that has been designated for CCV steelhead and CV spring-run Chinook. Critical habitat was designated under the same federal register notice for these two species, as their habitat requirements are very similar. PBFs within the action area for these two species include: (1) freshwater rearing sites, and (2) freshwater migration corridors. Both of these PBFs have been degraded from their historical condition due to human activity on and near the mainstem Sacramento River. Naturally-occurring floodplain habitat has been largely removed near the action area due to bank revetment and other levee repair actions, limiting habitat value for juvenile rearing. Similarly, habitat complexity has been reduced due to revetment activities and removal of vegetation, reducing macroinvertebrate production, shelter from predators, and thermal refugia.

sDPS Green Sturgeon

Critical habitat for sDPS green sturgeon also occurs in the action area. The PBFs of sDPS green sturgeon critical habitat that are within the action area include (1) food resources, (2) adequate flow regime for all life stages, (3) water quality, (4) migratory corridors, (5) adequate water depth for all life stages, and (6) adequate sediment quality. The mainstem Sacramento River serves primarily as a migration corridor for green sturgeon. Insufficient data exists regarding the dynamics of juvenile rearing in the mainstem Sacramento River, but they are thought to exhibit at least some rearing behavior in the river before entering the Delta. Compared to the salmonid species addressed in this BO, the PBFs of green sturgeon critical habitat within the action area have not been negatively affected to the same degree. Because sub-adult and adult life stages are associated with benthic habitat, water quality and low flow conditions are likely the most deleterious factors influencing green sturgeon critical habitat PBFs. Due to a highly altered flow regime in the Sacramento River watershed and a recent drought event, flows through the action area are often inconsistent in summer months and have been greatly decreased from historical levels. Less is known about the habitat preference and reach-scale spatial orientation of juveniles, though they are most likely affected by these factors as well.

<u>Factors Affecting Listed Species and Critical Habitat in the Action Area</u>

This section will focus on factors that are specific to the action area.

The mainstem Sacramento River has been degraded from its historic condition and many anthropomorphic and naturally occurring factors have led to the decline of anadromous fish in the surrounding lotic ecosystem. Due to the construction of Keswick and Shasta dams, as well as various other dams constructed on Sacramento River tributaries, flows and temperatures through the action area have been altered from their natural and historic regimes. Altered flow regimes can influence migratory cues, water quality (including contaminants, dissolved oxygen, and nutrients for primary productivity), and temperature.

Drought conditions have played a significant role from 2012 through 2016, as flows have decreased and temperatures have increased, leading to unfavorable environmental conditions in the river. This has resulted in direct and indirect impacts to listed fish as well as impacts to critical habitat. Increased temperatures have the potential to disrupt aquatic macroinvertebrate production, leading to declines in food availability in the action area (Ward and Stanford 1982). In addition, due to low flows, high concentrations of inorganic nutrients from agricultural activity may occur in the action area (Paerl *et al.* 2011). For CV spring-run Chinook and CCV steelhead, rearing site and migration corridor PBFs have been partially degraded as a result of flow and temperature alteration due to dam construction. Winter-run Chinook PBFs affected by altered temperatures and flows include: migratory corridors for both upstream and downstream migration; adequate flow conditions; adequate temperature conditions; and rearing habitat for juveniles. Affected PBFs for green sturgeon include adequate flow regime for all life stages, water quality, and migratory corridors.

The areas surrounding the portion of the Sacramento River that flows through the action area have been heavily urbanized. This has likely increased the amount of contaminant loading in the aquatic ecosystem. Heavy metals, PAHs, petroleum products, plastics, fertilizers, and many other contaminants can enter the river via urban runoff. In particular, the action area is adjacent to the Southern Pacific Railyard site in downtown Sacramento, a "superfund" site designated by the State of California due to excessive contamination of soils and groundwater over a 240-acre area with lead and other contaminants (Lee and Jones-Lee 1994).

Levees have been constructed along the banks of the Sacramento River, substantially reducing the density of riparian vegetation within the action area. Riparian vegetation provides a large host of ecosystem services and its removal has diminished habitat value within the action area. Riparian vegetation plays a key role in the conservation value of rearing habitat for all salmonid life stages. It provides shading to lower stream temperatures; increases the recruitment of LWM into the river, increasing habitat complexity; provides shelter from predators and; enhances the productivity of aquatic macroinvertebrates (Anderson and Sedell 1979, Pusey and Arthington 2003). It has also been shown to directly influence channel morphology and may be directly correlated with improved water quality in aquatic systems (Schlosser and Karr 1981, Dosskey *et al.* 2010).

<u>Importance of the Action Area to the Survival and Recovery of Listed Species</u>

The mainstem Sacramento River contains rearing habitat and a migration corridor for the juvenile life stage of all species addressed in this BO. The action area comprises approximately 14,190 feet linear feet of the river (2.6 RM) which may serve as rearing habitat for juveniles. The lower mainstem Sacramento River totals 302 RM from Keswick Dam to Rio Vista, making the action area approximately 0.8% of the total length of rearing habitat in the river. Although it is a small proportion of the total, the rearing habitat in the action area is important because it is downstream of major tributaries such as the Yuba River and Feather River, providing rearing opportunities for juveniles out-migrating from those systems.

Because it provides passage for all species between the Delta and their spawning habitat upstream, the migration corridor PBF is extremely important for their survival and recovery. Adults of all species returning from the ocean to spawn utilize the Sacramento River mainstem to travel upstream into various areas of the watershed. CCV steelhead and CV spring-run Chinook access a number of spawning reaches upstream of the action area, including the Yuba River, Feather River, and smaller mainstem tributaries such as Battle Creek, Antelope Creek, Cottonwood Creek, and many others. Winter-run Chinook access spawning sites in the mainstem Sacramento River below Keswick Dam; and sDPS green sturgeon access sites in the mainstem Sacramento River below Keswick Dam, in the Feather River, and potentially in the Yuba River. Annual recruitment of each of these species is partially dependent on available passage through the action area as they occupy a large geographical range upstream.

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 proposed action includes activities that may directly or indirectly impact winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS green sturgeon and/or the critical habitat of these species. The following is an analysis of the potential direct and indirect effects to listed fish species and/or their critical habitat that may occur because of implementing the I Street Bridge Replacement Project.

2.5.1 Effects of the Proposed Action to Listed Fish Species

2.5.1.1 Direct Effects

Listed salmonids may be impacted by instream construction activities. Construction-related effects may include debris falling into the active channel, interactions with the construction barge, tools and/or equipment falling into the active channel, or noise generated by displaced rock and sediment and the operation of construction machinery. Adult winter-run Chinook are known to migrate through the action area; juvenile and adult CCV steelhead, sDPS green sturgeon, and CV spring-run Chinook are known to rear in and migrate through the action area Any of these species/life stages may be present during the scheduled in-water work window and may be negatively affected by construction-related effects. BMPs, avoidance, and minimization techniques will be implemented, minimizing the probability of construction-related effects in the action area.

