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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

JAN 26 2009

In response refer to:
2007/08320:DHW

Gene K. Fong
Division Administrator
Federal Highway Administration
California Division
650 Capital Mall, Suite 4-100
Sacramento, California 95814

Dear Mr. Fong,

Thank you for your September 24, 2008, letter requesting consultation with NOAA's National Marine Fisheries Service's (NMFS) regarding the California Department of Transportation's (Caltrans) proposed Marin Sonoma Narrows Project (MSN Project) that will widen Highway 101 between State Route 37 in the City of Novato, Marin County, and the Corona Road Overpass in the City of Petaluma, Sonoma County, California. The enclosed biological opinion considers the effects of this proposed project on threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS), threatened Southern DPS of North American green sturgeon (*Acipenser medirostris*), designated critical habitat for CCC steelhead, and proposed designated critical habitat for North American green sturgeon in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). In addition, this letter transmits the result of NMFS' Essential Fish Habitat (EFH) consultation pursuant to section 305(b)(2) of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA).

Endangered Species Act Consultation

NMFS concludes in the biological opinion that the proposed action will not jeopardize the continued existence of CCC steelhead and North American green sturgeon nor adversely modify designated critical habitat for CCC steelhead and the proposed designated critical habitat for North American green sturgeon. However, we anticipate that take of steelhead as a result of this project will occur and, therefore, an incidental take statement with non-discretionary terms and conditions is included.

Essential Fish Habitat Consultation

NMFS has evaluated the proposed project for potential adverse effects to Pacific salmon EFH pursuant to section 305(b)(2) of the MSA. After reviewing the effects of the project on salmonid habitat as described in the enclosed biological opinion, NMFS has determined that the proposed

action will have an adverse effect on the fall run Central Valley (CV) Chinook salmon (*O. tshawytscha*) EFH in Novato and San Antonio creeks, and the Petaluma River. Section 305(b)(4)(A) of the MSA authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. For this project, conservation measures are included in the project description. In addition, the enclosed biological opinion also contains non-discretionary terms and conditions that will minimize adverse effects to EFH. Therefore, NMFS has not provided EFH Conservation Recommendations for this project.

If you have any questions about this section 7 and EFH consultation, or if you require additional information, please contact Mr. Dave Walsh at (707) 575-6016.

Sincerely,

Rodney R. McInnis
Regional Administrator

Enclosure

cc: Russ Strach, NMFS, Sacramento
Korie Schaeffer, NMFS, Santa Rosa
Jeffrey G. Jenson, John Yeakel, Kelly Nelson, Caltrans District 4, Oakland
Jeremiah Puget, North Bay Regional Water Quality Control Board
Melisa Escaron, California Department of Fish and Game
John Cleckler, U.S. Fish and Wildlife Service
Copy to File: 151422SWR2007SR0049

BIOLOGICAL OPINION

ACTION AGENCY: California Department of Transportation

ACTION: Marin Sonoma Narrows Highway 101 High Occupancy Vehicle Lane Widening Project: Novato to Petaluma

CONSULTATION CONDUCTED BY: National Marine Fisheries Service, Southwest Region

TRACKING NUMBER: 2007/08320

DATE ISSUED: January 26, 2009

I. CONSULTATION HISTORY

NOAA's National Marine Fisheries Service (NMFS) has been involved with the Marin Sonoma Narrows (MSN) Highway 101 Lane Widening Project since the 2002 preliminary planning stages. The pre-consultation and technical assistance began in May of 2002. During this time, affected habitat was discussed and salmonid presence was evaluated in the project areas.

In accordance with the National Environmental Policy Act/404 Memorandum of Understanding agreement (April 2006) between the Federal Highways Administration (FHWA) and California Department of Transportation (Caltrans), the MSN Project passed through a Checkpoint and Comment process during its planning inception which allowed other participating agencies to comment on some pivotal decisions regarding environmental and construction issues.

On November 1, 2007, NMFS responded to a Caltrans' request for agreement on the purpose and need and range of alternatives for the MSN Project pursuant to the NEPA/404 MOU with a letter stating that NMFS supported the decisions for project designs that would reduce impacts to aquatic resources; including bridge designs using the least amount of piles in watered channels and recommended free spanning bridges wherever feasible.

On May 7, 2008, NMFS participated in a Caltrans sponsored meeting in Oakland, California, to discuss the Least Environmentally Damaging Preferred Alternative (LEDPA) and conceptual mitigation under the NEPA/404 MOU. These discussions resulted in reducing impacts to wetlands and Highway 101 near the Redwood Landfill, and to incorporate 2:1 grading of slopes in order to further reduce project impacts. NMFS responded to these decisions with a letter that supported the LEDPA 12b, including the realignment and access point control in segment B, as the preferred alternative of reaching the goals set by Caltrans in easing traffic flow. In that letter, NMFS also offered a commitment to work alongside Caltrans staff in developing plans that will meet their construction goals while minimizing impacts to these protected resources.

On August 7, 2008, NMFS received a consultation request letter from Caltrans asking to initiate consultation under section 7 of the Endangered Species Act (ESA) and to concur with Caltran's determination of "May Effect, Not Likely to Adversely Affect" for the threatened Central California Coast (CCC) steelhead (*Onchorynchus Mykiss*) Distinct Population Segment (DPS), the Southern DPS of North American green sturgeon (*Asipenser medirostrius*), CCC steelhead critical habitat, and North American green sturgeon proposed critical habitat. The letter also requested Essential Fish Habitat (EFH) consultation pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Under the MSA, Caltrans determined that there would be minimal adverse affect on fall-run Central Valley Chinook salmon (*O. tshawycha*) EFH in the Petaluma River within the action area, but did not mention the location in the project area where these affects would occur.

On August, 22, 2008, NMFS contacted Caltrans to update the progress made in the consultation process. NMFS reported that some of the project activities would likely involve the capture and relocation of CCC steelhead and that this action would trigger take of a listed species under the ESA, and, therefore, NMFS would not concur with the initial determination and that the determination would need to be changed to "May Affect, Likely to Adversely Affect".

On August 18, 2008, and September 24, 2008, NMFS received written consultation requests from the FHWA for the MSN Project. The August 18th letter stated that the FHWA also determined a "may effect, not likely to adversely affect" for project activity impacts to listed species, and that the project activities would not destroy or adversely modify steelhead critical habitat in the project area. The letter also stated the project would have minimal adverse affect on fall-run Central Valley Chinook salmon EFH and that the informal consultation responsibilities had been previously delegated to Caltrans who would be consulting with NMFS for EFH. In the September 24th letter, the FHWA changed their determination from a "not likely to adversely affect" to a "likely to adversely affect" for section 7 of the ESA. The FHWA did not change the EFH determination for fall-run Chinook in this letter. In an email dated October 28, NMFS confirmed with Caltrans that the FHWA was the lead agency for the MSN Project.

II. DESCRIPTION OF THE PROPOSED ACTION

Under agreement with and funding from the FHWA, Caltrans proposes to fund the building of the MSN Project, which will widen 17.2 miles of Highway 101 in both the southern and northern directions to alleviate severe traffic increase in Marin and Sonoma counties. High Occupancy Vehicle (HOV) lanes and associated structures will be built starting south of State Route 37 in the City of Novato and ending north at the Corona Road overcrossing in the City of Petaluma. The MSN Project will be constructed in multiple phases over consecutive construction seasons with all work below Ordinary High Water (OHW) to occur between the dates of June 15 to October 31 at the creek crossings, with the exception of the proposed year-round pile driving activities in the Petaluma River. Bridge crossings other than the Petaluma River Bridge will likely be completed within one-to-two construction seasons, while the Petaluma River Bridge may take as many as four construction seasons. Construction will occur within the next five years from issuance of this biological opinion.

The MSN Project was initially planned as three separate projects, denoted as segments A, B, and C, with independent utility and logical termini.[1] These segments were combined into a single project area to address cumulative effects in the preliminary Environmental Impact Statement/ Environmental Impact Report. In this biological opinion, NMFS periodically refers to the A, B, and C format to relate the location of project activities within the action area.

In addition to the HOV lane widening, Caltrans has also proposed road improvement activities that include modifying and constructing Highway 101 bridge crossings, constructing new interchanges, upgrading drainage systems, constructing new frontage roads and bikeways, and relocating the flood prone "Segment B" of Highway 101 to the west.

Over the last 15 years, significant commercial and residential growth has led to severe traffic increases through this corridor of Highway 101. The project's intention is to convert Highway 101 from a freeway and partial expressway to a complete freeway in order to alleviate the traffic congestion by improving mobility through this corridor between Marin and Sonoma counties. The conversion will be accomplished by providing additional traffic lanes and interchange ramps.

A. Description of the Proposed Work

The new HOV lanes will be the standard 12 feet in width with 10-foot inside shoulders and a concrete median barrier. Road widening will occur at six bridge crossings over five creeks and one river. Caltrans has determined that the road widening at these six crossings may adversely affect steelhead and green sturgeon, and all other project activities for this project will have no effect to listed species and critical habitat. There are additional project activities in the MSN Project that are not directly over or around waterways, having varying distances between one to four miles from the creeks and river discussed in this biological opinion. Based on NMFS' familiarity with road and bridge projects, all other project activities involve upland road work that are far enough away from the waterways in NMFS' judgment to avoid effects to listed salmonids, green sturgeon, and their habitats. NMFS is concerned with the project activities at the bridge sites that will impact listed species and designated critical habitat and, therefore, will analyze the potential impacts at these six crossings. Widening over these crossings will either be accomplished by creating a center bridge that will effectively "fill in the gap" between north and southbound lanes and extend the outside shoulders, or with the construction of new bridges. As part of the construction in Segment B, two additional bridges will be constructed on San Antonio Road, located to the west of Highway 101.

Modifications to, or construction of, these crossings are to occur at the following five creeks and one river: Novato Creek, Rush Creek, San Antonio Creek, Washington Creek, Lynch Creek, and the Petaluma River. There are also two blind end tide channels off of the Petaluma River that are

[1] Segment A is the southern segment that extends 4.3 miles - from just south of State Route 37 to north to the Atherton Avenue Interchange in the City of Novato in Marin County; Segment B is the central segment, called the "narrows", that extends 8.2 miles between Atherton Avenue Interchange to the south and crossing over the Marin-Sonoma County line and ending at State Route 116 (East) to the north; and Segment C is the northern Segment, extending 4.7 miles from State Route 116 (East) to north of the Corona Overcrossing in the City of Petaluma (Sonoma County).

near construction activities. The two blind end tide channels are connected to the Petaluma River and could potentially provide seasonal rearing habitat for steelhead and green sturgeon; however, the extent of the project activities near the terminus of these channels is limited to equipment staging that, in NMFS' judgment, would not impact steelhead and green sturgeon.

If water is present at creek crossings, construction sites will be isolated from surface flow using temporary cofferdams for constructing bridge supports. The cofferdams will be constructed of interlocking sheet pilings, using a vibratory hammer and an impact hammer if difficult driving is encountered. Cofferdams will only be installed or removed between June 15 to October 31. Any water present in the creeks will be pumped or bypassed through pipes, using fish screens at both pipe ends. Flows in the Petaluma River will remain continuous through the project area via a minimum 60-foot navigable passage and will be maintained at all times under the bridge regardless of project activities. Where water diversion is necessary, the contractor will comply with Caltrans' Storm Water Pollution Prevention Plan (SWPPP), Best Management Plans (BMPs) NS-5, Clear Water Diversion.

Fish relocation activities will be conducted at the Petaluma River, Lynch, and Novato Creek locations.[2] Prior to the dewatering, a biologist will survey the area and seine and dip net for fish, prior to pumping. There are no set number of passes with the seines and dip nets, and the biologist will keep seining until no more fish are captured in several passes. Salmonids are expected to be captured first, with the rest of the time spent catching other fish species (Michael Fawcett, personal communication, October 15, 2007). Water will be drawn down to a level where fish are accessible and can be removed. Multiple draw downs of water and collections may be necessary to effectively remove fish from some of the dewatered areas. Dip nets will be used in the remaining small pools of water. All pumps will be monitored by a biologist to ensure that no fish are impinged on the intake end during the dewatering process. Fish will be located to similar or better suited habitat, either upstream or downstream and away from the construction area.

Temporary falsework will be used to provide structural support during the bridge building process, and will either be hung from the pier walls via metal hook systems or built up from timber pads. Wherever feasible, timber pads will be placed out of the wetted channel, along the banks with the use of construction machinery for setting up and/or dismantling the falsework. If the temporary falsework will require piles for proper support, then all pile driving activities will be conducted out of the channel and completely removed after construction is complete.

The other construction activities in the MSN Project will include the following: replacement of and improvements to the Highway 101 culvert drainage configuration[3]; shifting and straightening the 8.2 miles of Segment B and converting it from an expressway[4] to a freeway; and the construction of and modifications to interchanges, frontage roads, overcrossings (state

[2] Listed salmonids or green sturgeon are not anticipated to be present at the other bridge locations during in-water construction work as described below in the *Environmental Baseline.*

[3] Stormwater will be directed to existing highway drainage systems and use existing outfalls with updated storm water quality control systems.

[4] The stretch of Segment B is currently an expressway which includes four traffic lanes and narrow shoulders of varying widths, seven locations with limited sight distance, two locations with recurring flooding, and at-grade intersections and driveway access that adversely impact mainline operations.

roads) and undercrossings (county roads) along the entire MSN corridor. These MSN construction activities are in upland areas that are not near any waterways and, therefore, are not expected to affect listed species and critical habitat and therefore will not be analyzed in this biological opinion. For further detailed information on these activities please refer to Caltrans' biological assessment – *Marin Sonoma Narrows Widening Project: Biological Assessment for Central California Coast Steelhead, Southern Distinct Population Segment North American Green Sturgeon and Essential Fish Habitat for Chinook Salmon.*

Following is a discussion of site specific details:

1. Novato Creek Bridge Crossing in Segment A

The existing parallel bridges crossing Novato Creek are two independent five-span continuous reinforced concrete decks that measure 58.5 meters (m) (192 feet) each. The decks are supported by 44 octagonal piles in the center that measure 18 inches in diameter and two diaphragm type abutments at the ends on reinforced concrete piles. The Novato Creek Bridges accommodate six 3.6 m (12 foot) lanes, with 3.6 m (12 foot) inside shoulders and 2.4 m to 3.0 m (8 feet to 10 feet) outside shoulders.

The project would widen the bridge by constructing a center deck in the gap between the Novato Creek bridges - creating an additional 3.6 m (12 foot) lane with 3.0 m (10 foot) shoulders. Lane barriers would also be upgraded to the current standards. Modification of the supporting substructure will require Class 625 driven precast concrete piles at the abutments (end supports) and use Cast in Steel Shell (CISS) piles to construct the columns for the piers (middle supports). The new abutments and piers will match the alignment of the existing abutments and piles.

Four 600 millimeters (mm) (2 foot) diameter CISS piles will be used at each of the four piers; resulting in a total of 16 CISS piles. CISS piles will be driven into the ground, cleared of dirt, reinforced with steel bar, and filled with concrete. All concrete pouring will occur from a concrete pump truck staged on the creek bank. Existing piles in the area will either be removed with vibratory hammers or left in place and cut off below the ground. Cofferdams will be installed and made watertight at the pier locations to dewater the area of surface and subsurface flow.