Salmonid behavioral response to noise and disturbance caused by construction activities may negatively influence fish's downstream migration. Fish that migrate downstream may be exposed to short-term stress from being displaced from their rearing area and needing to locate a new rearing area. As such, listed salmonids may experience crowding and competition with resident fish for food and habitat, which can lead to reduced growth. Further, listed salmonids may be subject to increased predation risk while they are locating new rearing areas, leading to reduced survival. However, displaced fish will likely relocate to areas downstream that have suitable habitat and low competition; therefore, these potential negative effects are not expected to occur. Since only a small number of listed salmonids are likely to be in the action area and temporarily displaced by the proposed Project, it is not expected to affect the survival chances of individual fish or affect the population based on the size of the area that will be affected and the small number of fish likely to be displaced.

Instream construction activities may cause mortality, or reduced abundance, of benthic aquatic macroinvertebrates within the area where the bridge repairs will occur due to coarse sediment smothering. These effects to aquatic macroinvertebrates will be temporary and rapid recolonization (about 2 weeks to 2 months) is expected (Merz and Chan 2005). Furthermore, downstream drift is expected to temporarily benefit any downstream, drift-feeding organisms, including juvenile salmonids. The amount of food available for juvenile salmonids and other listed salmonids is therefore expected to return to at least to pre-Project conditions.

Although listed fish may be exposed to construction areas with reduced prey base, listed fish will be able to retreat to adjacent suitable habitat, and food resources will only be temporarily impacted. Therefore, effects of instream construction activities are expected to be minor and are unlikely to result in injury or death.

2.5.1.2 Indirect Effects

2.5.1.2.1 Unintentional Spill of Hazardous Substances

During construction, the potential exists for spills or leakage of toxic substances that could enter the Sacramento River. Refueling, operation, and storage of construction equipment and materials could result in accidental spills of pollutants (e.g., fuels, lubricants, concrete, sealants, and oil).

High concentrations of contaminants can cause direct and indirect effects to fish. Direct effects include mortality from exposure or increased susceptibility to disease that reduces the overall health and survival of the exposed fish. The severity of these effects depends on the contaminant, the concentration, duration of exposure, and sensitivity of the affected life stage. A potential indirect effect of contamination is reduced prey availability; invertebrate prey survival could be reduced following exposure, therefore making food less available for fish. Fish consuming infected prey may also absorb toxins directly. For salmonids, potential direct and indirect effects of reduced water quality during project construction will be addressed by utilization of vegetable-based lubricants and hydraulic fluids in equipment operated in the wet channel, and by implementing the construction site housekeeping measures incorporated in the project SWPPP. These measures include provisions to control erosion and sedimentation, as well as a Spill Prevention and Response Plan to avoid, and if necessary, clean up accidental releases of hazardous materials.

With these best management practices in place, impacts from contaminants are expected to be discountable for listed species.

2.5.1.2.2 Fish Rescue and Relocation

Prior to dewatering the area behind the sheet piles, fish will be captured and relocated from the area to be dewatered. Capture methods may include seining, dip netting, and/or electrofishing. The fish capture/relocation is included in this Project in order to avoid or minimize injury or death to fish due to dewatering. However, the handling of fish rescue itself may cause stress, injury, or death, even though it will be conducted by a qualified fish biologist and done according to a NMFS-approved relocation plan.

2.5.1.2.3 Sediment and Turbidity

Construction activities related to the bridge construction will temporarily disturb soil and riverbed sediments, resulting in the potential for temporary increases in turbidity and suspended sediments in the action area. Turbidity plumes are expected to affect a portion of the channel width and extend up to 600 feet downstream of the site. Construction-related increases in sedimentation and siltation above the background level could potentially affect fish species and their habitat by reducing juvenile survival, interfering with feeding activities, causing breakdown of social organization, and reducing primary and secondary productivity. The magnitude of potential effects on fish depends on the timing and extent of sediment loading and flow in the river before, during, and immediately following construction.

High concentrations of suspended sediment can have both direct and indirect effects on salmonids. The severity of these effects depends on the sediment concentration, duration of exposure, and sensitivity of the affected life stage. Based on the types and duration of proposed in-water construction methods, short-term increases in turbidity and suspended sediment may disrupt feeding activities or result in avoidance or displacement of fish from preferred habitat. Juvenile salmonids have been observed to avoid streams that are chronically turbid (Lloyd 1987) or move laterally or downstream to avoid turbidity plumes (Sigler *et al.* 1984). Sigler *et al.* (1984) found that prolonged exposure to turbidities between 25 and 50 nephelometric turbidity units (NTUs) resulted in reduced growth and increased emigration rates of juvenile coho salmon and steelhead compared to controls. These findings are generally attributed to reductions in the ability of salmon to see and capture prey in turbid water (Waters 1995). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). Berg and Northcote (1985) observed changes in social and foraging behavior and increased gill flaring (an indicator of stress) in juvenile coho salmon at moderate turbidity (30-60 NTUs). In this study, behavior returned to normal quickly after turbidity was reduced to lower levels (0-20 NTU).

Any increase in turbidity associated with instream work is likely to be brief and occur only near the site, attenuating downstream as suspended sediment settles out of the water column. Temporary spikes in suspended sediment may result in behavioral avoidance of the site by fish; several studies have documented active avoidance of turbid areas by juvenile and adult salmonids (e.g., Sigler *et al.* 1984, Lloyd 1987, Servizi and Martens 1992).

Although less is known about the timing of rearing and migration of sDPS green sturgeon, both adult and juvenile life stages are known to utilize the action area as a migration corridor and may exhibit rearing behavior there as well. Less is known about the specific detrimental physical and physiological effects of sedimentation and turbidity to sturgeon. However, it is thought that high levels of turbidity can generally result in gill fouling, reduced temperature tolerance, reduced swimming capacity and reduced forage capacity in lotic fishes (Wood and Armitage 1997).

Individual fish that encounter increased turbidity or sediment concentrations will likely move away from affected areas into more suitable surrounding habitat. In-water work will only occur from May 1 to November 30, which will limit the duration of the turbidity effects. Gravel will be washed to reduce the introduction of fine sediments to the stream.

Based on the proposed Project description, sedimentation events and elevation of turbidity associated with construction are expected to be minor and transient in nature. In addition, avoidance and minimization techniques will be implemented in this Project as well as BMPs pertaining to the minimization of sedimentation and turbidity ensuring the turbidity does not exceed the 20% threshold derived from the Sacramento and San Joaquin Rivers Basins Plan. These actions will minimize the extent of adverse effects associated with the proposed action.

2.5.1.2.4 Acoustic Effects

Piles that are driven into river bed substrate propagate sound through the water, which can damage a fish's swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder (Gisiner 1998, Popper et al. 2006). The swim bladder is the primary physiological mechanism that controls a fish's buoyancy. A perforated or hemorrhaged swim bladder has the potential to compromise the ability of a fish to orient itself both horizontally and vertically in the water column. This can result in diminished ability to feed, migrate, and avoid predators. Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish's viscera (Gaspin 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings 1995). It is important to note that acute injury resulting from acoustic impacts should be scaled based on the mass of a given fish. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper and Hastings 2009).

Fish can also be injured or killed when exposed to lower sound pressure levels for longer periods of time. Hastings (1995) found death rates of 50 percent and 56 percent for gouramis (Trichogaster sp.) when exposed to continuous sounds at 192 dB (re 1 μPa) at 400 Hz and 198 dB (re 1 μPa) at 150 Hz, respectively, and 25 percent for goldfish (Carassius auratus) when exposed to sounds of 204 dB (re 1 μPa) at 250 Hz for 2 hours or less. Hastings (1995) also reported that acoustic "stunning," a potentially lethal effect resulting in a physiological shutdown of body functions, immobilized gourami within 8 to 30 minutes of exposure to the aforementioned sounds.

Multiple studies have shown responses in the form of behavioral changes in fish due to human-produced noise (Wardle et al. 2001, Slotte et al. 2004, Popper and Hastings 2009). Instantaneous behavioral responses may range from slight variations, a mild awareness, to a startle response. Fish may also vacate their normally-occupied positions in their habitat for short or long durations. Depending on the behavior that is being disrupted, the direct and indirect negative effects could vary. Behavioral effects could affect juvenile fish more than adults, as there are essential behaviors to their maturation and survival, such as feeding, sheltering, and migration. An example of a significant, direct negative effect would be interruption or alteration of migratory behavior. In the context of the proposed action area, the migratory behavior of juvenile salmonids and green sturgeon may be affected by various pile driving and acoustic impacts. Though pile driving may affect migratory behavior, it is not expected to prevent salmonids and sturgeon from passing upstream or downstream because pile driving will not be continuous through the day (maximum 16,000 strikes per day), and will not occur at night, when the majority of fish migrate.

The permanent piles for the bridge abutments will be installed on land using an impact hammer. The proposed action includes installation of 100, 16-inch diameter steel or 16-inch precast concrete piles. According to an October 2012 update to the Caltrans hydroacoustic compendium (Caltrans 2012), the installation of 16-inch diameter steel piles with an impact hammer on land will result in single-strike sound levels of 198 dB_{peak} and 183 $dB_{root\ mean\ square\ (RMS)}$ at 10 meters (32.8 feet) from the pile with an estimated sound exposure level (SEL) of 171 dB. According to Caltrans (2012), the installation of 16-inch precast concrete piles with the use of an impact hammer on land will result in single-strike sound levels of 192 dB_{peak} and 181 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 174 dB. For both the steel and pre-cast concrete piles, the estimated peak sound level (183 dB) is below the interim threshold (206 dB) for fish injury for a single strike. However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB.

The piles for the temporary trestle will be installed in water using an impact hammer with attenuation. The proposed action includes installation of 160 piles for the temporary trestle. Piles will either be 16-inch diameter steel or 16-inch H piles. According to Caltrans (2012), the installation of 16-inch diameter steel piles will result in single-strike sound levels of 208 dB_{peak} and 187 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 176 dB. Use of attenuation, such as a bubble curtain, is assumed to provide a minimum 5 dB of sound reduction for all sound levels. According to Caltrans (2012), the installation of 16-inch H piles will result in single-strike sound levels of 195 dB_{peak} and 180 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 170 dB. Use of attenuation, such as a bubble curtain, is assumed to provide a minimum 5 dB of sound reduction for all sound levels.

The permanent piles for piers 2 and 5 will be installed inside a de-watered cofferdam using an impact hammer. The proposed action includes installation of 100, 16-inch diameter steel or 16-inch precast concrete piles. The dewatered cofferdams are assumed to provide 5 dB of attenuation, so following Caltrans (2012), the installation of 16-inch diameter steel piles with an impact hammer and 5dB of attenuation will result in single-strike sound levels of 203 dB_{peak} and 182 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 171 dB. With the use of attenuation, the installation of 16-inch precast concrete piles with the use of an impact hammer behind a de-watered cofferdam will result in single-strike sound levels of 183 dB_{peak} and 171 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 161 dB. For both the steel and pre-cast concrete piles, the estimated peak sound level is below the interim threshold for fish injury for a single strike. However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB.

The permanent piles for the bridge fender system will be installed using an impact hammer that will be operated from a construction barge. The proposed action includes installation of 60, 16-inch precast concrete piles. According to Caltrans (2012), the installation of 16-inch precast concrete piles with the use of an impact hammer and no attenuation will result in single-strike sound levels of 188 dB_{peak} and 176 $dB_{root\ mean\ square\ (RMS)}$ at 10 meters (32.8 feet) from the pile with an estimated SEL of 166 dB. With the use of attenuation, the maximum single-strike sound level is estimated to be 183 dB_{peak} and 171 dB_{RMS} at 10 meters (32.8 feet) from the pile and an estimated SEL of 161 dB. For both the attenuated and unattenuated scenarios, the estimated peak sound level is below the interim threshold for fish injury for a single strike. However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB.

Spud piles to keep the barge in place will be installed in water using an impact hammer either with or without attenuation. The proposed action will use eight, 16-inch diameter steel piles to affix the barge in place. According to Caltrans (2012), the installation of 16-inch diameter steel piles will result in single-strike sound levels of 208 dB_{peak} and 187 dB_{RMS} at 10 meters (32.8 feet) from the pile with an estimated SEL of 176 dB. Use of attenuation, such as a bubble curtain, is assumed to provide a minimum 5 dB of sound reduction for all sound levels.

The permanent piles for piers 3 and 4 will be eight, 108-inch steel casings. The piles for piers 3 and 4 will be installed using either a vibratory hammer or a hydraulic driven oscillator/rotator system. Additionally, the cofferdams will be installed using a vibratory driver. No impact driving will be used for the cofferdams. Neither the vibratory hammer nor a hydraulic driven oscillator/rotator system are expected to cause injury to fish. This is because the injury threshold for fish is higher using these machines because the shape of the sound is different.

NMFS currently uses a dual metric criteria to assess onset of injury for fish exposed to pile driving sounds [Fisheries Hydroacoustic Working Group (FHWG) 2008]. Specifically, this includes a peak level of 206 dB and an accumulated SEL of 187 dB for fish equal to or greater than 2 grams. If either threshold is exceeded, then physical injury is assumed to occur. There is uncertainty as to the behavioral response of fish exposed to high levels of underwater sound produced when driving piles in or near water. Based on the information currently available, and until new data indicate otherwise, NMFS uses a 150 dB RMS threshold for behavioral responses in salmonids and green sturgeon. Though the dB value is the same, the 150 dB RMS threshold for behavioral effects is unrelated to the 150 dB effective quiet threshold.