Two additional platforms will be built within the gap areas on each bank to provide a work surface for the pile rig equipment to drive piles at the Pier 3 and 4 locations. The platforms will employ a closed-fill system to protect it from tidal influences in the creek, and will be constructed from interlocking sheet piles to form an enclosed area that will be back filled with gravel. Sheet piles will be placed with either a vibratory or impact hammer and gravel fill will be washed prior to use.

Both platforms will extend 39 feet at each end of the bridge to the creek banks. The platform on the south bank will use 11,360 cubic feet of backfill to create 1,698 square feet of work surface, and the platform on the north bank will use 12, 285 cubic feet of backfill to create 1,800 square feet of work surface. In the event that the platform does extend into the creek channel then fish

relocation and dewatering plans have been proposed prior to the back filling process and construction of the platforms will be performed no earlier than June 15.

Following construction the closed-fill system and the falsework will be removed. A 20-foot wide road along one side of the bridge at each abutment will be constructed to move materials into and out of the work area. After the construction materials are retrieved, the creek banks will be stabilized and erosion control methods will be employed.

2. San Antonio Creek Bridges (frontage and mainline) in Segment B

Currently there are two bridges crossing San Antonio Creek: a crossing at Highway 101 (or mainline) consisting of two independent parallel bridge crossings; and a crossing at San Antonio Road (or frontage) to the west of Highway 101 consisting of a single bridge with two lanes. As part of the transition from an expressway to a freeway in Segment B, these two bridges will be modified and reassigned to traffic crossings at new frontage roads that will run parallel and flank the east and west sides of Highway 101. The 8.1 miles of Highway 101 will then be moved west, away from its existing configuration which is a flood prone area. Two new bridges will be constructed at the new Highway 101 and San Antonio Road crossing locations – resulting in a total of four bridge crossings over San Antonio Creek. Riparian and non-riparian tree loss will occur at the San Antonio Creek and Highway 101 locations as a result of the two new bridges and access roads.

If subsurface flow is present in the creek then cofferdams will be placed around the footing locations to dewater the area. Steelhead presence is not expected at these locations (as described below in the *Environmental Baseline*), and, therefore, fish relocation activities will not be conducted. Water will be pumped from the cofferdams to a truck or sediment basin and sealed from the inside to make watertight. The precast concrete piles will then be driven inside the cofferdams using an impact hammer, followed by the pouring of concrete over the piles to form the footings.

a. The Current Mainline Crossing (San Antonio Creek)

The southbound Highway 101 crossing will be removed, and the northbound crossing will be reconnected to a new frontage road that will run on the east side parallel to Highway 101. The southbound bridge on Highway 101 will be removed following the construction of the new Highway 101 Bridge to the west, and will involve the breaking and removing of the existing concrete. The bridge section will be dropped over land onto filter fabric or similar materials and removed. BMPs will be employed to prevent falling debris from entering the creek.

b. The New Mainline Crossing (San Antonio Creek)

The new mainline crossing will be built on the raised and realigned portion of Highway 101 that will run west of the existing highway. The bridge will be a cast in place concrete pre-stressed box girder with reinforced pier caps and abutments. The bridge will either be a five span structure at 192.5 m (635 feet) long by 35.11 m (116 feet) wide, or a three span structure at 130.5

m (431 feet) long by 35.11 m (116 feet) wide. The three span bridges would include a Mechanically Stabilized Earth wall at abutment 1 which will result in the shorter bridge.

The five span bridges would use four columns per pier for a total of 16 columns for the four piers, and the three span bridge alternatives would also use four columns per pier for a total of eight columns for the two piers. Each concrete column will measure 1.68 m (5.5 feet) in diameter and placed on a concrete footing measuring 6.7 m by 6.7 m by 1.8 m deep (22 feet by 22 feet by 6 feet). For the five span bridge option, twenty-five precast concrete piles will driven, using vibratory and impact hammers, into the creek bed and banks for each of the four footings - totaling 100 piles. If the three span bridge option is used then 50 concrete piles will be driven for the two footings using the same methods. The precast concrete piles will measure 380 mm by 380 mm (15 inches by 15 inches).

c. The Current Frontage Crossing (San Antonio Creek)

The existing historic San Antonio Creek Bridge is approximately 30.8 m (101 feet) long and 7.0 m (23 feet) wide. The existing structure is not wide enough to provide adequately sized lanes and shoulders, and the historic nature of the bridge does not allow for it to be modified. Therefore, a new bridge crossing will be constructed to service traffic on San Antonio Road, and the current bridge will be reconnected to a frontage road running north from San Antonio Road where it will terminate at a cul-de-sac. There will be no alterations made to this bridge for connecting it to the frontage road.

d. The New Frontage Crossing (San Antonio Road) Creek

The new frontage crossing will be constructed for two-way vehicular and bicycle/pedestrian traffic, and will accommodate traveling to and from destinations to the west of Highway 101. There are two bridge alternatives for the new frontage bridge crossing San Antonio Creek; the first alternative is proposed as a cast-in-place concrete slab with reinforced concrete pier caps and abutments. This bridge will consist of seven spans at approximately 69.3 m (227.5 feet) long and 12.90 m (42 feet) wide. The substructure will use Class 625 driven precast concrete piles at the abutments and driven CISS piles at the piers. Five CISS piles, measuring 600 mm (24 inches) in diameter, will be required per pier for a total of 30 CISS piles for the six piers.

A second alternative proposed is a two span cast-in-place concrete pre-stressed box girder bridge with reinforced concrete pier caps and abutments that would measure 71.5 m (235 feet) long and 12.90 m (42 feet) wide and use two reinforced concrete columns at 1.22 m (4 feet) in diameter and abutments both supported on a concrete pile cap with driven precast concrete piles. The column footings will measure 8.5 by 8.5 by 1.8 m deep (28 feet by 28 feet by 6 feet) with each column footing requiring 25 driven CISS piles to construct – for a total of 50 piles. The pile size required for the footings is 380 mm by 380 mm (15 inches by 15 inches).

For the first alternative, grading of the banks around the abutments will be required to raise the abutment profile followed by pile driving the concrete piles for the abutments and construction of the concrete abutments. CISS piles will be driven into the ground, cleared of dirt, reinforced

with steel bar, and filled with concrete. These foundation piles will extend as columns into the deck slab.

3. Petaluma River Bridge in Segment C

The existing Petaluma River Bridge consists of two separate structures, each measuring 270 m (885 feet) long and 9.6 m (31 feet) wide. The original bridges were built in 1955 and have had been modified over the years to accommodate future traffic conditions, including additional 3.6 m (12 feet) lane and 3.0 m (10 feet) inside and outside shoulders.

The project is scheduled for three to four construction seasons, starting with construction of a new center bridge between the existing bridges in the first season. The following seasons will consist of demolition and removal of the southbound bridge followed by the removal of the northbound bridge, including bridge pilings, followed then by construction of the new bridges within the old bridge footprints. Pile driving for the column footings will occur year-round. Other construction activities that will occur year-round on land include: bridge demolition, vegetation clearing and planting, and road construction for site access, removal of existing piles, falsework removal and cleanup, and concrete pouring (which may involve some work over water using appropriately sealed forms). Access to the work areas will occur from the north using an existing secondary road and from the south using Petaluma Boulevard South.

Two structure alternatives are currently proposed for the new 260.5 m (855 feet) long and 35.110 m (115 feet) wide, five-span bridge: Alternative 1 would consist of a reinforced concrete box girder superstructure; and Alternative 2 would consist of a Precast/Prestressed Concrete Bulb "T" girder superstructure.

The new bridge will be supported on four piers along the spans and two abutments at either bank. The Piers (2, 3, 4, and 5) will be comprised of three-to-five columns seated on a column footing. Each footing will measure 10.67 m (35 feet) by 8.5 m (28 feet) by 2.0 m (7 feet) deep. Either 762 mm (30-inch) diameter Cast In Drilled Hole (CIDH) or CISS piles will be used to construct the footings. The amount of footings and piles required at the center, southbound and northbound decks was determined and summarized below by Caltrans engineers:

1. Center deck - Number of permanent piles will range from 100 piles (1 footing/bent x 4 bents x 25 piles/footing) to 160 piles (1 footing/bent x 4 bents x 40 piles/footing).

2. Southbound deck - Number of permanent piles will range from 160 piles (1 footing/bent x 4 bents x 40 piles/footing) to 200 piles (2 footings/bent x 4 bents x 25 piles/footing).

3. Northbound deck - Number of permanent piles will range from 160 piles (1 footing/bent x 4 bents x 40 piles/footing) to 200 piles (2 footings/bent x 4 bents x 25 piles/footing).

In summary, a final 3-column bent structure will require approximately 480 permanent piles at the bents. A final 5-column bent structure will require approximately 500 permanent piles at the bents.

Piers 3 and 4 are located within the wetted channel below OHW and will require cofferdams for footing construction, while Piers 2 and 5 are located on either bank above OHW, but will use cofferdams if subsurface flows are present during the footing construction.

Two to 20 of the CISS piles can be installed per day, with vibratory and impact hammers, and are estimated to receive from 200 to 600 strikes, with the impact hammer, until they extend into bedrock. Pile driving will be within the confines of the cofferdams and will occur for a minimum of 60 days over an 18-month timeframe.

A 300 m (1000-foot) by 11 m (36 foot) trestle bridge will be built in the river to provide a platform for working on the new piers, removing the old piers, and constructing temporary falsework, temporary erection towers, and fender piles. An 18 m (60-foot) wide channel will be maintained for navigation past the Petaluma River Bridge throughout the entire construction seasons. The trestle and fenders will use either H-piles or steel pipe piles. These piles will be approximately 510 mm (20 inches) to 610 mm (24 inches) in diameter. Piles will initially be driven with a vibratory hammer, followed with between five to 20 strikes with an impact hammer to confirm bearing. Three hundred piles are anticipated for building the trestle and the fenders and will take between 20 and 75 days, at two to ten piles per day, over a three year period, and stay within the June 15 to October 31 timeframe. A barge may be used in lieu of the trestle and consequently reduce some need to pile drive.

Cofferdams will be placed at the old and new locations for Piers 3 and 4. The configuration of the cofferdams will be determined by the contractor and depend on the current conditions in the river and construction season, but it will either be anticipated to be one cofferdam for each pier location that would encompass the old piers and new pier locations, for a total of two cofferdams, or up to one cofferdam per pier for a total of six cofferdams.

Additional cofferdams could also be used at Piers 2 and 5 if ground water is present. The locations for Piers 2 and 5 are out of the flood prone zone and will not require dewatering. Four additional 39-foot long by 22-foot wide cofferdams will be required for the demolition and removal of the existing columns and footings at Piers 5 and 6, resulting in a net dewatered area of 3,432 feet^2 of additional dewatered area.

The total dewatered area including all cofferdams at Piers 3, 4, 2, and 5, regardless of configuration, will result in 26,232 feet^2; however, the 60-foot wide channel requirement will likely determine the number of cofferdams that can be installed at a given time, hence all areas are not likely to be dewatered at once.

Some cofferdams will use intermediate walls that will aid in dewatering particular sections within the cofferdam and mitigate in fish escapement and dewatering activities. All cofferdams that are required for pile driving will be installed from June 15 to October 31, regardless of pile driving schedules, over any of the three to four construction seasons. Once cofferdams are installed, pile driving activities are proposed to occur year-round within the cofferdams. When pile driving is completed, cofferdams will be removed between June 15 and October 31.

4. Lynch Creek Crossing in Segment C

The existing Lynch Creek Bridge is comprised of two independent bridges with four lanes for north and southbound traffic measuring 3.6 m (12 feet) with 0.6 m (2 feet) inside shoulders and a 1.2 m (4 feet) outside shoulders. Both of the existing three spans decks were built in 1955 and are constructed of reinforced concrete slabs measuring 24.1 m (79 feet) in length with reinforced concrete pile piers and reinforced concrete "U" open abutments.

The Lynch Creek Bridge will be widened to accommodate an additional 3.6 m (12 feet) lane, 3.0 m (10 feet) shoulders and ramp taper. Widening will consist of connecting the two existing bridges in the center median and widening both outside shoulders. Caltrans also proposes to replace the existing bridge barriers with current standard barriers.

The location and bearing for the new abutments and piers will match with the alignments of the existing abutments and piers. A sound wall will be constructed on the southbound side of the structure and supported on a bridge barrier. Access to the existing Lynch Creek channel will be required for pile driving and falsework construction. The piles will extend into the superstructure.

The widening of the existing bridge requires the construction of a new cast-in-place reinforced concrete slab superstructure including new concrete pier caps and abutments. The substructure consists of class 625, 305 mm by 305 mm (12 inch by 12 inch) diameter driven precast concrete piles. It is anticipated that there will be 10 new driven precast concrete piles per pier for a total of 20 for the two piers.

Access to the existing channel will be required for construction. It is anticipated that the contractor will primarily access the site from the center median and along the shoulders of the existing highway. A crane will be positioned at the abutment locations and reach out to drive pilings.

Falsework will be used at this location to support construction loads, including falsework bents using braced timber posts supported on timber pads placed on top of existing ground or braced steel piles driven into the ground.

A cofferdam and dewatering system may be constructed for the pier construction using a vibratory hammer if water is present in the area. Following construction the temporary falsework material will be removed.

5. Road Drainage Improvements

Currently, in all three segments of the 17.2 mile project area, water drains to the depressed median between the north and south bound lanes where it enters drainage inlets at low points and is transferred via cross culverts to swales along the outside of Highway 101 and then drains into adjacent water courses. There are currently 35 cross culverts in segment A, and 15 in segment C of Highway 101; all of which will either be reconditioned, decommissioned, or replaced. The

median between the north and southbound lanes will be raised and filled to construct the two HOV lanes and modifications will be made to the current drainage inlets and cross culverts.

Improvements to the current road drainage system will incorporate bio-filtration strips and swales to receive storm water discharges from the highway or other impervious surfaces. The project will also likely include offsite storm water treatment. Other measures to reduce pollutants carried by storm water runoff include bio-filtration strips, bio-filtration swales, and Austin sand filters.

6. Staging Locations

Staging locations will be used for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices.

The primary staging area in Segment A will be located within the interchange at the South Novato overcrossing. Section B staging will be located within the new interchange at the Sanitary Landfill Road, at the new interchange off of Kastania Road, and below and along the sides of the Petaluma River Bridge. Section C staging will be located within the interchange at State Route 116.

Other staging areas will be located within the State Right-of-Way and subject to approval of the contractor's submitted SWPPP. Contractors may independently seek off-site staging locations. Off-site staging locations will be subject to the requirements of resource agencies and will be the responsibility of the contractor.

7. Best Management Practices (BMPs)

The following BMPs are incorporated into the proposed MSN Project for minimizing effects to federally-listed species and salmon habitat:

1. Work will be restricted in Novato, San Antonio, and Lynch creeks to low-flow periods between June 15 and October 31 to avoid effects to steelhead or green sturgeon or any life stages of steelhead during their migratory seasons. This window can be increased based on creek and river conditions, if approved in writing by NMFS. Work from the banks and from trestle, falsework and inside closed cofferdams can occur year-round.

2. The amount and duration of pile driving will be minimized. For any pile driving occurring in wetted areas that may be occupied by adult and juvenile steelhead (or green sturgeon in the Petaluma River), sound pressure levels generated from pile driving activities will be restricted to levels below thresholds that result in injury to fish.