Distances to the thresholds for acoustic effects under the different construction scenarios are summarized in Table 3.

Avoidance and minimization measures for pile driving include, the seasonal work window which will avoid many sensitive life stages, limiting pile driving to daylight hours to allow migration through the area at night, vibrating piles to the maximum extent possible, the use of a vibratory driver for the cofferdams, the use of a vibratory hammer or hydraulic oscillator/rotator system for the large casings at piers 3 and 4, and the use of attenuation methods such as installing inside a dewatered cofferdam or the use of bubble curtains.

Sound has the ability to injure fish physically by damaging a fish's swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder. Additionally, it can harass fish by instigating behavioral changes. These behavioral changes can also lead to injury or death, such as fish being scared into higher predation areas. This project will involve impact pile driving with a bubble curtain used as attenuation and vibratory hammers. The calculations above state that there is the potential for the cumulative acoustic effects to exceed the effective quiet threshold allowing for injury or behavioral changes. Based on the acoustic effects analysis (Table 3), peak sound pressures are estimated to be above the thresholds for injury and/or mortality of listed fish within 0 to 14 meters (0 to 45.9 feet) of the pile driving, depending on the size of piles used and the use of sound attenuation techniques. Peak sound pressures are not estimated to be above the threshold for injury and/or mortality of listed fish >14 meters (or 45.9 feet) from the pile driving. Cumulative sound exposure levels are expected to exceed the 187 dB threshold for physical injury for fish greater than 2 grams, from 54 to 541 meters (177 to 1,774.9 feet) of the pile, depending on the size of piles used and the use of sound attenuation techniques (Table 3). Non-injurious behavioral effects are expected to occur from 251 to 2,929 meters (828.4 to 9,609.6 feet) of the pile, depending on the size of pile used and the use of sound attenuation techniques (Table 3). Through avoidance and minimization measures, the effect of sound on listed species will be minimized.

Table 3. Acoustic effects under different construction scenarios.

Pile Location	Pile Type	Driver Type	Installation	Number of Strikes Per Pile	Piles Per Day	Strikes Per Day	Reference Distance (m)	Attenuation (dB)	Peak (dB)	SEL (dB)	RMS (dB)	Distance (m) to Threshold			
												Onset of Physical Injury			Behavior
												Peak dB	Cumulative SEL dB		RMS dB
													Fish >2 g	Fish < 2 g	
												206 dB	187 dB	183 dB	150 dB
Abutments 1 and 6	16-inch diameter steel	Impact	Land	800	20	16000	10	0	198	171	183	3	251	251	1585
	16-inch precast concrete	Impact	Land	800	20	16000	10	0	192	174	181	1	398	398	1166
Temporary Trestle	16-inch diameter steel	Impact	Water	800	20	16000	10	0	208	176	187	14	541	541	2929
	16-inch diameter steel	Impact	Water with attenuation	800	20	16000	10	5	203	171	182	6	251	251	1359
	16-inch H pile	Impact	Water	800	20	16000	10	0	195	170	180	2	215	215	1000
	16-inch H pile	Impact	Water with attenuation	800	20	16000	10	5	190	165	175	1	100	100	464
Piers 2 and 5	16-inch diameter steel	Impact	Inside de-watered cofferdam	800	20	16000	10	5	203	171	182	6	251	251	1359
	16-inch precast concrete	Impact	Inside de-watered cofferdam	800	20	16000	10	5	183	161	171	0	54	54	251
Bridge Fender System	16-inch diameter concrete	Impact	Water	1000	20	20000	10	0	188	166	176	1	117	117	541
	16-inch diameter concrete	Impact	Water with attenuation	1000	20	20000	10	5	183	161	171	0	54	54	251
Spud Piles	16-inch diameter steel	Impact	Water	800	8	6400	10	0	208	176	187	14	541	541	2929
	16-inch diameter steel	Impact	Water with attenuation	800	8	6400	10	5	203	171	182	6	251	251	1359
Piers 3 and 4	108-inch steel casings	Vibratory hammer	Water	NA	2 weeks /pile	NA	Vibratory pile driving not expected to cause injury to fish								
	108-inch steel casings	Hydraulic driven oscillator / rotator	Water	NA	2 weeks /pile	NA	Hydraulic oscillator/rotator systems rotate piles into place and do not generate high underwater noise levels								

2.5.2 Effects of the Proposed Action to Critical Habitat

Critical habitat has been designated in the action area for winter-run Chinook, CV spring-run Chinook, California Central Valley steelhead, and southern DPS of green sturgeon. The PBFs that occur within the action area for winter-run Chinook are: (1) migratory corridors for both upstream and downstream migration, (2) habitat and prey items that are free of contaminants, and (3) riparian habitat for juvenile rearing. The PBFs within the action area for sDPS green sturgeon are: (1) food resources, (2) adequate flow regime for all life stages, (3) water quality, (4) migratory corridors, (5) adequate water depth for all life stages, and (6) adequate sediment quality. The PBFs within the action area for CV spring-run Chinook and CCV steelhead are (1) freshwater rearing sites and (2) freshwater migration corridors.

Migratory corridors for winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS green sturgeon are likely to be negatively affected by the proposed action. The bridge piers and fenders associated with the proposed Action will create a permanent increase to in-river obstructions, but, given the width of the river and that many of the piles are aligned with each other along the trajectory of the river flow, this should not negatively impact the migration corridors in either direction for listed species. There will be a permanent loss of 0.44 acres SRA below the OHWM, and an additional permanent loss of 1 acre of cottonwood riparian habitat above the OHWM that supports critical habitat. Additionally, RSP and bridge pilings will permanently affect 1.33 acres of critical habitat. This loss of critical habitat results in on-site adverse impact to the designated critical habitat of listed species.

Habitat and prey items for winter-run Chinook (PBF 2) may be temporarily affected by contaminants due to the proposed action. Habitat may be contaminated via increased turbidity and sediments in the water column due to pile driving, the construction barge running aground, and the removal of temporary trestle and spud piles. Additionally, water, sediments, and potential prey items may become contaminated from petrochemicals from construction equipment. Contamination is not likely to persist after construction work is complete, so the habitat and prey items will likely not be permanently affected due to the proposed action. Avoidance and mitigation efforts for sedimentation and contamination are discussed in section 1.3.5.

While the proposed action is not likely to affect flow conditions for sDPS green sturgeon (PBF 2) within the action area, the presence of the barge during the in-water work window may temporarily affect localized flow conditions, since the barge will be anchored via piles driven into the corners of the barge.

Food resources for sDPS green sturgeon (PBF 1) may be temporarily affected by contaminants due to the proposed action. Potential prey items may become contaminated from petrochemicals from construction equipment. Contamination is not likely to persist after construction work is complete, so food resources will likely not be permanently affected due to the proposed action. Avoidance and mitigation efforts for sedimentation and contamination are discussed in section 1.3.5.

The proposed action may affect water quality for sDPS green sturgeon (PBF 3). The water may be contaminated via increased turbidity and sediments in the water column due to pile driving, the construction barge running aground, and temporary trestle and spud pile removal. Additionally, the water may become contaminated from petrochemicals from construction equipment. Contamination is not likely to persist after construction work is complete, so the water will likely not be permanently affected due to the proposed action. Avoidance and mitigation efforts for sedimentation and contamination are discussed in section 1.3.5.

Sediment quality for sDPS green sturgeon (PBF 6) may be temporarily affected by contaminants due to the proposed action. Sediments may become contaminated from petrochemicals from construction equipment. Contamination is not likely to persist after construction work is complete, so the habitat and prey items will likely not be permanently affected due to the proposed action. Avoidance and mitigation efforts for contamination are discussed in section 1.3.5.

2.5.3 Mitigation /Conservation Bank Credit Purchases

The proposed action also includes off-site mitigation for permanent impacts to streambed designated critical habitat of ESA listed anadromous salmonids at a ratio of 3:1 for permanent impacts to habitat below the OHWM and in-water column habitat; totaling 1.33 acres from the new bridge piers and RSP, and from the bridge shading of aquatic habitat. Caltrans will additionally compensate for the permanent fill of 1.85 acres of other waters of the United States in the Sacramento River by purchasing mitigation bank credits at either (1) a minimum of 2:1, for a total of up to 3.7 acres, if credits are for preservation of habitat; or (2) a minimum of 1:1, for a total of 1.85 acres, if the credits are for creation of habitat. Caltrans plans to mitigate for the loss of 1.44 acres of riparian forest by mitigating onsite to the maximum extent practicable. Offsite compensation will be used to achieve no net loss of existing in-kind riparian cover habitat values. Caltrans will compensate for the loss of 1.44 acres of riparian forest by purchasing mitigation bank credits at either (1) a minimum of 2:1, for a total of up to 2.88 acres, if credits are for preservation of habitat; or (2) a minimum of 1:1, for a total of 1.44 acres, if the credits are for creation of habitat.

The purchase of mitigation credits will address the loss of ecosystem functions due to the modification of the riverbank and streambed. These credit purchases are ecologically relevant to the impacts and the species affected because the NMFS-approved conservation/mitigation banks that serve the Project area include SRA, riparian forest and floodplain credits with habitat values that are already established and meeting performance standards. In addition, the banks are located in areas that will benefit the ESUs/DPSs affected by the proposed action.

The purchase of credits provides a high level of certainty that the benefits of a credit purchase will be realized because each of the NMFS-approved banks considered in this BO have mechanisms in place to ensure credit values are met over time. Such mechanisms include legally-binding conservation easements, long-term management plans, detailed performance standards, credit release schedules that are based on meeting performance standards, monitoring plans and annual monitoring reporting to NMFS, non-wasting endowment funds that are used to manage and maintain the bank and habitat values in perpetuity, performance security requirements, a remedial action plan, and site inspections by NMFS. In addition, each bank has a detailed credit schedule and credit transactions and credit availability are tracked on the Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS). RIBITS was developed by the U.S. Army Corps of Engineers, with support from the Environmental Protection Agency, the U.S. Fish and Wildlife Service, the FHWA, and NMFS to provide better information on mitigation and conservation banking and in-lieu fee programs across the country. RIBITS allows users to access information on the types and numbers of mitigation and conservation bank and in-lieu fee program sites, associated documents, mitigation credit availability, service areas, as well as information on national and local policies and procedures that affect mitigation and conservation bank and in-lieu fee program development and operation. RIBITS also contains links to bank establishment documents. The Bullock Bend Mitigation Bank was established June 23, 2016; the Cosumnes Floodplain Mitigation Bank was established August 4, 2008; the Fremont Landing Conservation Bank was established October 19, 2006; and the Liberty Island Conservation Bank was established July 21, 2010.

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 Diversions

Water diversions for municipal and industrial use are found in action area. Depending on the size, location, and season of operation, any of the diversions that are unscreened may entrain and kill many life stages of aquatic species, including juvenile listed anadromous fish species.

2.6.2 Increased Urbanization

Increases in urbanization and housing developments can affect habitat by altering watershed characteristics, and changing both water use and storm water runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those that are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

Increased urbanization also is expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially re-suspending contaminated sediments and degrading areas of submerged vegetation. This, in turn, will reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids and green sturgeon moving through the system. Increased recreational boat operation is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the associated water bodies.

2.6.3 Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur within the Sacramento River watershed. The effects of such actions result in continued degradation, simplification and fragmentation of riparian and freshwater habitat.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to listed species and critical habitats 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 critical habitat for the conservation of the species.

In our *Range-wide Status of the Species* section, NMFS summarized the current likelihood of extinction of each of the listed species. We described the factors that have led to the current listing of each species under the ESA and across their ranges. These factors include past and present human activities and climatological trends and ocean conditions that have been identified as influential to the survival and recovery of the listed species. Beyond the continuation of the human activities affecting the species, we also expect that ocean condition cycles and climatic shifts will continue to have both positive and negative effects on the species' ability to survive and recover. The *Environmental Baseline* section reviewed the status of the species and the factors that are affecting their survival and recovery in the action area. The *Effects of the Action* section reviewed the exposure of the species and critical habitat to the proposed action and cumulative effects. NMFS then evaluated the likely responses of individuals, populations, and critical habitat. This *Integration and Synthesis* section will consider all of these factors to determine the proposed action's influence on the likelihood of both the survival and recovery of the listed species, and on the conservation value of designated critical habitats.

In order to estimate the risk to CCV steelhead, CV spring-run Chinook, winter-run Chinook, and green sturgeon as a result of the proposed action, NMFS uses a hierarchical approach. The condition of the ESU or DPS is summarized from the *Status of the Species* section of this BO. We then consider how the status of populations in the action area, as described in the *Environmental Baseline*, is affected by the proposed action. Effects on individuals are summarized, and the consequence of those effects is applied to establish risk to the diversity group, ESU, or DPS.