   Pile-driving activities will be conducted only during daylight hours to allow movement of steelhead or green sturgeon that may be present in the project vicinity to pass the construction area during night time hours. Monitoring of acoustic levels will confirm that pile driving activities are not harmful to steelhead or green sturgeon. Caltrans will monitor underwater sound levels during pile driving that occurs during the steelhead migration season

(November 1 through June 14). A hydrophone device will be used to hydroacoustically monitor sound levels. If the current thresholds (above 206 dB peak Sound Pressure Level (SPL) and 187 accumulated dB Sound Exposure Level (SEL) at 10 m from the pile being installed) that cause death or injury to fish are exceeded, Caltrans will stop the pile driving activities until sound levels can be maintained under the prescribed thresholds. In addition, if pile driving in the Petaluma River begins in the summer, Caltrans will monitor underwater sound levels for a period of two weeks at the beginning of pile driving activities and further attenuate sound if necessary.

3. All equipment will be stored outside of all waterways, including wetlands. Per the SWPPP for the project, a silt fence will be installed around the perimeter of these locations. The staging areas will also be situated 15.2 m (50 feet) from existing drainages.

4. Silt fences will be installed. The silt fencing will be delineated on the final plans and fences will be installed and remain on-site until the project is completed. Silt fences and/or coir rolls will be installed on the slopes adjacent to the work area to prevent silt from entering the watershed.

5. Appropriate temporary cofferdams will be used to dewater the construction sites and divert water through the action area during the construction period to prevent impeding creek flow or water flow through the work areas. If dewatering at a site is required, a qualified Caltrans biologist will be present during the dewatering period to inspect and ensure that sensitive aquatic species will not be trapped within the temporary cofferdams.

   If steelhead or green sturgeon are found within the cofferdams, a NMFS-approved biologist will capture, and relocate these fish to an appropriate area away from the construction site. Caltrans will submit for approval the dewatering and fish capture and relocation plans to NMFS once the design plans are finalized.

6. Erosion controls will be maintained throughout the demolition and construction periods.

7. All construction materials will be removed from the streambed at the completion of the construction project to maintain flow through the action area during the construction period, including cofferdams, pipes, filter fabric, and gravel.

8. All excess soil will be disposed at an approved upland site.

9. All project-introduced material will be removed once the work is complete.

10. Water trucks and dust controlling agents will be used to control dust in excavation and fill areas, rocking temporary access road entrances and exits will be rocked, and temporary stockpiles will be covered.

11. Any disturbed stream channel areas will be recontoured to pre-project conditions to the extent practicable.

12. Potential pollutants will be limited or reduced at their source before they come in contact with project receiving waters during construction. These BMPs are also known as "good housekeeping practices" and will be in place throughout the bridge construction phases.

    The measures include but are not limited to BMPs for: water conservation; vehicle and equipment cleaning, fueling and maintenance; dewatering; paving and grinding; temporary stream crossing; concrete finishing and curing; clear water diversion; and material and equipment use over water.

13. Demolished material will be prevented from entering waterways; water will be away from work areas; construction equipment will use attachments to catch debris; approved covers or platforms will be used to collect debris; accumulated debris and waste generated during demolition will be stockpiled away from watercourses; and wildlife will be ensured safe passage, as necessary.

14. Reflectors on portable light trees will be used to focus the light on the work area and minimize the amount of light spilling over to adjacent areas during any night work. In addition, noise-reducing enclosures will be used around noise-generating equipment. Equipment will be located as far as possible away from noise-sensitive areas, and sound control devices such as mufflers will be used on construction equipment to dampen noise as much as possible.

8. Riparian Enhancement

Caltrans will use the riparian mitigation plan developed by the California Department of Fish and Game. The requirements in this mitigation plan include the following:

> Each native riparian tree greater than 4 inches Diameter at Breast Height (DBH) that is removed or damaged will be replaced with native trees in a riparian area at a minimum 3:1 ratio. For each non-native riparian tree that is removed or damaged, trees will be replaced with native riparian trees at a minimum 1:1 ratio. Temporarily impacted riparian understory will be replaced at a 1:1 ratio. Oak trees in the riparian zone will be replaced at a 5:1 ratio.

Caltrans is also exploring several options for implementing riparian enhancement around the creeks where construction will occur to compensate for effects to riparian habitat. Additional riparian enhancement or compensation may be achieved outside of the project area using a combination of the following:

1. Purchasing of credits at a resource agency-approved mitigation bank servicing the action area.

2. Purchasing of conservation easements at or as close to the project site as practical within Marin and/or Sonoma counties.

3. Purchasing of fee title and preserving the land with riparian vegetation as close to the project site as practical within Marin and/or Sonoma counties.

B. Description of the Action Area

The action area includes "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 includes the lineal extent (upstream to downstream) of bridge crossings (both current and proposed) over five creeks, one river, and two tide channels along the Highway 101 corridor between PM 18.6/27.6 in Marin County and PM 0.0/7.1 in Sonoma County. These areas are located at the following Highway 101 crossings: Novato Creek, Rush Creek, San Antonio Creek, the Petaluma River, Washington Creek, and Lynch Creek. The action area also extends to the east of Highway 101 to include the tide channels stemming from the Petaluma River and terminating at Redwood Landfill to the south, and west of Highway 101 in segment B out to the proposed new bridge crossing at San Antonio Road. The action area also extends 500-feet upstream from the crossing in each creek and river to account for fish relocation and 200 m (656 feet) downstream of each crossing to include temporary effects from equipment staging and turbidity. The action area extends laterally to encompass the riparian corridor to the top of the banks of all creeks and the river.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

1. Threatened CCC steelhead Distinct Population Segment (DPS) (January 5, 2006; 71 FR 834).

2. Threatened Southern DPS of North American green sturgeon (April 7, 2006; 71 FR 17757).

3. Designated critical habitat for CCC steelhead (September 5, 2005; 70 FR 52488).

4. Proposed designated critical habitat for the southern DPS of North American green sturgeon (September 8, 2008; 73 FR 52084).

Fall-run Central Valley Chinook salmon are not listed under the ESA, but are a species of concern, and use the Petaluma River, and possibly Novato Creek, for part of their life history stages. Provisions are made under the Pacific salmon Fisheries Management Plan for this species and, in accordance with the MSA, project activities were evaluated for impacts to EFH as described in the transmittal letter. Since they are not listed as threatened or endangered under the ESA, fall-run Chinook salmon will not be mentioned further in this biological opinion.

Genetic analysis has identified two DPSs of green sturgeon that qualify as species under the ESA: (1) a northern DPS consisting of populations in coastal watersheds northward of and including the Eel River; and (2) a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. On April 6, 2005, NMFS reaffirmed its earlier determination that the northern DPS does not warrant an ESA listing (70 FR 17386). Because of substantial loss of spawning habitat, the concentration of a single spawning population in one section of the Sacramento River, and

multiple other risks to the species, NMFS listed as threatened the southern DPS of North American green sturgeon on April 7, 2006 (70 FR 17757).

A. Species Description and Life History

1. CCC Steelhead

Steelhead are anadromous fish, spending some time in both fresh and saltwater. The older juvenile and adult life stages occur in the ocean, until the adults ascend freshwater streams to spawn. Eggs (laid in gravel nests called redds), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels), and young juveniles are all found in freshwater. Juvenile steelhead rear in freshwater until they become large enough to migrate to the ocean to finish rearing and maturing to adults. For detailed information on steelhead life history, see Busby *et al.* (1996). Although variation occurs, steelhead usually live in freshwater for 1 to 2 years in Central California, then spend 2 or 3 years in the ocean before returning to their natal stream to spawn. Steelhead may spawn 1 to 4 times over their life.

Typically, adult steelhead immigrate to Coastal California streams from December through April, peaking in January and February, and juveniles emigrate as smolts to the ocean from January through June, with peak emigration occurring in April and May (Fukushima and Lesh 1998). Steelhead fry rear in edgewater habitats and move gradually into pools and riffles as they grow larger (Busby *et al.* 1996). Cover is an important habitat component for juvenile steelhead, both as a velocity refuge and as a means of avoiding predation. Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Rearing steelhead juveniles prefer water temperatures of 7.2-14.4 degrees Celsius (°C) and have an upper lethal limit of 23.9°C. They can survive in water up to 27°C with saturated dissolved oxygen conditions and a plentiful food supply. Fluctuating diurnal water temperatures also aid in survivability of salmonids.

Although variation occurs, CCC steelhead usually live in freshwater for 2 years, then spend 1 or 2 years in the ocean before returning to their natal stream to spawn. Steelhead may spawn 1 to 4 times over their lifespan. Steelhead from the Russian River system typically immigrate to freshwater between October and April, peaking in January and February, and migrate to the ocean from January through June, with peak emigration occurring in April and May (Fukushima and Lesh 1998).

2. Southern DPS of North American Green Sturgeon

The green sturgeon is the most widely distributed and most marine-oriented of the sturgeon species. Like all sturgeon, they are an anadromous, long-lived, and slow growing species (Adams *et al.* 2002). The largest fish have been aged at 42 years, but this is probably an underestimate and maximum ages of 60-70 years or more are likely (Moyle 2002). Green sturgeon are known to range in near shore marine waters from Mexico to the Bering Sea, and are commonly observed in bays and estuaries along the western coast of North America. First spawning occurs at 15 years for males, and 17 years for females.

Adult green sturgeon return to freshwater to spawn every two to five years, and generally show fidelity to their spawning site. Adults typically migrate into freshwater beginning in late February, spawning occurs from March to July, with peak activity from April to June. Confirmed spawning populations in North America occur in the Rogue, Klamath, and Sacramento rivers. Green sturgeon may migrate long distances upstream to reach spawning habitat. Spawning occurs in deep turbulent areas of large rivers. Eggs are likely broadcast over large cobble substrate where they settle into the spaces between the cobbles. Like salmonids, green sturgeon require cool water temperatures for egg and larvae development, with optimal temperatures ranging from 15 °C to 19°C.

Green sturgeon larvae first feed at 10 days, and grow rapidly, reaching 300 mm (12 inches) in one year. Juvenile and adult green sturgeon are benthic feeders (Moyle 2002). Juvenile green sturgeon in the San Francisco Estuary feed on opossum shrimp (*Neomysis mercedie*) and amphipods (*Corophium spp.*) (Moyle 2002). Adults captured in the Sacramento-San Joaquin Delta feed on invertebrates, including shrimp, mollusks, amphipods, and even small fish (Adams *et al.* 2002). Juvenile green sturgeon spend from one to three years in freshwater before they enter the ocean (Adams *et al.* 2002).

The southern DPS of North American green sturgeon spawn in the deep turbulent sections of the upper reaches of the Sacramento River. As juvenile green sturgeon age, they migrate downstream and live in the lower delta and bays, spending from three to four years there before entering the ocean. Adult green sturgeon return from the ocean every one to five years to spawn, and generally show fidelity to their upper Sacramento River spawning sites. Patterns of telemetry data suggest that Southern DPS fish use oversummering grounds in coastal bays and estuaries along northern California, Oregon, and Washington, and overwintering grounds between Vancouver Island, BC and southeast Alaska (Lindley *et al.*, 2008).

B. Status of Species and Critical Habitat

1. CCC Steelhead

Historically, approximately 48 populations[5] of steelhead existed in the CCC steelhead DPS (Bjorkstedt *et al.* 2005). Many of these populations (about 20) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts. The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (Bjorkstedt *et al.* 2005, McElhaney *et al.* 2000).

While historical and present data on abundance are limited, CCC steelhead numbers are substantially reduced from historical levels. A total of 94,000 adult steelhead were estimated to

[5] Population as defined by Bjorkstedt *et al.* 2005 and McElhaney *et al.* 2000 as, in brief summary, a group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group. Such fish groups may include more than one stream. These authors use this definition as a starting point from which they define four types of populations (not all of which are mentioned here).

spawn in the rivers of this DPS in the mid-1960s, including 50,000 fish in the Russian River – the largest population within the DPS (Busby *et al.* 1996). Recent estimates for the Russian River are on the order of 4,000 fish (NMFS 1997). Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vincente, Soquel, and Aptos creeks) of individual run sizes of 500 fish or less (62 FR 43937). For more detailed information on trends in CCC steelhead abundance, see: Busby *et al.* 1996, NMFS 1997, and NMFS 2005a.

Some loss of genetic diversity has been documented and attributed to previous among-basin transfers of stock and local hatchery production in interior populations in the Russian River (Bjorkstedt *et al.* 2005). Reduced population sizes and fragmentation of habitat in San Francisco streams has likely also led to loss of genetic diversity in populations from those streams.

CCC steelhead have experienced serious declines in abundance, and long-term population trends suggest a negative growth rate. This indicates the DPS may not be viable in the long term. DPS populations that historically provided enough steelhead strays to support dependent populations may no longer be able to do so, placing dependent populations at increased risk of extirpation. However, because CCC steelhead have maintained a wide distribution throughout the DPS, roughly approximating the known historical distribution, CCC steelhead likely possess a resilience that is likely to slow their decline relative to other salmonid species in worse condition. The most recent status review concludes that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (NMFS 2005a). On January 5, 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834).

2. Southern DPS of North American Green Sturgeon

The population size of the southern green sturgeon DPS is unknown, but is clearly much smaller than in the northern green sturgeon DPS and is, therefore, more vulnerable to catastrophic events (Adams *et al.* 2002). Recent habitat evaluations conducted in the upper Sacramento and Feather rivers suggest that, as for anadromous salmonids, large amounts of potential spawning habitat were made inaccessible or altered by dams (BRT 2005). Current spawning habitat for green sturgeon has been reduced to a limited area of the upper Sacramento River.

Data on the entrainment of juvenile sturgeon from the Sacramento-San Joaquin Delta pumping facilities of the Central Valley Project and State Water Project provide an indication of how green sturgeon abundance has changed since 1968. The estimated average number of green sturgeon entrained each year at California's John Skinner Fish Facility prior to 1986 was 732; from 1986 on, the average number decreased to 47. At the Federal Tracy Fish Collection Facility, the average prior to 1986 was 889; from 1986 on, the average number also decreased to 47 (April 6, 2005, 70 FR 17386). This substantial decrease in numbers is also consistent with decreases in entrainment of white sturgeon within the same time periods. Decreases in numbers of green sturgeon entrained in these facilities occurred while water export levels at both facilities have increased substantially (*i.e.*, more water was pumped, but fewer green sturgeon were entrained).

The most recent status review update concluded that the southern green sturgeon DPS is likely to become endangered in the foreseeable future due to the substantial loss of spawning habitat, the concentration of a single spawning population in one section of the Sacramento River, and multiple other risks to the species (BRT 2005). Based on this information, the southern population of North American green sturgeon was proposed as threatened on April 6, 2005 (70 FR 17386). NMFS published a final rule on April 7, 2006 (71 FR17757), listing the southern population of North American green sturgeon as threatened, which took effect June 6, 2006.