<u>Status of the Species and Environmental Baseline</u>

There are several criteria that would qualify the winter-run Chinook population at moderate risk of extinction (continued low abundance, a negative growth rate over two complete generations, significant rate of decline since 2006, increased hatchery influence on the population, and increased risk of catastrophe), and because there is still only one population that spawns below Keswick Dam, winter-run Chinook are at a high risk of extinction in the long term. Although many of the PBFs of winter-run Chinook critical habitat are currently degraded and provide limited high quality habitat, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

CV spring-run Chinook remain at moderate risk of extinction based on the evaluation for years 2012 – 2014 (Williams et al. 2016). However, 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 strongholds will deteriorate into high extinction risk in the coming years based on the population size or rate of decline criteria (NMFS 2016b). Although many of the PBFs of CV spring-run Chinook critical habitat are currently degraded and provide limited high quality habitat, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

The status of the CCV steelhead DPS appears to have remained unchanged since the 2016 status review and the DPS is likely to become endangered within the near future throughout all or a significant portion of its range (NMFS 2016a). Many of the PBFs of CCV steelhead critical habitat are degraded and provide limited high quality habitat. 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 watershed are considered to have high intrinsic value for the conservation of the species, as they are critical to ongoing recovery efforts.

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 (NMFS 2015). Currently, many of the PBFs of sDPS green sturgeon are degraded and provide limited high quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, and presence of contaminants in sediment. Although currently many of the PBFs of sDPS green sturgeon critical habitat are degraded and provide

limited high quality habitat, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.
The evidence presented in the *Environmental Baseline* section indicates that past and present activities within the Sacramento River basin have caused significant habitat loss, degradation, and fragmentation. This has significantly reduced the quality and quantity of the remaining PBFs within action area of the Sacramento River for the populations of CCV steelhead, winter and CV spring-run Chinook, and sDPS green sturgeon that utilize this area. Alterations in the flow regimes of the Sacramento River system, removal of riparian vegetation and shallow water habitat, recued habitat complexity, construction of armored levees for flood protection, and the influx of contaminants from agricultural and urban dischargers have also substantially reduced the functionality of the waterways.

Cumulative Effects

Water diversions, increased urbanization, and continuing rock revetment and levee projects can be reasonably assumed to occur in the future in the action area. The effects of these actions result in the continued degradation, simplification, and fragmentation of the riparian and freshwater habitat. Some of these actions, particularly those which are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

Summary of the Effects of the Proposed Action

Fish will be harassed, injured, or killed during completion of the proposed action through various pathways. Direct effects from Project activities could result in physically crushing fish, negative effects through behavioral responses, or prey items killed from sediment or pollutant buildup. Any spills or leaks of toxic substances from construction equipment could cause direct or indirect effects to fish that risk mortality or reduces the overall health and survival of exposed fish. A rescue and relocation plan involves capturing fish and physically handling and relocating them, which risks injury and death. Construction-related increases in sedimentation and siltation above background level could potentially affect fish species and their habitat reducing survival of juveniles or interfering with feeding, migrating, and rearing activities. A large and varied amount of pile driving can create enough sound to damage a fish's internal organs or affect their migration and behavioral responses. Avoidance and mitigation measures, as well as BMPs, have been put in place to decrease any negative effects to listed species.

Critical habitat has been designated in the action area for winter-run Chinook, spring-run Chinook, CCV steelhead, and sDPS green sturgeon. PBFs affected for each species are listed in section 2.5.2. The proposed action will permanently affect an area that already contains degraded PBFs. The migratory corridors and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species. Therefore, the loss of any amount of these PBFs in the action area would negatively affect all of the listed species that utilize the action area.

NMFS Recovery Plan

The NMFS Recovery Plan for salmonids proposes actions to be taken on the Sacramento River to enhance fish passage and habitat. Four of these actions relevant to the proposed action are (1) Restore and maintain riparian and floodplain ecosystems along both banks of the Sacramento River to provide a diversity of habitat types including riparian forest, gravel bars and bare cut banks, shady vegetated banks, side channels, and sheltered wetlands, such as sloughs and oxbow lakes following the guidance of the Sacramento River Conservation Area Handbook. (2) Ensure that riverbank stabilization projects along the Sacramento River utilize biotechnical techniques that restore riparian habitat, rather than solely using the conventional technique of adding riprap. (3) Curtail further development in active Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes. (4) Implement projects that promote native riparian (e.g.,willows) species including eradication projects for nonnative species (e.g., Arundo, tamarisk). The proposed Project reduces the riparian ecosystem by converting critical habitat to hardscape. The levee repair regrades an existing levee and contributes to the continued rip rapping of the riparian habitat along the Sacramento River. This bridge represents new development in active Sacramento River floodplains and removes permanently 1.4 acres of cottonwood riparian habitat.

Summary

According to the most recent status reviews, CV spring-run Chinook, winter-run Chinook, CCV steelhead, and sDPS green sturgeon are at some level or threat or risk of extinction due to past and present activities within the Sacramento River basin that have caused significant habitat loss, degradation, and fragmentation. Cumulative effects like water diversions, increased urbanization, and continuing rock and levee projects will all continue to happen in the action area without necessarily requiring federal permitting. During this proposed Project, fish will be harassed, injured, or killed during completion of the proposed action through various pathways. Direct effects from the Project as well as pollution events, rescue and relocation, turbidity increases, pile driving, and a loss of critical habitat all have the potential to affect fish. Avoidance and mitigation measures, as well as BMPs, have been put in place to decrease any negative effects to listed species.

The proposed construction will temporarily decrease the action area's ability to safety support listed fish at a variety of life stages and will increase the risk of mortality events or behavioral changes. Permanent effects will be seen on 1.44 acres of cottonwood riparian habitat (both above and below the OHWM) and 1.33 acres of critical habitat below the OHWM in the form of RSP and pier piling placement. These valuable areas that support critical habitat will be turned into hardscape. These permanent impacts only represent a small loss in the scope of the available habitat, but the high intrinsic conservation value of the area means this loss will be detrimental for the listed species that use the action area. On and offsite mitigation will attempt to address the loss of ecosystem function due to the modification of the riverbank and streambed (see section 1.3.6). Measures are included in the proposed action to protect fish and designated critical habitat. These measures, in addition to the purchase of mitigation credits, are expected to prevent the negative effects to individuals, populations, and designated critical habitat from reducing appreciably the likelihood of either the survival or recovery of a listed species in the wild by reducing their numbers, reproduction, or distribution; or appreciably diminishing the value of designated critical habitat for the conservation of the species.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, 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 winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS 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 ITS.

2.9.1 Amount or Extent of Take

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

NMFS anticipates incidental take of juvenile winter-run Chinook, adult and juvenile CV spring-run Chinook, adult and juvenile CCV steelhead, and subadult sDPS green sturgeon from impacts directly related to sedimentation and turbidity, pile driving and impairment of essential behavior patterns as a result of these activities, potential fish entrainment, and the possibility deleterious materials entering the waterway at the project construction site. The incidental take is expected to be in the form of harm, harassment, or mortality of winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS green sturgeon resulting from the installation and removal of temporary and permanent piles during bridge construction. Incidental take is expected to occur for any in-water work window seasons when of winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS green sturgeon individuals could potentially be in the action area. NMFS cannot, using the best available information, quantify the anticipated incidental take of individual winter-run Chinook, CV spring-run Chinook, CCV steelhead, and sDPS green sturgeon because of the variability and uncertainty associated with the population size of the species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the action area. However, it is possible to describe the ecological surrogates for the incidental take.