3. Factors Responsible for Status of Steelhead/Southern DPS of North American Green and Salmonid Critical Habitat/Proposed Green Sturgeon Critical Habitat

Threats to naturally reproducing steelhead and green sturgeon are numerous and varied. Among the most serious and ongoing threats to their survival in these DPSs are changes in hydrology, and habitat degradation and loss. The following discussion provides an overview of the types of activities and conditions that adversely affect steelhead and green sturgeon DPSs and their habitats.

a. Habitat Degradation and Destruction

A major cause of the decline of salmon, steelhead, and green sturgeon is the loss or severe decrease in quality and function of essential freshwater and estuarine habitat. Most of this habitat loss and degradation has resulted from anthropogenic watershed disturbances caused by agriculture, logging, urban development, water diversion, road construction, erosion and flood control, dam building, and grazing. Most of this habitat degradation is associated with the loss of essential habitat components necessary for steelhead and green sturgeon survival. For example, the loss of deep pool habitat as a result of sedimentation and stream flow reductions has reduced rearing and holding habitat for juvenile and adult salmonids. The alteration of the estuaries in conjunction with increased sediment loads in the watersheds from land use activities and lower stream flows due to water diversions and other watershed changes, have delayed sandbar breaching in the fall, delayed adult steelhead migration into streams, reduced and degraded estuary rearing habitat for both juvenile steelhead and green sturgeon, and created a significantly altered freshwater-saltwater transition zone for steelhead smolts (CDFG 1998). North American green sturgeon populations are currently considered to be more susceptible to the quality declines in spawning habitat over other habitat types (September 8, 2008; 73 FR 52084).

b. Natural Stochastic Events

Natural events such as droughts, landslides, floods, and other catastrophes have adversely affected steelhead and green sturgeon populations throughout their evolutionary history. The frequency of, and the resulting effects of these events are now often increased and exacerbated by anthropogenic changes to watersheds such as logging, road building, and water diversion. The ability of these species to rebound from natural stochastic events has been limited as a result of these and other anthropogenic factors which have degraded the freshwater and estuarine habitats upon which these species depend, and thus abundance of these populations have been depressed to critically low levels.

c. Ocean Conditions

Variability in ocean productivity has been shown to affect steelhead and green sturgeon survival both positively and negatively. Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production from 1925 to 1989 and their marine environment. Beamish *et al.* (1997) noted decadal-scale changes in the production of Fraser River sockeye salmon (*O. nerka*) that they attributed to changes in the productivity of the marine environment. They (along with many others) also reported the dramatic change in marine conditions occurring in 1976-77, at the beginning of an El Niño event. El Niño conditions, which occur every 3-5 years, negatively affect ocean productivity for salmonids. It is unclear to what extent ocean conditions have played a role in the decline of these species; however, ocean conditions have likely affected steelhead and green sturgeon population abundances throughout their evolutionary history.

d. Water Conveyance

Depletion and storage of natural flows have drastically altered natural hydrological cycles in many California rivers and streams. Alteration of streamflows has increased juvenile salmonid mortality for a variety of reasons: migration delay resulting from insufficient flows or habitat blockages, loss of usable habitat due to dewatering and blockage, stranding of fish resulting from rapid flow fluctuations, entrainment of juveniles into unscreened or poorly screened diversions, and increased juvenile mortality resulting from increased water temperatures (Chapman and Bjornn 1969, Berggren and Filardo 1993, 61 FR 56138). Important elements of water quality include water temperatures within the range that corresponds with migration, rearing, and emergence needs of fish and the aquatic organisms upon which they depend (61 FR 56138). Green sturgeon, which are benthic feeders exposed to high suspended sediment concentrations as they forage on the bottom, would likely not be affected by elevated levels of suspended sediment in the action area. Juvenile green sturgeon have been routinely entrained at pumping facilities along the Sacramento-San Joaquin Delta from rapid changes in flow and are also susceptible to suction dredging practices.

e. Harvest

There are few good historical accounts of the abundance of salmon and steelhead harvested along the California coast (Jensen and Swartzell 1967). Early records did not contain quantitative data by species until the early 1950s. In addition, the confounding effects of habitat destruction, drought, and variable ocean conditions on steelhead survival make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of salmonids in West Coast rivers. Green sturgeon harvest consists of bycatch that is exclusive to two white sturgeon fisheries – the Klamath tribal and other Tribal salmon gill-net fisheries (Adams *et al.* 2002). The numbers of green sturgeon caught in these fisheries has declined substantially from 6,466 fish in 1985-1989 to 1,218 fish in 1999-2000.

f. Artificial Propagation

Releasing large numbers of hatchery fish can pose a threat to wild salmon and steelhead stocks through genetic impacts, competition for food and other resources, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs are primarily caused by the straying of hatchery fish and the subsequent hybridization of hatchery and wild fish. Artificial propagation threatens the genetic integrity and diversity that protects overall productivity against changes in environment (61 FR 56138). The potential adverse impacts of artificial propagation programs are well documented (Waples 1991, Waples 1999).

g. Marine Mammal Predation

Predation is not known to be a major factor contributing to the decline of West Coast salmon and steelhead populations relative to the effects of fishing, habitat degradation, and hatchery practices. Predation may have substantial impacts in localized areas. Harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus*) numbers have increased along the Pacific Coast (NMFS 1999).

h. Reduced Marine-derived Nutrient Transport

Reduced marine-derived nutrient (MDN) transport to watersheds is another consequence of the past century of decline in salmon abundance (Gresh *et al.* 2000). Salmon may play a critical role in the survival of their own species in that MDN from salmon carcasses has been shown to be vital for productive invertebrate prey communities in streams providing for the growth of juvenile salmonids (Bilby *et al.* 1996, Bilby and Bisson 1998). The return of salmon to rivers makes a significant contribution to the flora and fauna of both terrestrial and riverine ecosystems (Gresh *et al.* 2000). Evidence of the role of MDN and energy in ecosystems infers this deficit may indicate an ecosystem failure that has contributed to the downward spiral of salmonid abundance (Bilby *et al.* 1996).

i. Invasive Species

A potential major factor affecting the species in the action area is the introduction of non-native or invasive species. As native fishes in the San Francisco Bay estuary became depleted in the late 19th century, non-native fishes were brought to the bay including American shad, striped bass, common carp, and white catfish. As their populations boomed, those of native fishes declined further, due to competition and predation. Introduction of non-native species accelerated in the 20th century through unintended introductions of fish and invertebrates from the release of ballast water from cargo ships entering the estuary from foreign ports. Several invasive species, including the yellowfin goby, shimofuri goby, and the overbite clam are now ubiquitous in San Francisco Bay's tidal marshes; these three species comprised the majority of the fish and invertebrates entrained during 2006 dredging at the mouth of the Petaluma River. Establishment of invasive species was probably facilitated by altered hydrologic regimes and reduction in habitats for native species. The spread of invasive species throughout the San Francisco Bay region has potentially affected many native species, including listed salmonids,

through predation and competition for food and habitat (Cohen and Carlton 1995). Prey selection by green sturgeon, which feed on benthic invertebrates, has likely been affected as well, as the native species populations have been replaced by invasive species. It is not known how well the green sturgeon has adjusted to its available diet in response to the altered benthic community.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is the analysis of the effects of past and ongoing human and natural factors leading to the current status of the species in the action area. 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 impacts of State or private actions which are contemporaneous with the consultation in process (50 CFR §402.02).

Table 1: Steelhead, Green Sturgeon, and Critical Habitats in the streams and river affected by the proposed project:

Creek or River	Steelhead Present	Steelhead Critical Habitat	Green Sturgeon Present	Proposed Green Sturgeon Critical Habitat
Petaluma	Yes	Yes	Yes**	Yes
Novato	Yes*	No	No	No
Lynch	Yes*	Yes	No	No
San Antonio	No	Yes	No	No
Rush	No	No	No	No
Washington	No	No	No	No

* Steelhead are unlikely to be present in the portion of the action area in Novato and Lynch creeks (see below).
** Green sturgeon are unlikely to be encountered during project construction (see below).

A. Steelhead Critical Habitat and Proposed Green Sturgeon Critical Habitat within the Action Area

The portions of Novato and Lynch creeks, and the Petaluma River, within the action area are corridors for adult steelhead upstream migration to spawning and rearing habitat and corridors for steelhead smolt to rearing habitat and the Pacific Ocean. As shown in Table 1, San Antonio Creek, the Petaluma River, and Lynch Creek are designated critical habitat for CCC steelhead (70 FR 52488). Novato Creek is not designated as critical habitat for CCC steelhead. Rush and Washington creeks are not designated as critical habitat for listed salmonids, nor do they contain steelhead (as described below). All tidally influenced areas in the Petaluma River are proposed as critical habitat for green sturgeon (73 FR 52084). No other waterways within the action area are proposed as critical habitat for green sturgeon.

Critical habitat for CCC steelhead within the Petaluma River Hydrologic Sub-area (HSA) was described by NMFS' Critical Habitat Analytical Review Team (CHART) (NMFS 2005b). The CHART defined critical habitat for CCC steelhead on the stream-reach scale based on the quantity, quality, and distribution of Primary Constituent Elements (PCEs), which are the principle biological or physical constituent elements of habitat needed for the completion of the salmonid life-cycle, and include migration, spawning, rearing, and estuarine. For example, one PCE is spawning habitat; a component of the stream environment that must be present in sufficient quantity, quality, and distribution for salmonids to successfully reproduce.

Essential features of critical habitat in the action area include the estuarine water column, foraging habitat, and food resources used by these salmonids as part of their juvenile downstream migration or adult spawning upstream migration. PCEs of designated critical habitat for CCC steelhead in the action area include migration areas free from obstruction and excessive predation with: (1) water quality, water quantity and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; (2) natural cover such as submerged and overhanging large wood, and aquatic vegetation; and (3) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation (69 FR 71880).

1. Novato Creek

The creek reach in the action area is channelized with a generally trapezoidal shape possibly formed by flood control practices. The channel width averages 100 feet in the action area. Riparian canopy is absent on both sides of the Novato Bridge crossing, including the gap, and the riparian undergrowth is regularly removed from the stream banks during flood control maintenance. The portion of channel in this maintained area has a soft and muddy bottom that holds heat during the daytime.

Streamflow in Novato Creek is perennial and typically ranges from one-to-five cubic feet per second (cfs) during the summer months. Most if not all water in the area is tidally influenced; reaching approximately 4,000 feet above the Highway 101 crossing to Diablo Avenue (Caltrans 2008). Also during the summer some water is released from the North Marin Water District facilities upstream of the action area. Novato Creek water temperatures measured in May 1996 ranged from 19-26°C (60-73 degrees Fahrenheit (°F)) and ranged from 19-24°C (60-70°F) in June 1996. Although water temperatures have not been recorded in the period of July through September, Rich (1997) estimates water temperatures are considerably higher than optimal for steelhead during its rearing life stage.

The stream channel is dominated by low gradient areas and the streambed is mostly composed of sand and silt. In general, instream cover for juvenile steelhead is lacking. Some instream cover is provided by undercut banks and walls, concrete, and small amounts of emergent vegetation. Large instream woody debris, boulders, and other features for structural complexity are lacking in this portion of the action area. Overwinter habitat conditions are poor because the channel lacks habitat complexity and velocity refuge. Oversummering conditions are marginal due to the lack of habitat complexity and high water temperatures (Rich 1997).

2. San Antonio Creek

San Antonio Creek is a tributary of the Petaluma River. Overall San Antonio Creek is well-established containing high quality habitat that could potentially provide seasonal rearing habitat for juvenile steelhead (Hamaker, *et al.* 2003). The substrate is predominately large cobble, although the area beneath the Highway 101 crossing contains a deep layer of silt. There is also little to no riparian vegetation under the Highway 101 bridge; however, the upstream reaches contain riparian cover dominated by California buckeye (*Aesculus californica*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), California black walnut (*Juglans californica*), coast live oak (*Quercus agrifolia*), valley oak (*Q. lobata Née*), and bay laurel (*Umbellularia californica*).

Most of the creek is ephemeral during the summer with the exception of the tidally influenced lower reach east of Highway 101 where it connects to the Petaluma River. The creek bed within the action area is dry in the summer and into the winter in most years, which creates an effective migration barrier for steelhead between the reach at the Highway 101 crossing and the creek's terminus at the Petaluma River. San Antonio Creek may provide some salmonid habitat at the mouth, where there is a tidal influence from the Petaluma River.

3. The Petaluma River

The Petaluma River, for most of its course, is more of an elongated, tidal estuary than an actual river. It drains and 130-square-mile watershed, extending to the 2,300-foot summit of the Sonoma Mountains. Most of the river's tributaries join around the City of Petaluma. From there the waters flow along a broad, 18-mile long estuary moving past hayfields and an extensive marsh and terminating at the north-west end of San Pablo Bay.

Historically, the tidal marshes located within San Pablo Bay and the tidally-influenced reaches of the Petaluma River provided a highly productive estuarine environment for juvenile anadromous salmonids. During the course of their downstream migration through San Pablo Bay, juvenile salmon and steelhead may still utilize the estuary for seasonal rearing, although recent data suggest that migration to the sea is rapid, as compared with migration in estuaries located at higher latitudes (MacFarlane and Norton 2001). Returning adult salmon and steelhead navigate their way through San Pablo Bay as they seek upstream spawning grounds of their natal streams.

Within the action area the Petaluma River is highly channelized with little habitat complexity. The channel is broad with low summer and high winter flows ranging from zero to 65 cfs (US Geological Survey gage station 11459000). The river is fully tidal 11 miles (18 kilometers) from its mouth. The high range of tidal influence is due in part to the low gradient and low elevation through the marshes below Petaluma

As water velocity in the Petaluma River increases with storm events, adult salmon may use off channel areas, such as the marina and tide channels below the bridge, for refuge. Riparian cover is lacking through the area both upstream and down, likely due to urban encroachment and flood control maintenance. Vegetation persisting along the banks consists predominately of pickleweed and other low lying herbaceous vegetation.

The water depth throughout the Petaluma River has been maintained by annually dredging to a minus eight foot depth for 100 feet of channel width from the river mouth to Western Avenue in Petaluma. The need for dredging is a consequence of the high sedimentation rates, a result of high suspended sediment loads in the Petaluma River and adjacent San Pablo Bay. Water depths around the bridge vary between 20 to 30 feet.

These dredging activities have degraded the benthic habitat by removing prey organisms which form the diet of green sturgeon. NMFS is currently conducting a study to determine the recovery rate of the benthic community in the nearby marina, just south of the Petaluma River Bridge. Although the data have yet to be analyzed, it is likely that the benthic community does not fully recover prior to the subsequent dredging episodes. A reduction in this benthic community has likely resulted in minimal effect regarding loss of prey items for salmonids because benthic organisms at these depths (20-30 feet) are not typically part of their diet. Past dredging activities exposed juvenile salmonids to a risk of potential entrainment to upland disposal sites, from which there are no outlets back to the marina or the Petaluma River.

4. Lynch Creek

Lynch Creek is a small perennial tributary to the Petaluma River. At the Highway 101 crossing, Lynch Creek has been highly modified to a trapezoidal channel with earthen and concrete stabilized banks. The creek is dry during the summer months in the action area. Downstream, it is tidally influenced where it meets the Petaluma River. To either side of Highway 101 and within the gap between the bridge, there is little woody riparian vegetation and reduced shading of the channel, which leads to higher water temperatures during the summer months. Upstream riparian vegetation becomes dense with adequate canopy cover for shade and blackberry that provides some stability to the banks. The substrate throughout Lynch Creek is composed of sand and small gravels contributed by eroding upstream banks.

B. Status of Species within the Action Area

Given the proposed in-water construction period, June 15 through October 31, and the life history of steelhead, only juvenile steelhead are likely to be present in some of the creek portions of the action area during in-water construction. In addition to juvenile steelhead, NMFS also anticipates impacts to steelhead adults and smolts in the Petaluma River as a consequence of proposed year-round pile driving

As shown in Table 1, Rush Creek, Washington Creek, and San Antonio Creek are not currently thought to contain steelhead (Caltrans 2008), due in part to poor habitat quality and ephemeral flow in the reaches at the crossings. San Antonio Creek may provide some habitat at the mouth, where there is a tidal influence from the Petaluma River; however, the reach at the Highway 101 crossing is dry during most of the year, and migration into the creek is blocked as described above. Steelhead are not anticipated to occur in the action area in San Antonio Creek.

1. Novato Creek

NMFS is unaware of any rigorous estimates of steelhead abundance from Novato Creek. However, there have been several limited fish surveys undertaken in Novato Creek in recent years (Rich 1997, Fawcett Environmental Consulting 2000, Leidy *et al.* 2005, Fawcett Environmental Consulting 2006); all of these surveys encountered steelhead. One of the surveys, Fawcett Environmental Consulting (2006), was conducted wholly in the proposed project area. That survey was conducted during a previous sediment removal project; in that survey biologists collected 12 juvenile steelhead from a reach within a larger 6,130 feet area of Novato Creek that included the bridge site. Collections upstream of the project area have encountered steelhead throughout the watershed. More recent surveys conducted by Fawcett on July 9 and 10 of 2008 (Michael Fawcett, personal communication, January 20, 2009) covered a distance of approximately 3 miles, from Diablo Avenue above the Highway 101 crossing to the Northern Pacific Railroad Bridge downstream from the Highway 101 crossing, and caught 63 steelhead in Novato Creek and five in Warner Creek, upstream from the project site. All fish were aged as young of the year and collected from suitable habitat for summer rearing juvenile steelhead. Rearing conditions are absent at the Highway 101 crossing, where the water temperatures and salinity levels are high and little cover is provided from both instream and overwater sources. Based on this information, NMFS believes the current habitat conditions in Novato Creek within the action area are unsuitable for supporting juvenile steelhead and, therefore, they are unlikely to be present in this portion of the action area during construction.

2. San Antonio Creek

Although Skinner (1962) reported that San Antonio Creek was historically used by steelhead; subsequent reports indicated that CCC steelhead are now extirpated from that watershed. In the July 1968 California Department of Fish and Game (CDFG) surveys, San Antonio Creek was visually surveyed from the San Antonio Slough upstream to Chileno Valley Road. No steelhead were observed and the creek's fishery value was deemed poor due to intermittent summer flows, scarce spawning gravel, and suspected dairy effluent (Michaels and Thomson 1968a). In September 1981, Leidy (1984) electrofished three sites on San Antonio Creek between Highway 101 and Chileno Valley Road, and steelhead were not found.

3. Petaluma River

Between 1962 and 2005, the Petaluma River and its tributaries were sampled for steelhead or resident rainbow trout at several locations within the Petaluma River watershed. Skinner (1962) indicated that the mainstem Petaluma River was lightly used as steelhead habitat. Thomson and Michaels (1968) surveyed portions of the Petaluma River accessible by automobile from the upstream limit of tidal influence to the headwaters in July 1968 without observing steelhead. In July 1993, Leidy (2002) electrofished the Petaluma River upstream from the Corona Road crossing and did not find salmonids. Contrary to these findings are reported observations of migrating adult steelhead spawning pairs in the Petaluma River (David Woodbury, NMFS, personal communication, October 2008) with estimates believed to be approximately 60 fish (David Woodbury, NMFS, personal communication, October 2008).

NMFS has determined that green sturgeon presence will not occur in any of the creeks mentioned in this biological opinion due to lack of suitable habitat for this species. Green sturgeon presence is possible in the Petaluma River due to suitable water conditions for this species and its connectivity to the San Pablo Bay. Juvenile green sturgeon are known to inhabit San Pablo Bay, into which the Petaluma River flows.

NMFS was able to find only one account of green sturgeon in the Petaluma River. In 1997, a tagged adult green sturgeon was netted at the mouth of the Petaluma River where it was determined to have been holding for an eleven hour period during its migration to the Sacramento River (David Woodbury, NMFS, personal communication, October 2008). Between 1980 and 1995, stations within San Pablo Bay were sampled each month using midwater and bottom trawls (Baxter *et al.* 1999). The data show that green sturgeon collected by trawls in San Pablo Bay ranged from 328 to 733 mm in length. Given that the trawls are not designed to adequately sample sturgeon, the data cannot be used to accurately estimate green sturgeon abundance. Juvenile green sturgeon are year-round residents in San Pablo Bay and likely forage in the Petaluma River, as their relative, the white sturgeon, are commonly caught there and feed on similar prey.

Local fisheries experts are unaware of any observations of green sturgeon presence in the action area at the Highway 101 crossing upriver to Washington Street (Bill Cox, CDFG, personal communication, October 2, 2008; Michael Fawcett, personal communication, October 3, 2008). Thus, the available information indicates that adult green sturgeon neither spawn in the Petaluma River nor use it as a migratory pathway. Because the lower section of the Petaluma River is tidal, juvenile green sturgeon likely enter the river. Although they are most likely to remain near the mouth because of locality to San Pablo Bay (a known feeding area) it is possible they could be found as far upstream as the Petaluma River crossing. Due to the lack of observations and overall dwindling numbers of the southern DPS of North American green sturgeon, NMFS reasons encountering one in the action area during the construction of the new crossing over the Petaluma River is unlikely.

4. Lynch Creek

A few of the tributaries to the Petaluma River may continue to support small spawning populations of CCC steelhead, including Lynch Creek (Leidy *et al.* 2005). These streams are generally short, low gradient streams that have poor quality summer rearing habitat, but in which a few steelhead may spawn annually.

During the summer months, the habitat conditions at the Lynch Creek Bridge crossing are not conducive for salmonids, and although juvenile steelhead do rear in the watershed during these months, suitable habitat for rearing only exists in the tidally influenced reaches of Lynch Creek downstream from the Highway 101 bridge crossing. Therefore, it is unlikely that steelhead will be present at the project work sites during the instream construction period between June 15 and October 31.

V. EFFECTS OF THE PROPOSED ACTION

Construction of and modifications to bridges and crossings will result in the capture and relocation of juvenile steelhead at the crossings over Novato Creek and the Petaluma River, prior to dewatering the work areas. Steelhead have not been observed in San Antonio Creek for some time and are currently considered to be extirpated from the system as described above.

In Novato Creek and the Petaluma River, steelhead collection and relocation activities will occur during the summer low-flow period after smolts have emigrated and before adults have immigrated to the proposed project site, and NMFS expects that only juvenile steelhead will be present and effected by relocation activities. Those juvenile steelhead that are not collected in Novato Creek and the Petaluma River will be exposed to the effects of dewatering and pile driving. In addition to juvenile steelhead, adults and smolts will also be affected in the Petaluma River by exposure to sound pressure stemming from the year-round pile driving activities.

Both adult and juvenile green sturgeon have access to the Petaluma River Bridge construction site, which is tidally influenced. Although NMFS did not find evidence from prior surveys and literature sources to verify any green sturgeon within the action area of the Petaluma River, there is still the possibility of juvenile presence for at least part of the year due to the river's connection to the San Pablo Bay. The lack of observations in the Petaluma River as a whole would likely make encountering a green sturgeon during the project activities low enough to discount any effect to this species as a result of project activities.

Aquatic habitats and steelhead may also be exposed to turbidity and toxic chemicals. Small areas of aquatic habitat are expected to be permanently lost in the action area once the project is complete. Temporary impacts include turbidity and toxic chemical impacts to water quality and riparian loss. Shading increases from closing gaps between crossings will create permanent impacts, while habitat loss will have both temporary and permanent impacts.

A. Fish Relocation

Fish relocation activities pose a risk of injury or mortality to rearing juvenile salmonids. Any fish collecting gear, whether passive (Hubert 1996) or active (Hayes *et al.* 1996) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish capture varies widely, depending on the method used, the ambient conditions, and the expertise and experience of the field crew. Since fish relocation activities will be conducted by qualified fisheries biologists following both CDFG and NMFS guidelines, direct effects to and mortality of juvenile salmonids during capture will be minimized. Based on similar relocation efforts NMFS is familiar with, approximately 1.5 percent of the fish relocated may be injured or killed.

Fish relocation efforts will take place prior to or concurrent with the dewatering of waterways. No areas will be dewatered prior to June 15. The potential does exist for juvenile steelhead injury or mortality to occur during relocation. NMFS has not found evidence of any green sturgeon occupying the action area or reaches above the action area and does not expect any green sturgeon to be encountered during relocation activities. Fish relocation attempts will occur

one time following the construction of each constructed coffer dam at all locations where dewatering is necessary. The amount of fish relocations per crossing is dependant on the number of cofferdams needed at each crossing. Capture and relocation of juvenile steelhead is anticipated for the Petaluma River, where multiple relocations over multiple seasons will occur due to the placement of cofferdams over multiple seasons, from as few as six to as many as ten cofferdams, depending river conditions. Regardless of cofferdam configuration in the Petaluma River, the square footage of dewatered area will remain equal; however, in the scenario where cofferdams will be built for individual piers, there is the possibility that juvenile steelhead that have been previously relocated may enter the action area between relocations and consequently be relocated multiple times.

Based on the recent survey efforts conducted in Novato Creek for sediment removal activities just upstream from the action area, NMFS does not believe that juvenile steelhead will likely to be encountered in this portion of the action area. In the Petaluma River, although there are an estimated 60 adult spawning pairs passing through the action area during the winter and early spring months, there are no recent surveys of juvenile numbers in or near this portion of the action area. Thus, the number of juvenile steelhead in the Petaluma River subject to capture and relocation subsequent to construction of cofferdams cannot be reliably estimated. Given the timing of the project and quality of the habitat within the action area, NMFS anticipates only a small number of juvenile steelhead will likely be present during the proposed action.

Therefore, NMFS will assume that all juvenile steelhead present within the portion of the action area at the bridge site in the Petaluma River will be exposed to capture and relocation efforts that will occur between June 15 and October 31. NMFS expects that juvenile steelhead mortality associated with capturing, handling, and relocation for this project will be equal to 1.5 percent of the fish relocated, and when added with the potential for multiple relocations of the same individual fish, would equate to 3 percent total mortality of juvenile steelhead in the portion of the action area in the Petaluma River.

Caltrans will use qualified fishery biologists who will take appropriate precautions during fish relocation activities to minimize adverse affects to juvenile steelhead. Captured fish are planned to be relocated to areas of similar habitat located either downstream or upstream of the Highway 101 crossings.

Relocated fish may also endure stress from crowding at the relocation sites and increased competition for available resources such as food and habitat. This may reduce the survival chances of some fish. Some of the fish at the relocation sites may leave the site, and move to areas either upstream or downstream that have greater availability of habitat and less fish density. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse. NMFS does not believe this impact will cascade through the watershed population of steelhead based on the small area that will likely be affected. Fish relocation efforts are expected to minimize project impacts to steelhead in both locations by removing them from areas where they would have experienced high rates of injury and mortality. Furthermore, fish will be relocated to areas that possess similar habitat and water quality parameters (*e.g.*, temperature) to their original locations, and will be distributed appropriately to prevent overcrowding.

B. Dewatering

Cofferdams installed in Novato Creek and the Petaluma River will narrow the water flow through the areas. Flow is not expected at the San Antonio Creek or Lynch Creek locations, but if cofferdams are required for these creeks, only subsurface flow would be pumped out. The streamflow within the project vicinity is expected to be close to normal seasonal conditions except through the areas where cofferdams are installed. The cofferdam footprint in the Petaluma River will be much greater than other locations, although these dewatered areas will not be expected to cause volatile fluctuations in the flow regime. Maintaining the minimum 60-foot passage in the Petaluma River through the cofferdams will further suppress any flow effects associated with dewatering.

All cofferdams will be installed between June 15 and October 31 for all of the three to four construction seasons in the Petaluma River and over one season at the other creek locations and likely be placed during the lowest tide levels. Most fish are anticipated to follow receding tides out of the construction area. Some cofferdams will be left in place for extended periods of time in the Petaluma River. These cofferdams are not expected to hinder or prevent passage of salmonids due to the maintained 60-foot area of passage described in the *Description of the Proposed Action*. However, cofferdams will reduce rearing habitat for steelhead in the action area. Based on the project information available to date, NMFS assumes that any cofferdams in the creeks will be installed and removed during one summer construction season (June 15 to October 31), although not all cofferdams in the creeks will be installed during the same construction season. In the Petaluma River, NMFS assumes that once cofferdams are installed, they will be left in the river until completion of pile driving in the Petaluma River, which may occur outside of the summer construction season. NMFS assumes that whenever pile driving ends in the Petaluma River, cofferdams will only be removed between June 15 and October 31.

Stream flow diversion and work space dewatering is also expected to cause temporary loss, alteration, and reduction of aquatic habitat within the action area. Stream flow diversions could harm individual steelhead by concentrating or stranding them in residual wetted areas (Cushman 1985) before they are relocated, or causing them to move to adjacent habitats (Clothier 1953, Clothier 1954, Kraft 1972, Campbell and Scott 1984).

Steelhead could be killed or injured if crushed beneath the cofferdams during installation, though direct mortality is expected to be minimal because of the small number of steelhead in the action area and due to relocation efforts prior to installation of the diversion system. In addition to the initial fish capture and relocation at each cofferdam, a fisheries biologist will remain in the cofferdam to net and rescue any additional fish that may become stranded throughout the dewatering process at each coffer dam.

Steelhead not removed from the work area will die during dewatering activities. However, NMFS anticipates the number of juvenile steelhead killed as a result desiccation from the dewatering activities to be very low due to the low numbers of steelhead expected to be present within the action area. NMFS has not found evidence of any juvenile green sturgeon occupying the action area or reaches above the action area and does not expect any juvenile or adult green

sturgeon to be encountered during dewatering activities. NMFS expects that juvenile steelhead mortality associated with dewatering for this project will be similar to the unintentional mortality rate from capturing, handling, and relocation procedures. This amount of mortality would equate to 1.5 percent of juvenile steelhead that are encountered in the Petaluma River during capture and relocation efforts between the months of June 15 and October 31. In the Petaluma River, relocation mortality (3 percent described above) is likely higher than dewatering mortality because of the potential of capturing a steelhead juvenile multiple times, which would increase the stress levels and the likelihood of death.

Benthic macroinvertebrates may be temporarily lost or their abundance reduced when individual organisms are stranded or when creek habitats are dewatered (Cushman 1985). Effects to macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because construction activities will be relatively short-lived, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates (Cushman 1985, Thomas 1985, Harvey 1986) is expected following rewatering. In addition, the effect of macroinvertebrate loss on juvenile steelhead is likely to be negligible because food from upstream sources (via drift on the water surface) would be available downstream of the dewatered areas since stream flows will be maintained outside of the cofferdam. Based on the foregoing, the loss of aquatic macroinvertebrates as a result of dewatering activities is not expected to adversely affect salmonids.

C. Turbidity

Increased turbidity is anticipated to occur during the construction and removal of the cofferdams and dewatering. Research with salmonids has shown that high turbidity concentrations can reduce feeding efficiency, decrease food availability, reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and also cause fish mortality (Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Mortality of very young coho salmon and steelhead fry due to increased turbidity has been reported by Sigler *et al.* (1984). Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival.