It is impossible to precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) 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 spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

Ecological surrogates are Project elements that are expected to result in take and are somewhat predictable and/or measurable. Ecological surrogates can be monitored to approximate the level of take that occurs. Ecological surrogates for construction effects are described below. Overall, the number of listed fish that may be incidentally taken during activities is expected to be small, due to the proposed work window.

1) Direct Effects

Incidental take is expected to occur from construction-related effects in the form of injury or death of listed species. Additionally, take in the form of harassment is likely to occur as a result of displacement due to construction operations. Disruption of habitat utilization is likely to result in increased predation risk, decreased feeding, and increased competition. The behavioral modifications are expected to result from disruption of habitat use. Fish may become entrained in the new steel piles and may be injured or killed if the piles are dewatered. Two cofferdams are to be dewatered and will remain in place only during construction of the new bridge piers. The dimensions of each cofferdam are 25 feet by 80 feet, or 2,000 square feet. The temporary cofferdams and trestle piles will occupy 0.095 acres of river bottom during construction. This area contains the permanent effects and serves as the ecological surrogate for direct effects because it is where construction or dewatering will directly affect listed species. There is not a stronger ecological surrogate based on the information available at this time. It is not possible to quantify the exact numbers of individuals that may be affected. If Caltrans exceeds the 0.095 acre footprint, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to cease operations and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels.

2) Rescue and Relocation

The proposed Project involves a fish rescue and relocation plan designed to recover any fish caught in cofferdams. It is impossible to estimate how many fish may need to be relocated from cofferdams. A fish rescue and relocation plan will be used as an ecological surrogate. If this plan is not submitted to the resource agencies for approval at least 60 days prior to initiating activities to install cofferdams, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to coordinate with NMFS on ways to reduce the amount of take down to anticipated levels.

3) Increased Sedimentation and Turbidity

The analysis of the effects of the proposed Project anticipates that the turbidity levels produced by installation and removal of piles will not exceed 20% over background, the threshold derived from the Sacramento and San Joaquin Rivers Basins Plan. The 20% turbidity level is being used as an ecological surrogate. If turbidity exceeds 20% over background levels, and construction activities fail to halt and adjust work to return to acceptable levels, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to cease operations and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels.

4) Pile Driving and Acoustic Impacts

The proposed Project effects anticipates installation of all of the steel piles for the new fenders to be driven by vibratory and impact hammers. Pile driving with an impact hammer will occur during daylight hours, but will likely not be continuous throughout the entire working day. The Project will use the piles listed in Table 3. All piles will be driven during the in-water pile driving work window, between May 1 and November 30.

Pile driving with an impact hammer is expected to cause incidental take in the form of injury and mortality to salmonids and sturgeon through exposure to temporary high noise levels or sustained exposure to lower sound levels (> 206 dB peak or 183 or 187 dB SEL) within the water column during the installation of the piles. NMFS will use the area of sound pressure wave impacts extending into the water column from each pile, and the time period for pile driving as a surrogate for number of fish.

Based on the acoustic effects analysis (Table 3), peak sound pressures are estimated to be above the thresholds for injury and/or mortality of listed fish within 0 to 14 meters (0 to 45.9 feet) of the pile driving, depending on the size of piles used and the use of sound attenuation techniques. Peak sound pressures are not estimated to be above the threshold for injury and/or mortality of listed fish >14 meters (or 45.9 feet) from the pile driving. Cumulative sound exposure levels are expected to exceed the 187 threshold for physical injury for fish greater than 2 grams from 54 to541 meters (177 to 1,774.9 feet) of the pile, depending on the size of piles used and the use of sound attenuation techniques (Table 3). Non-injurious behavioral effects are expected to occur from 251 to 2,929 meters (828.4 to 9,609.6 feet) of the pile, depending on the size of pile used and the use of sound attenuation techniques (Table 3). If Caltrans' monitoring indicates that sound levels greater than 206 dB peak, 187 dB or 183 dB cumulative SEL, or 150 dB RMS extend beyond the distances expected for the pile size and attenuation type, the amount of incidental take would be exceeded. If these ecological surrogates are not met and maintained, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to cease operations and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels.

5) Loss of Habitat

NMFS anticipates that ESA listed anadromous fish may be harmed as a result of significant habitat impacts that will increase the likelihood of injury and death from habitat modifications at the repair site that reduce the quantity and quality of rearing habitat and by creating habitat conditions that increase the likelihood predation.

It is impossible to precisely quantify and track the amount or number of individuals that are expected to be incidentally harmed as a result of the proposed action due to the varying population size (annually and seasonally), annual variations in the timing of spawning and migration, variation in individual habitat use with the action area, and difficulty in making observations of injured or dead fish. The ecological surrogate for incidental take associated with the action is the permanent loss of 1.33 acres of habitat below the OHWM and the degradation of riparian vegetation where migrating and rearing juveniles of the species exist within the footprint of the proposed action.

Anticipated incidental take will be exceeded if the ecological surrogates described in the sections above are not met, the Action is not implemented as described in the BA prepared for this Action, all conservation measures are not implemented as described in the BA (including successful completion of monitoring and reporting criteria), or the Action is not implemented in compliance with the terms and conditions of this incidental take statement. If these ecological surrogates are not met and maintained, the proposed action will be considered to have exceeded anticipated take levels, thus requiring Caltrans to cease and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated 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).

The measures described below are non-discretionary, and must be undertaken by Caltrans so that they become binding conditions of any contracts or permits, as appropriate, for the exemption in section 7(o)(2) to apply. Caltrans has a continuing duty to regulate the activity covered by this incidental take statement. If Caltrans (1) fails to assume and implement the terms and conditions or (2) fails to require its contractor(s) to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Caltrans must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement [50 CFR§402.14(i)(3)].

1. Measures shall be taken to minimize sedimentation events and turbidity plumes.
2. Measures shall be taken to reduce the potential sound impacts.
3. Measures shall be taken to revegetate temporarily impacted areas below and above the OHWM with native plants and shrubs.
4. Caltrans shall monitor and report on the amount or extent of incidental take.

2.9.4 Terms and Conditions

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

The following terms and conditions implement reasonable and prudent measure 1: Measures shall be taken to minimize sedimentation events and turbidity plumes.

a) BMPs shall be implemented to prevent sediment incursion into the active channel.
b) Water discharged into the Sacramento River during construction will be filtered with a filter bag, diverted to a settling tank or infiltration area, and/or treated in a manner to ensure that discharges conform to the water quality requirements of the waste discharge permit.
c) Turbidity and settable solids shall be monitored according to water quality permits. If acceptable limits are exceeded, work shall be suspended until acceptable measured levels are achieved.