Based on the effects described above, it is anticipated that rearing juvenile steelhead downstream of the work areas may be affected by short-term increases in turbidity caused during the construction and removal of the cofferdams, dewatering, bank grading, and the addition and removal of gravel fill. These pulses of turbidity may cause fish to move downstream to avoid the turbidity. Pulses of increased turbidity are not anticipated to reach lethal levels with preventative BMPs in place. However, pulses of increased turbidity may result in juvenile steelhead temporarily vacating preferred habitat areas and/or temporarily reducing their feeding efficiency. This impact will extend into the beginning of the first storm events of each construction year. However, due to the timing of the project and the limited habitat within the action area, only low numbers of juvenile steelhead are anticipated to be affected and the minimal nature of the turbidity levels are not expected to have a detectable impact on the survival of individual fish. Road drainage improvements will lower future turbidity levels by incorporating new catchment devices into their design. New cross culverts will be incorporated with the existing culverts to

prevent severe flooding in wet years and to compensate for the increase of impermeable surface area created by the HOV lanes. The storm water shedding from the road surface will be drained in the existing swales on to the sides of Highway 101. While the volume of water draining the swales will increase, the storm water treatment structures incorporated into the system will improve the overall quality of water discharged from the roads and drainage system.

As a benthic dwelling species, green sturgeon are adapted to living in areas with fine sediment bottoms and, thus, are tolerant of high levels of turbidity. The project design and best management practices avoid or minimize localized turbidity; therefore, short-term impacts associated with turbidity during implementation of this project are expected to be insignificant for any green sturgeon within the action area of the Petaluma River.

D. Toxic Chemicals

Heavy construction equipment will be utilized within the dewatered creek channels during construction activities. Oils and similar substances from construction equipment can contain a wide variety of hydrocarbons, some of which evaporate rapidly while others adsorb to sediments and may persist for long periods of time. These polynuclear aromatic hydrocarbons can prove harmful to benthic communities (EPA 1993) which are a salmonid food source. Fluid leaking from construction equipment can also contain metals, which do not degrade in the environment. Some metals (*e.g.*, mercury, cadmium, lead, chromium) bioaccumulate in aquatic organisms inhabiting metals contaminated environments. Some of the sub-lethal effects that metals can cause in salmonids include: immobilization and impaired locomotion, reduced growth, reduced reproduction, and impairment of olfactory and brain functions (Eisler 2000).

Fluid leakage can occur during operation, refueling and during maintenance activities. There is a potential for leakage of toxic chemicals to occur during the project that may have the potential to affect salmonids. In order to minimize the potential adverse affects associated with using heavy equipment, heavy equipment will be operated primarily within the dewatered reach of the creek. NMFS anticipates that if there is a leak and Caltrans BMPs are followed, it will be contained and cleaned up prior to entering the flowing water, making it unlikely that salmonids will be adversely affected.

In addition to toxic chemicals associated with the heavy equipment, water that comes into contact with wet cement during construction of the new bridges can also adversely affect water quality and steelhead downstream of the work area. Water that comes in contact with wet cement can result in an imbalance of pH levels. Many authors have reported that an imbalance in pH can cause as much as 75 percent mortality of salmonids (Thut and Schmiege 1991). However, the work areas will be sufficiently isolated from watered areas making a contamination scenario unlikely.

E. Pile Driving Activities

As described above in the *Description of the Proposed Action*, pile driving will be restricted in Novato, San Antonio, and Lynch creeks to low-flow periods between June 15 and October 31 to

avoid effects to migrating steelhead (adults or smolts). Pile driving may occur year-round in the Petaluma River.

Available information indicates that fish may be injured or killed when exposed to elevated levels of underwater sound pressure generated from driving steel piles with impact hammers (Hastings and Popper 2005). Pathologies associated with very high sound levels are collectively know as barotraumas. These include hemorrhage and rupture of internal organs, including the swimbladder and kidneys in fish. Death can be instantaneous, occur within minutes after exposure, or occur several days later. High sound pressure levels can also result in hearing damage to fish. Dual metric criteria are currently used to correlate physical injury to fish from underwater sound pressure produced during the installation of piles (Agreement in Principal between NMFS and FHWA/Caltrans, June 2008). If either accumulated Sound Exposure Level (SEL) of 187 dB re one micropascal squared-second (183 dB for fish less than 2 grams) or a single strike peak sound pressure level (SPL) of 206 dB re one micropascal is received by a fish, then physical injury may occur. NMFS and FHWA/Caltrans are currently discussing updating the criterion used by NMFS (root mean squared of 150 dB re one micropascal) to assess potential sub-injurious levels of impact.

The degree to which an individual fish exposed to underwater sound from pile driving may be affected is dependent on a number of variables, including, but not limited to, size of the fish, hearing ability of fish, presence of swimbladder, lifestage, fish behavior, presence of predators, sound amplitude and frequency, and effectiveness of any sound attenuation technology. Also, sound wave forms are affected by the size and type of pile and installation equipment.

Caltrans is proposing to install piles for this project year-round in the Petaluma River. The installation of CISS piles with an impact hammer in the Petaluma River would be expected to result in adverse effects to listed adult, juvenile, and smolt steelhead present in the impact area during pile driving operations due to high levels of underwater sound that would be produced. In order to minimize potential effects to steelhead from exposure to elevated levels of underwater sound produced during pile driving at the other creek locations, Caltrans will only conduct pile driving with an impact hammer from June 15 to October 31 and also proposes to attenuate sound by using all means possible while pile driving within the cofferdams. All pile driving outside of the above mentioned timeframe in the Petaluma River will use a hydrophone device to monitor sound levels. If the current thresholds (above 206 dB peak SPL and 187 accumulated dB SEL at 10 m from the pile being installed) that cause death or injury to fish are exceeded, Caltrans will stop the pile driving activities until sound levels can be maintained under the prescribed thresholds.

Caltrans proposes a year-round pile driving schedule for the new Petaluma Bridge. The first construction season will result in the installation of approximately 100 to 160 CISS piles for the center deck of the bridge and 160 to 200 piles for each of the new southbound and northbound decks that will be built the over the following three to four construction seasons. The use of a vibratory hammer to set the CISS piles will not result in injury to fish in the surrounding area since this type of hammer produces sound waves that differ from those of impact hammers and are considered to not produce physical injuries. The estimated number of strikes needed to drive each CISS pile with the impact hammer to depth is 200 to 600 per pile for a maximum total of

4,000 to 12,000 strikes per day, if 20 piles are installed per day and 400 to 1,200 strikes if two piles are installed per day.

The underwater sound produced from driving CISS piles for this project was evaluated using the total number of hammer strikes per pile and an estimate of the single strike peak SPL and SEL at a given distance. This information was used in a mathematical model that estimates the distance from the pile where physical injury to exposed fish may occur. The distance to where physical injury may occur from 762 mm (30-inch) diameter CISS piles in the Petaluma River was determined to be 1,000 m (3,281 feet) for fish weighing over two grams, given a worst case scenario of 12,000 strikes per day. The "over two gram" criterion was used as juvenile steelhead in the action area are more likely to weigh more than two grams. Therefore, under the worst case open water pile driving scenario, without sound attenuation, any fish within 1,000 m of the piles driven in a given day could be physically injured.

Caltrans has incorporated several measures to minimize exposure of fish, and attenuate high levels of underwater sound during pile driving, such as pile driving within cofferdams and using wood blocks between the piles and the impact hammer.[6] Pile driving near water causes sound energy to radiate indirectly into the water as a result of ground borne vibration at the bottom beneath the river. The low-frequency ground borne vibration can cause localized sound pressure waves in the water that are radiated from the bottom of the river. A minimum water depth is required to allow sound to propagate through water in an area. For pile driving sounds, the minimum depth for this propagation is 3 to 6 feet, depending on frequency. Sound waves do not propagate through air as readily as water. All CISS pile driving will occur within dewatered cofferdams which will provide a source of attenuation by creating an air space between the pile and the water column. Hydroacoustic monitoring outside of the cofferdams will certify the attenuation and all pile driving activities will stop if sound levels are exceeded. Based on these measures that will be used for pile driving outside of the June 15 to October 31 timeframe in the Petaluma River, NMFS believes injury or mortality to migrating steelhead is unlikely.

Steelhead migrating through the action area in late December through mid-May may experience minimal delays during exposure to elevated levels of underwater sound produced during pile driving. The delays are expected to last less than 12 hours since pile driving will occur only during daylight hours. These delays are unlikely to affect spawning success because they are short and spawning grounds are within five miles of this portion of the action area. Adult steelhead may hold below the action area in response to noise levels and, as a consequence, may increase their chances to predation; however, adult steelhead predators (*e.g.*, seals and sea lions) have not been observed in the Petaluma River and are not expected in the area during adult migration. Smolts that may be delayed during migration would likely find cover if they do hold above the bridge, and then continue migration during the evening hours after pile driving has stopped. Nevertheless, a small number of these delayed smolts may be exposed to increased predation from birds or other fish. Overall, few smolts are likely to be delayed, and even fewer are likely to experience increased predation. Smolts rely on tidal cues during outmigration and prefer migration at night. Depending on the amount of sound produced and time intervals between pile driving activities in a given day of pile driving there may be no delays in adult and

[6] As stated above, if current thresholds that cause injury to fish are exceeded, Caltrans will stop the pile driving activities until sound levels can be maintained under the prescribed thresholds.

smolt migrations. The use of effective attenuation devices and hydroacoustic monitoring during pile driving activities will likely prevent physical injuries to steelhead while they are delayed from migrating through the area as levels will not exceed those thresholds that result in injuries or mortality to salmonids.

As described above, green sturgeon are unlikely to be present in the action area. NMFS notes that even if one was present, the proposed project would not likely result in physically injure to a green sturgeon if exposed to underwater sound pressure produced during pile driving due to the attenuation devices.

The trestle platforms at the Petaluma River Bridge will only be constructed between June 15 and October 31 and use H-piles that will be placed mainly with the use of a vibratory hammer. Sound levels produced by vibratory hammers are not only lower, but generate different sound wave forms and lower sound frequencies that are believed to be less injurious than those produced by impact hammers. Injuries or mortalities to salmonids are not anticipated. Driving of piles with an impact hammer for trestle platforms in all waterways will be limited to 5-20 strikes per pile to confirm the strength of the pile to support the trestle platforms. This limited number of strikes is not expected to exceed injury thresholds.

Sheet piles will be used to construct the cofferdams and small piles will be used to construct falsework in all waterways. Only vibratory hammers will be used to construct the cofferdams and falsework. Based on data collected during the installation of steel sheet piles with a vibratory hammer at the Port of Oakland (Anderson and Reyff, 2006), peak sound pressure levels generated during this project are not expected to exceed thresholds for physical injury.

A small number of juvenile steelhead may be present in and around the portions of action area outside of the cofferdams in the Petaluma River. These fish will be foraging and rearing prior to outmigration as smolts. In the Petaluma River, most juvenile steelhead are expected to inhabit areas upstream of the bridge where freshwater and better habitat conditions are available. This would be especially true during the winter seasons when storm events occur and water quality and quantity increase. Nevertheless, a very small number of juvenile steelhead may be present near the cofferdams in the Petaluma River in the summer. Because Caltrans will monitor during the first two weeks of pile driving during the summer as noted in the *Description of the Proposed Action*, and take the necessary steps to further attenuate sound levels if necessary, NMFS expects that injury or mortality to juvenile steelhead is unlikely. NMFS assumes that pile driving during the summer that occurs after Caltrans has monitored sound levels during the adult and smolt migration seasons would incorporate any additional sound attenuation that may have been found necessary during this monitoring. Therefore, pile driving in the summers after the first season of pile driving during adult and smolt migration is not expected to injure or kill juvenile salmonids near the cofferdams in the Petaluma River.

NMFS cannot precisely quantify the small number of juvenile steelhead that may be present in the Petaluma River near pile driving activities during the summer but expects that the number will be small based on habitat conditions in the Petaluma River at this location.

The pile driving schedule in Novato Creek is expected to take one season (June 15 – October 31) and will use 16 – 600 mm (24-inch) CISS piles, with each pile requiring between 200 to 600 hammer strikes to achieve proper depth. Using the upper limit of 600 strikes each to drive 16 piles would result in 9,600 strikes if all the CISS piles were installed in a single day. Analysis using the same approach, as described in the above Petaluma River pile driving scenario, would require a minimum safe distance of 736 m (2,429 feet) for fish weighing over two grams from the impact site without the use of attenuation devices. This distance exceeds the size of cofferdams in Novato Creek; however, it is unlikely that this level of impact will be realized, given the small amount of piles that will be driven at this location and the amount of days available to conduct pile driving. The safe distance calculation is dependant on the number of strikes per day and it is unlikely that all 16 piles will be driven in a single day. The safe distance required from the impact site will also be reduced because Caltrans will drive piles within cofferdams, which NMFS expects will provide some sound attenuation.

Because of the uncertainty regarding the level of sound attenuation, NMFS will use the worst case scenario above to determine the maximum distance that could result in injury or death to juvenile steelhead in Novato Creek. With a safe distance of 736 meters (2,429 feet) upstream and downstream of piles being driven, NMFS has determined that juvenile steelhead are not likely to be found inside of this area.[7] Juvenile steelhead in Novato Creek are expected to be farther up in the watershed where water quality conditions are suitable for rearing over the summer months. The reaches where steelhead have been found in the summer were well beyond the distance determined for sound impacts that can injure or kill fish during pile driving, and based on the limited amount of pile driving needed at this crossing and the few amount of days that will be needed to finish this construction element of the project, NMFS does not believe there will be any pile driving related impacts to juvenile steelhead in Novato Creek.

Twenty pre-cast concrete piles will be driven into Lynch Creek. Available information indicates that the installation of concrete piles generates sound wave forms that are less injurious than steel piles of similar size. A study conducted at the Port of Oakland (Abbott *et al.* 2005) revealed that several species of fish which were held in cages 10 meters from the pile were not physically injured when exposed to several hundred underwater sound pulses during the installation of 24-inch octagonal concrete piles with an impact hammer. Based on these observations and the dry conditions over the summer months, impacts to steelhead are not anticipated from driving concrete piles at the Lynch Creek crossing.

A small number of Juvenile steelhead in the Petaluma River may experience sound levels due to pile driving that affect their behavior; however, NMFS expects these levels will be attenuated enough to not significantly disrupt normal behavior patterns, which include feeding and sheltering for juvenile steelhead, and are therefore discountable.

[7] This result is based on the habitat conditions in Novato Creek near the pile driving location, and recent surveys indicating steelhead have not been found within this distance of the bridge.

F. Habitat Impacts

1. Instream Habitat Loss

The installment of piers in the Petaluma River, Novato Creek, San Antonio Creek, Lynch Creek will result in instream habitat losses of 0.22 acres (9,583 square feet (ft^2)), 0.0012 acres (52 $feet^2$), 0.0023 acres (100 $feet^2$), 0.0222 acres (967 $feet^2$) respectively. This overall loss of instream habitat is small relative to the overall action area in these reaches. Lynch Creek will experience a greater loss of habitat than the other creek crossings relative to its size; however, steelhead do not use this portion of the action area; having only been found in Lynch Creek below the Highway 101 crossing, where habitat is limited and tidally influenced. The habitat area that will be lost in San Antonio Creek is also not utilized by steelhead. The portion of the action area that is impacted by this habitat loss in Novato Creek and the Petaluma River is used predominantly for adult and juvenile steelhead migration with some marginal rearing. The new piers are not expected to slow or prevent steelhead migrations through any of these waterways and can provide velocity refuge for steelhead during particularly high winter flows.

2. Shading

The combined amount of permanent impacts due to shading between the bridge spans will be 0.7403 acres (32,247 $feet^2$). The riparian cover located within the bridge gaps will likely wither and eventually die from the lack of sunlight as a consequence of shading. This amount of riparian cover in the gaps is minimal at all crossings with the exception of Lynch Creek and the new San Antonio Creek bridge crossings; however, steelhead use only the lower portion of Lynch Creek and have not been observed in San Antonio Creek at any of the bridge crossings. There is currently a lack of shade at the bridge crossings that likely results in higher water temperatures and any additional shading could potentially benefit salmonids by lowering water temperatures at or below these areas.

The reaches at the bridge crossings are used by steelhead migration and are deficient in the PCEs associated with other stages in the salmonid life-cycle. Salmonid species are attracted to shaded areas that provide an ambient light source. This additional shade from the new bridges would result in conditions that are expected to leave enough ambient light for successful salmonid navigation through the area.

3. Riparian

The dominant plant species found in the riparian corridors within the action area include California bay laurel (*Umbellularia californica*), California buckeye (*Aesculus californica*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*), valley oak (*Quercus lobata*), Himalayan blackberry (*Rubus discolor*), poison oak (*Toxicodendron diversilobum*), and stinging nettle (*Urtica dioica*).

Riparian vegetation removal for this project will result in both temporary and permanent loss. Permanent impacts include loss of habitat due to shading and placement of bridge abutments and

approach roads. Temporary impact numbers include bioswale areas, designated staging areas, and areas in between the cut and fill line and the project footprint.

Riparian habitat loss will result from the clearing of banks to allow access to the construction sites and the placement of new crossings and connecting road. The riparian corridor along the banks of San Antonio Creek is better established than the corridors at the other locations, due to the two smaller crossings at San Antonio Road and Highway 101, and the overall limited land use in the area. Trees along the banks that provide overhanging canopy will be removed along with low lying brush and herbaceous vegetation along the creek banks. At the San Antonio Creek locations, Caltrans expects the 2.39 acres (104,138 ft^2) of permanent riparian removal and 0.64 acres (42,989ft^2) of temporary removal. The amount of riparian removal along San Antonio Creek is greater than in the other locations; however, the amount is relative to the riparian vegetation remaining in the area, which is ample enough to continue providing shade and cover within the area. Both temporary and permanent effects will also be mitigated should steelhead population re-establish within the San Antonio Creek.

Riparian removal at the Petaluma River and the Novato Creek locations consists of ground vegetation only and will result in a permanent loss of 0.34 acres (14,868ft^2) and 0.40 acres (17,372ft^2), and a temporary loss of 0.99 acres (42,989ft^2) and 0.47 acres (20,546ft^2) respectively. The impacts associated with this loss can result in an increase of sediment from eroding banks. Much of the Petaluma River vegetation is low ground cover, consisting mainly of pickle weed that while providing some bank support, does not support good quality habitat for fish. Ground cover will be re-vegetated with native plants after completing construction in these areas. BMPs for erosion control will be in place during all phases of construction to control erosion.

The Lynch Creek crossing has sparse riparian vegetation in the gap and along the banks. The amount of permanent riparian loss in this area is expected to be 0.28 acres (12,227ft^2) and a temporary riparian loss of 0.22 acres (9,391ft^2). The current amount of riparian cover at the bridge crossing does not contribute to lower water temperatures or provide cover for steelhead. Steelhead would use this reach for a migration corridor to habitat farther upstream, but have only been known to use the lower reaches of Lynch Creek, that are tidally influenced by the Petaluma River. Steelhead migrations through the area are more associated with flow than riparian cover in Lynch Creek and would still able to navigate through the reach at the crossing to more suitable habitat farther upstream unimpeded during wetter years.

Riparian habitat providing instream cover and food resources for salmonids will be temporarily impacted by the removal of bank cover and over-hanging canopy along creek banks. Although it may take 10 to 50 years to restore the full function of this component of salmonid habitat where vegetation clearing will occur on banks, the proposed restoration of planting riparian vegetation prescription in accordance with CDFG guidelines, over time will restore the function of the riparian habitat lost due to the construction activities. Habitat will be degraded during this riparian growth recovery period. Rearing juvenile and smolt steelhead will have less cover and potential prey resources for food. Migrating fish moving through the area will be more susceptible to predation. The riparian areas other than San Antonio Creek are sparse and do not provide much cover as would a riparian area with dense, mature vegetation.

4. Instream Habitat Loss

Temporary instream habitat loss will result from dewatering operations in the Petaluma River and Novato Creek. Temporary loss of habitat in the San Antonio and Lynch creeks will not be significant because steelhead are not anticipated to be present in these areas during or after construction. Instream work at a minimal level of intensity would require diverting channel flow from the pathways of equipment and the construction of falsework on timber pads. If in-channel construction is conducted in these creeks during a wet year or in early June, water will need to be diverted from the construction areas using cofferdams and associated equipment. The areas that will need dewatering would occur under existing and newly constructed bridges during the construction of the center decks and new bridges. The predicted cofferdam locations are between the north and southbound lanes at the Highway 101 crossing and these areas are narrow and the work space needed in the dewatered areas is on a small scale, therefore, the amount of temporary habitat loss is predicted to be small.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. 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.

Impacts from urbanization, such as increased runoff from new areas of impervious surfaces, and sediment and turbidity associated with road repair and construction, are likely to continue to occur in the action area. Some degradation of water quality in the Petaluma River is likely contributed by boat traffic and marina activities near the bridge crossing. The pace of such development fluctuates based on economic conditions, and has currently slowed. In recent years, additional aquatic habitat protections have been applied by State and Federal agencies to development projects. Based on these factors, NMFS concludes that the level of habitat degradation in the action area resulting from cumulative effects is expected to remain fairly constant or somewhat reduced during the next several years when the project is implemented.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

Steelhead in the CCC DPS are suffering severe and long-term declines, both range-wide and within the action area. Across the region, significant destruction and degradation of spawning and rearing habitat has occurred. Threats to naturally reproducing steelhead are numerous, varied, and ongoing. NMFS listed as threatened the southern DPS of North American green sturgeon on April 7, 2006, (70 FR 17757) because of substantial loss of spawning habitat, the concentration of a single spawning population in one section of the Sacramento River, and multiple other risks to the species.

The MSN Project activities will directly affect steelhead and steelhead critical habitat. NMFS anticipates that take in the Petaluma River of listed juvenile steelhead as a result of this project

will be in the nature of injury, mortality and temporary capture and harassment. Some juvenile steelhead that were not captured and relocated from the cofferdams will perish from desiccation resulting from dewatering the cofferdam. A small number of juvenile steelhead may be injured or killed during relocation. This level of injury and mortality is expected to be small based on the results of other similar relocation efforts, the thoroughness of relocation efforts and the low steelhead numbers anticipated in the action area

Other take is expected in the form of harassment of steelhead from sound levels resulting from year-round pile driving in the Petaluma River. This take is expected to harass fish as they pass through the area and could result in migration delays both up and down river. Sound attenuation devices will be used and sound levels will be monitored to keep impacts below the sound thresholds for tissue injury and mortality. A small number of smolts are likely to experience increased predation due to delay.

The temporary capture and harassment will be of limited duration and mortality numbers due to relocation, dewatering, and delay in the Petaluma River will be low. BMPs incorporated into the project will avoid and minimize the impacts associated with these activities. Therefore, the summed amount of the steelhead take is not expected to have any long-term effects on the survival of the affected steelhead population that should be able to replace their lost numbers once fish return to their normal behavior patterns. Due to the small number of juveniles and smolts lost, adult returns are likely to be only minimally affected, if at all. There will be enough returning adults to populate the Petaluma River watershed with steelhead juveniles in numbers equivalent to those currently found in the watershed, including the action area.

NMFS has determined that it is unlikely that North American green sturgeon will occur in the action area due to the lack of observations of this species in the Petaluma River. Green sturgeon do have access to this reach of the Petaluma River, but there is minimal to no risk that they will be in this area during construction. There they are unlikely to be adversely affected.

The amount of permanent habitat loss is minimal when compared to the overall migratory corridor above and below the modified and new bridges and is not expected to create a migration barrier (at most or all flows). PCE's within the action area also include some marginal rearing habitat for steelhead. Short-term impacts from construction activities will be minimal and localized at the project site, and are unlikely to affect critical habitat up or downstream. Long-term impacts to the rearing PCE from construction will be limited to the actual footprint of the new bridge crossing. Much larger areas in the creeks and river will remain undisturbed, as will the higher quality rearing and spawning habitats up and downstream of the action area. Therefore, the project is not expected to affect the value critical habitat for species conservation.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of the species and critical habitat, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is NMFS' biological opinion that the MSN Project

is not likely to jeopardize the continued existence of threatened CCC steelhead or the southern DPS of North American green sturgeon.

After reviewing the best available scientific and commercial information, the current status of critical habitat, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is NMFS' biological opinion that the MSN Project is not likely to destroy or adversely modify designated critical habitat or proposed critical habitat for CCC steelhead or the southern DPS of North American green sturgeon, respectively.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without 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 NMFS as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by Caltrans, 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 their designee(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)).

A. Amount or Extent of Take

The MSN Project is expected to result in minimal incidental take of threatened CCC steelhead. As described above in the biological opinion, juvenile steelhead are expected to be subject to capture for relocation efforts. A small number of fish are likely to be killed as a result of relocation efforts in the Petaluma River during dewatering. A few fish may avoid relocation efforts and be killed when the work area is dewatered. The number of threatened CCC steelhead that may be incidentally taken during fish collection and relocation cannot be precisely quantified in the Petaluma River, but is expected to be a small amount.

Therefore, take is quantified as: all fish present in the cofferdams installed in the Petaluma River may be captured by dewatering and relocation activities. NMFS anticipates a small number of these juvenile steelhead will either avoid relocation efforts and be killed during dewatering, or be injured or killed during capture and relocation. No more than 4.5 percent of juvenile steelhead within the proposed cofferdams in the Petaluma River will be injured or killed.

Take from pile driving is quantified as: all steelhead (adult, smolts, and juveniles) present in the Petaluma River portion of the action area during pile driving. These fish are likely to experience disruption in normal behavior patterns when pile driving is done using an impact hammer. For example, adults and smolts may experience migration delays due to the sound pressure waves generated by pile driving in the Petaluma River; however, spawning habitat used by steelhead is not far upstream from the action area and spawning success is not expected to be compromised by short-term migration delays. Outmigrating smolts in the spring are expected to be able to pass the short distance trough the action area via the 60-foot navigation channel that Caltrans has proposed to maintain in the Petaluma River. Smolts migrating during the day may experience short-term disruption during migrations as they may hold above the action area during pile driving activities. During the holding times, smolts would likely seek cover until the pile driving activities have stopped then continued migration through the area under the cover of night. Nevertheless, a small number of these smolts may experience increased predation.

Because the precise number of steelhead delayed or exposed to increased predation cannot be determined, NMFS will use the underwater sound thresholds described above in the biological opinion as surrogates for incidental take. If underwater sound produced during five or more strikes on a single day exceeds the anticipated levels of 206 dB peak SPL and 187 accumulated dB SEL at 10 m from the pile being installed, incidental take is likely to be exceeded.

B. Effect of the Take

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to CCC steelhead.

C. Reasonable and Prudent Measures

Pursuant to section 7(b)(4) of the ESA, the following reasonable and prudent measures are necessary and appropriate to minimize incidental take of threatened CCC steelhead:

1. Measures shall be taken to minimize injury and mortality to listed steelhead from fish relocation activities, dewatering activities, and bridge construction.

2. Measures shall be taken to minimize injury and mortality to listed steelhead from pile driving activities.

3. FHWA and Caltrans shall provide reports to NMFS on the effectiveness of the project's incidental take minimization measures.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, Caltrans and their designee(s) must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary. Monitoring requirements are included below, as per 50 CFR 402.12(i)(3): "In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service [NMFS] as specified in the incidental take statement."

The following terms and conditions implement Reasonable and Prudent Measure 1.

1. Caltrans shall provide NMFS with a "Fish Relocation Plan" and a "Dewatering Plan" for review 30 days prior to the start of dewatering and fish relocation activities. The Fish Relocation Plan shall outline all fish collection and relocation methods and materials. The plan shall be submitted to NMFS' Santa Rosa Area Office (see address below). The Dewatering Plan shall outline all dewatering methods, including dewatering timeframes before and after pile driving within the cofferdams. Plans for storing and cleaning water pumped from the river and creeks prior to discharge must be described. The plan shall be submitted to NMFS' Santa Rosa Area Office (see address below).

2. Caltrans shall retain a qualified biologist with expertise in the areas of anadromous salmonid biology, including handling, collecting, and relocating salmonids; salmonid/habitat relationships; and biological monitoring of salmonids. Electrofishing, if used, shall be performed by a qualified biologist and conducted according to the "NOAA Fisheries Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act", June 2000. A Statement of Qualifications for all biologists who will be employed on the project shall be provided to NMFS for review 30 days prior to any onsite project construction (or demolition) related activities.

3. The biologist shall monitor the construction site during fish relocation and dewatering activities to minimize or avoid take of salmonids. The biologist shall be on site during all these events to ensure that all listed salmonids are captured, handled, and relocated safely. The biologist shall notify NMFS biologist Dave Walsh (707) 575-6016 or dave.walsh@noaa.gov one week prior to relocation activities in order to provide an opportunity for NMFS staff to observe the activities.

4. Listed salmonids shall be handled with extreme care and kept in water to the maximum extent possible during relocation activities. All captured fish shall be kept in cool, shaded, aerated water protected from excessive noise, jostling, or overcrowding any time they are not in the stream and fish shall not be removed from this water except when released. To avoid predation, the biologist shall have at least two containers and segregate young-of-year salmonids from older salmonids and other potential aquatic predators. Captured salmonids shall be relocated, as soon as possible, to a location out of the project's impact area, which has suitable habitat conditions, and which allows for maximum survival of the transported salmonids.

5. Caltrans shall provide NMFS with an annual summary report within 90 days of the completion of fish relocation and monitoring activities. The report shall include the methods used during the fish relocation and monitoring efforts, location, number and species captured, number of mortalities by species, and other pertinent information related to the monitoring and fish relocation activities. Reports shall be submitted to NMFS Santa Rosa Area Office (see address below).

6. All pumps used in the work area shall be equipped with screens that meet the following NMFS fish screening criteria:

a. Perforated plate: screen openings shall not exceed 3/32 inches (2.38 mm), measured in diameter.
b. Woven Wire: screen openings shall not exceed 3/32 inches (2.38 mm measured diagonally).
c. Screen material shall provide a minimum of 27 percent open area.
d. Approach velocity shall not exceed 0.33 feet per second.

7. Caltrans shall provide written notification to NMFS at least 14 days prior to commencement of in-channel bridge construction, or over-channel bridge demolition. Written notification shall be sent to NMFS' Santa Rosa Area Office (see address below).

8. All cofferdams must be inspected and maintained on a daily basis to ensure its integrity for the duration of the work schedule below OHW.

The following terms and conditions implement Reasonable and Prudent Measure 2.

9. Pile driving of the CISS piles in wetted channels (or within cofferdams in wetted channels) shall occur only during daylight hours with the sun above the horizon. This is to ensure that pile driving does not occur at dawn or dusk, which can be peak movement times for juveniles.