The following terms and conditions implement reasonable and prudent measure 2: Measures shall be taken to reduce the potential sound impacts.

a) Noise attenuation methods, such as a bubble curtain, shall be used.
b) Pile driving shall not be conducted at night when migration is most prevalent.

The following terms and conditions implement reasonable and prudent measure 3: Measures shall be taken to revegetate impacted areas below and above the OHWM with native plants and shrubs.

a) All mitigation credits shall be purchased from a NMFS approved conservation bank.
b) All mitigation credits shall be purchased prior to the end of construction.
c) Documentation of the purchase of mitigation credits shall be sent to NMFS.
d) Plants placed on-site as a form of mitigation shall be irrigated and maintained for 3 years.
e) The removal of existing riparian and native vegetation shall be minimized to the maximum extent practicable.

The following terms and conditions implement reasonable and prudent measure 4: Caltrans shall monitor and report on the amount or extent of incidental take.

a) Caltrans shall provide a report of project activities to NMFS by December 31 of each construction year.

b) The report shall include project schedules, project completions, and details regarding project implementation for each given year.
c) This report shall include a summary description of in-water constraint activities, avoidance and minimization measures taken, and any observed take incidents.
d) Caltrans shall visually monitor the waterway in the action area during operations for any affected fish, including, but not limited to, CV spring-run Chinook, CCV steelhead, winter-run Chinook, and the sDPS green sturgeon. Observation of affected fish shall be reported to NMFS by telephone at (916) 930-3600, by FAX at (916) 930-3629, or at the address given below within 24 hours of the incident. Operations shall be halted immediately until Caltrans coordinates with NMFS to determine the cause of the incident and whether any additional protective measures are necessary to protect listed salmonids and green sturgeon. Any protective measures that are determined necessary to protect listed salmonids and sturgeon shall be implemented as soon as practicable within 72 hours of the incident. Affected fish are defined as:
   a. Dead or moribund fish at the water surface;
   b. Showing signs of erratic swimming behavior or other obvious signs of distress;
   c. Gasping at the water surface; or
   d. Showing signs of other unusual behavior.

   A follow-up written notification shall also be submitted to NMFS which includes the date, time, and location that the carcass or injured specimen was found, a color photograph, the cause of injury or death, if known, and the name and affiliation of the person who found the specimen. Written notification shall be submitted to NMFS at the above address. Any dead specimen(s) shall be placed in a cooler with ice and held for pick up by NMFS personnel or an individual designated by NMFS to do so.

Updates and reports required by these terms and conditions shall be submitted to:

Assistant Regional Administrator
National Marine Fisheries Service
California Central Valley Office
650 Capitol Mall, Suite 5-100
Sacramento California 95814-4607

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) Caltrans should 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 and sturgeon habitat restoration projects within the Sacramento River Basin.

(2) Caltrans should use a vibratory hammer whenever possible to avoid acoustic impacts to ESA-listed fish.
(3) Equipment used for the Project shall be thoroughly inspected off-site for drips or leaks.
(4) To the extent practicable, equipment shall be serviced with petroleum or other contaminant sources off-site.
(5) Equipment used for the Project shall be thoroughly cleaned off-site to prevent introduction of contaminants.

2.11 Reinitiation of Consultation

This concludes formal consultation for I Street Bridge Replacement Project.

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

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. 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 Caltrans and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plan (FMP) developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

EFH designated under the Pacific Coast Salmon FMP may be affected by the proposed action. Additional species that utilize EFH designated under this FMP within the action area include fall-run/late fall-run Chinook salmon. Habitat Areas of Particular Concern (HAPCs) that may be either directly or indirectly adversely affected include (1) complex channels and floodplain habitats, and (2) thermal refugia.

3.2 Adverse Effects on Essential Fish Habitat

Effects to the HAPCs listed in section 3.1 are discussed in context of effects to critical habitat PBFs as designated under the ESA in section 2.5.2. Effects to ESA-listed critical habitat and EFH HAPCs are appreciably similar; therefore, no additional analyses are conducted. A list of adverse effects to EFH HAPCs is included in this EFH consultation. Affected HAPCs are indicated by number corresponding to the list in section 3.1:

Pile Driving:
• Permanent loss of habitat (1)

Sedimentation and Turbidity:
• Reduced habitat complexity (1)
• Reduced size and connectivity of spawning patches (1)
• Increased scouring (1)
• Degraded water quality (1,2)
• Reduction in aquatic macroinvertebrate production (1)

Contaminants and Pollution-related Effects:
• Degraded water quality (1, 2)
• Reduction in aquatic macroinvertebrate production (1)

De-watering of Piles and/or Attenuation Casing:
• Degraded water quality (1, 2)
• Temporary loss of habitat (1, 2)

Vegetation removal:
• Permanent loss of natural shade cover (2)
• Permanent loss of habitat (1)

3.3 Essential Fish Habitat Conservation Recommendations

The following are EFH conservation recommendations for the proposed Project:

(1) Caltrans should 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 and sturgeon habitat restoration projects within the Sacramento River Basin. HAPCs that would benefit from implementation of restoration projects include (1) complex channels and floodplain habitats and (2) thermal refugia.

(2) Caltrans should post interpretive signs within the action area describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

Fully implementing the EFH conservation recommendations above would protect EFH for Pacific coast salmon by avoiding or minimizing the adverse effects described in section 3.2.

3.4 Statutory Response Requirement

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

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

3.5 Supplemental Consultation

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

4. FISH AND WILDLIFE COORDINATION ACT

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development (16 USC 661). The FWCA establishes a consultation requirement for Federal agencies that undertake any action to modify any stream or other body of water for any purpose, including navigation and drainage (16 USC 662(a)), regarding the impacts of their actions on fish and wildlife, and measures to mitigate those impacts. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources, and providing equal consideration for these resources. NMFS' recommendations are provided to conserve wildlife resources by preventing loss of and damage to such resources. The

FWCA allows the opportunity to provide recommendations for the conservation of all species and habitats within NMFS' authority, not just those currently managed under the ESA and MSA.

The following recommendations apply to the proposed action:

(1) Caltrans should post interpretive signs within the action area describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

The action agency must give this recommendation equal consideration with the other aspects of the proposed action so as to meet the purpose of the FWCA.

This concludes the FWCA portion of this consultation.

5. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion is Caltrans. Other interested users could include City of Sacramento, City of West Sacramento, U.S. Coast Guard, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife. Individual copies of this opinion were provided to Caltrans. This opinion will be posted on the Public Consultation Tracking System website (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

5.2 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.

5.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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