10. FHWA and Caltrans shall monitor underwater sound during all impact hammer pile driving activities on land or in water for CISS piles used in the construction of the Petaluma River Bridge footings. If underwater sound produced during five or more strikes on a single day exceeds the anticipated levels of 206 dB peak SPL and 187 accumulated dB SEL at 10 m from the pile being installed, then pile driving must cease and NMFS must be contacted within 24 hours: Dave Walsh (707) 575-6016 or dave.walsh@noaa.gov, or the NMFS Santa Rosa Office (707) 575-6050. The purpose of the contact is for Caltrans to describe the measures that will be taken to reduce underwater sound levels. Once NMFS agrees to the measures to reduce underwater sound, pile driving may proceed unless monitoring detects underwater sound levels greater than those specified above. If sound levels exceed those specified above, Term and Condition 10 repeats until sound levels are below the levels specified above.

11. An environmental noise technician shall monitor the construction site during pile driving activities to monitor sound impact avoidance measures and record the outcomes of each pile driving event. The technician shall be on site during all these events to ensure that all sound attenuation devices are being used and that sound impact avoidance protocols are adhered to.

12. Each pile driving incident shall be monitored and recorded in a log that includes the sound levels at the stopping time and the sound levels at the starting time. If sound levels are above SPL and SEL, actions will be taken to lower the sound level to a level that will not produce injurious sound pressure levels to salmonids.

13. Sound attenuation devices will be used for all pile driving activities.

14. If Caltrans is unable to meet these sound attenuation criteria then impact driving of CISS pile shall only occur from May 15 through November 30 in any given construction season to allow adult and smolt steelhead migration to their natal streams and the ocean.

15. At the Petaluma River location, if pile driving of CISS piles commences within the June 15 to October 31 timeframe in the first work season, Caltrans shall monitor these activities, using the hydroacoustic equipment, for a period of no less than two weeks. If the sound levels fall below the sound thresholds of 206 dB peak SPL and 187 accumulated dB SEL at 10 m from the pile being installed, then Caltrans may continue to drive CISS piles with an impact hammer until November 1. Otherwise, Caltrans may continue to pile drive as long as additional sound attenuation can reduce underwater sound below the thresholds above.

The following terms and conditions implement Reasonable and Prudent Measure 3.

16. FHWA and Caltrans shall provide reports to NMFS on the effectiveness of the project's incidental take minimization measures no later than 90 days following the end of each construction season, including an annual minimization measure effectiveness report for the Petaluma River activities.

17. FHWA and Caltrans shall provide annual reports to NMFS with the results of the hydroacoustic monitoring program. The first report shall be submitted to NMFS no later than January 31, following the first year of construction, and shall provide year-round results of the previous construction season. The second annual hydroacoustic report, covering the second year monitoring period, shall be provided to NMFS by January 31 in the year following the second year of construction (see address below).

18. FHWA and Caltrans shall provide NMFS with an annual summary report within 90 days of the completion of fish relocation and monitoring activities each year. The report of relocation shall include the methods used during the fish relocation and monitoring efforts, location, number and species captured, number of mortalities by species, and other pertinent information related to the monitoring and fish relocation activities. Reports shall be submitted to NMFS Santa Rosa Area Office (see address below).

19. FHWA, Caltrans, or contractor shall allow any NMFS employee(s) or any other person(s) designated by NMFS, to access the MSN Project work areas during the construction period for the purpose of observing monitoring activities, evaluating fish and stream conditions, performance of Caltrans' BMPs, or perform other monitoring/studies. NMFS will notify Caltrans

Resident Engineer 48 hours prior to plan site visits and will contact Caltrans personnel prior to entering the construction site.

20. All reports or plans required for the above terms and conditions shall be sent to:

NMFS Santa Rosa Area Office
Supervisor, Protected Resources Division
Southwest Region
National Marine Fisheries Service
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404

X. REINITIATION NOTICE

This concludes formal consultation on the proposed Marin Sonoma Narrows High Occupancy Vehicle Widening Project. As provided in 50 CFR §402.16, 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 take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

XI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or develop additional information.

1. NMFS recommends that piles not be installed during steelhead migration - December through mid-May in the Petaluma River.

2. NMFS recommends that FHWA and Caltrans consult with NMFS to develop a long range planning approach that seeks to minimize and avoid the impacts of road-related projects on listed salmonids.

3. Caltrans should identify and prioritize any maintenance and construction projects which, if implemented, can improve ESA-listed salmonid migration or in-stream environmental conditions.

4. Caltrans in coordination with NMFS should use this project to initiate studies to acquire empirical data for establishing criteria for the cumulative effects to fish from exposure to underwater sound produced during multiple pile driving strikes.

XII. LITERATURE CITED

Abbott, R., J. Reyff, and G. Marty. 2005. Monitoring the effects of conventional pile driving on three species of fish. Final report submitted to Manson Construction Co. April 8, 2005.

Adams, P.B., C.B. Grimes, S.T. Lindley, and M.L. Moser. 2002. Status Review for North American Green Sturgeon, *Acipenser medirostris*.

Anderson, C.R., and J.A. Reyff. 2006. Underwater sound measurement data for the driving of steel sheet piles and square concrete piles. Port of Oakland, Berth 23. Vortex Marine Construction. Oakland, CA.

Baxter, R., K. Hieb, S. DeLeon, K. Flemmingm, and J. Orsi. 1999. Report on the 1980-1995 fish, shrimp, and crab sampling in the San Francisco Estuary, California. Edited by J. Orsi. California Dept. of Fish and Game, Tech. Rpt. 63, November 1999. 503 pp.

Beamish, R.J., and D.R. Bouillion. 1993. Pacific salmon production trends in relation to climate. Canadian Journal of Fisheries and Aquatic Sciences 50:1002-1016.

Beamish, R.J., C.M. Neville, and A.J. Cass. 1997. Production of Fraser River sockeye salmon (*Oncorhynchus nerka*) in relation to decadal-scale changes in the climate and the ocean. Canadian Journal of Fisheries and Aquatic Sciences 54:543-554.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Berggren, T.J. and M.J. Filardo. 1993. An analysis of variables influencing the migration of juvenile salmonids in the Columbia River Basin. North American Journal of Fisheries Management 13:48-63.

Bilby, R.E., and B.R. Fransen *et al.* 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: evidence of stable isotopes. Canadian Journal of Fisheries and Aquatic Sciences. 53:164-173.

Bilby, R.E., and P.A. Bisson. 1998. Function and Distribution of Large Woody Debris. Pages 324-346. *In*: Naiman, R.J. and R.E. Bilby, editors. River Ecology and Management: Lessons from the Pacific Coastal Ecoregion. Springer-Verlag. New York. 705 pages.

Bjorkstedt E.P., B.C. Spence, J.C. Garza, D.G. Hankin, D. Fuller, W.E. Jones, J.J. Smith, and R. Macedo. 2005. An Analysis of Historical Population Structure for Evolutionarily

BRT (Biological Review Team). 2005. Green Sturgeon (*Acipenser medirostris*) Status Review Update. National Marine Fisheries Southwest Fisheries Science Center, Santa Cruz, California.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NOAA Fisheries-NWFSC-27. 261 pages.

California Department of Transportation (Caltrans). July 2008. Biological Assessment for the Marin Sonoma Narrows Project.

Campbell, R.N.B., and D. Scott. 1984. The determination of minimum discharge for 0+ brown trout (*Salmo trutta L.*) using a velocity response. New Zealand Journal of Marine and Freshwater Research. 18:1-11.

Chapman, D.W., and T.C. Bjornn. 1969. Distribution of salmonids in streams, with special reference to food and feeding. *In* T.G. Northcote, ed., Symposium on salmon and trout in streams, pgs. 153-176. H.R. MacMillan Lectures in Fisheries, University of British Columbia, Institute of Fisheries, Vancouver.

Clothier, W.D. 1953. Fish loss and movement in irrigation diversions from the west Gallatin River, Montana. Journal of Wildlife Management. 17:144-158.

Clothier, W.D. 1954. Effect of water reductions on fish movement in irrigation diversions. Journal of Wildlife Management. 18: 150-160.

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management. 5:330 339.

Eisler, Ronald. 2000. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 1, Metals. Lewis Press, Boca Raton, Florida EPA (Environmental Protection Agency). 1993. Office of Water. Guidance Specifying Management Measures of Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-93-001c. January 1993.

EPA (Environmental Protection Agency). 1993. Office of Water. Guidance Specifying Management Measures of Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-93-001c. January 1993.

Fawcett Environmental Consulting. 2000. Brief summary of aquatic species captured and relocated from the Novato Creek Flood Control Project site, August 2000. Report

Fawcett Environmental Consulting. 2006. Brief summary of aquatic species captured and relocated from the Novato Flood Control Project, Phase VIII, June 2006. Report

Fukushima L., and E.W. Lesh. 1998. Adult and juvenile anadromous salmonid migration timing in California streams. California Department of Fish and Game 84(3):133- 145.

Furrer, T. Website: United Anglers of Casa Grande. Accessed September 15, 2007. http://www.uacg.org/.

Gregory, R. S., and T. G. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile Chinook salmon (*Oncorhynchus tshawytcha*) in turbid laboratory conditions. Canadian Journal of Fisheries and Aquatic Sciences 50:233-240.

Gresh, T., J. Lichatowich, and P. Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the northeast pacific ecosystem. Fisheries 15(1):15-21.

Hamaker T., Hiss A., and Kettley, L. 2003. *Special-Status Fish Habitat Surveys for the State Route 101 Novato Narrows Project.* Technical Memorandum. CH2M HILL. 8 pp.

Hanson, L.C. 1993. The foraging ecology of Harbor Seals, *Phoca vitulina*, and California Sea Lions, *Zalophus californianus*, at the mouth of the Russian River, California. Master of Science thesis, Sonoma State University, Rohnert Park, California.

Harvey, B.C. 1986. Effects of suction gold dredging on fish and invertebrates in two California streams. North American Journal of Fisheries Management 6:401-409.

Hastings, M.C., and A. N. Popper. 2005. Effects of Sound on Fish. Prepared for the California Department of Transportation. January 28, 2005. http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_on_Fish23Aug05.pdf.

Hayes, D.B., C.P. Ferreri, and W.W. Taylor. 1996. Active fish capture methods. Pages 193-220 *in* B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society. Bethesda, Maryland. 732 pages.

Hubert, W.A. 1996. Passive capture techniques. Pages 157-192 *in* B.R. Murphy and D.W. Willis, editors. Fisheries Techniques. Second Edition. American Fisheries Society. Bethesda, Maryland. 732 pages.

Jensen, P.T., and P.G. Swartzell. 1967. California salmon landings 1952 through 1965. California Department of Fish and Game, Fish Bulletin 135:1-57.

Johnson, S.L. 1988. The effects of the 1983 El Niño on Oregon's coho (*Oncorhynchus kisutch*) and Chinook (*O. tshawytscha*) salmon. Fisheries Research 6:105-123.

Kraft, M.E. 1972. Effects of controlled flow reduction on a trout stream. Journal of Fisheries Research. Board of Canada 29:1405-1411.

Leidy, R.A. 1984. Distribution and Ecology of Stream Fishes in the San Francisco Bay Drainage (and associated unpublished data, 1981-1984). Hilgardia 52(8).

Leidy, R.A. 2002. Unpublished stream survey data 1992-2002. U.S. Environmental Protection Agency.

Leidy, R.A., G.S. Becker, and B.N. Harvey. 2005. Historical Distribution and Current Status of Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) in Streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, California.

Lindley, S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, E. Rechisky, J.T. Kelly, J. Heublein, A.P. Klimley. 2008. Marine migration of North American green sturgeon. Trans. Am. Fish. Soc. Accepted for publication.

MacFarlane, R.B., and E.C. Norton. 2001. Physiological ecology of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) at the southern end of their distribution, the San Francisco Estuary and Gulf of the Farallones, California. Fish. Bull. 100:244-257.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NOAA Technical Memorandum NMFS-NWFSC-42. 156 pages.

Moyle, P.B. 2002. Inland Fishes of California. University of California Press. Berkeley, California.

NMFS (National Marine Fisheries Service). 1997. Status review update for West Coast steelhead from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 68 pages. Conditions. Prepared for Environmental Science Assoc., June 19, 1997.

NMFS (National Marine Fisheries Service). 1999. Status review update for four deferred ESUs of Chinook salmon from Washington, Oregon, California, and Idaho. National Marine Fisheries Service, Northwest Fisheries Science Center. 100 pages, plus appendixes.

NMFS (National Marine Fisheries Service). 2005a. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. United States Department of Commerce, National

Oceanic and Atmospheric Administration, National Marine Fisheries Service. June 2005. 512 pages.

NMFS (National Marine Fisheries Service). 2005b. Final assessment of the National Marine Fisheries Service's Critical Habitat Review Teams (CHARTs) for seven salmon and steelhead evolutionarily significant units (ESUs) in California. July 2005. 23 pages, plus appendices.

Pile Driving Compendium. 2007. The Compendium of Pile Driving Sound Data. Prepared by Illinworth and Rodkin for the California Department of Transportation. http://www.dot.ca.gov/hq/env/bio/files/pile_driving_snd_comp9_27_07.pdf.

Reiser, D.W., and T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. United States Department of Agriculture Forest Service General Technical Report PNW-96. 54 pages.

Rich, A.A. 1997. Novato Creek Flood Control Project, Marin County, Fishery Resources

Sigler, J.W., T.C. Bjornn, and F.H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead and coho salmon. Transactions of the American Fisheries Society 113:142-150.

Skinner, J.E. 1962. Fish and Wildlife Resources of the San Francisco Bay Area.

Thomas, V. G. 1985. Experimentally determined impacts of a small, suction gold dredge on a Montana stream. North American Journal of Fisheries Management 5:480- 488.

Thomson, B., and J. Michaels. 1968a. Stream Survey Petaluma Creek. CDFG report submitted to Marin County Public Works Department. 2 pages.

Thomson, B., and J. Michaels. 1968b. Stream Survey Adobe Creek. CDFG report submitted to Marin County Public Works Department. 2 pages.

Thut, R. N., and D.C. Schmiege. 1991. Processing Mills. Pages 369-387 *in* Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. W.R. Meehan, editor. American Fisheries Society Special Publication 19. American Fisheries Society. Bethesda, Maryland.

Velagic, E. 1995. Turbidity study: a literature review. Prepared for Delta planning branch, California Department of Water Resources by Centers for Water and Wildland Resources, University of California, Davis.

Waples, R.S. 1991. Definition of "Species" Under the Endangered Species Act: Application to Pacific Salmon. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS F/NWC-194. 15 pages.

Waples, R.S. 1999. Dispelling some myths about hatcheries. Fisheries 24(2):12-21.

Waters, T. F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7.

XIII. FEDERAL REGISTER NOTICES CITED

61 FR 56138: Endangered and Threatened Species; Threatened Status for Central California Coast Coho Salmon Evolutionarily Significant Unit (ESU). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, United States Department of Commerce. Final Rule. Federal Register, Volume 61, No. 212, October 31, 1996. pages 56138-56149.

62 FR 43937: National Marine Fisheries Service. Final Rule: Listing of Several Evolutionary Significant Units of West Coast Steelhead. Federal Register, Volume 62 pages 43937-43954. August 18, 1997.

69 FR 71880: Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionary Significant Units of Pacific Salmon and Steelhead in California; Final Rule. Federal Register 70, No 170: 52488-52586. September 2, 2005.

70 FR 17386. April 6, 2005. Proposed Rule: Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register, Volume 70 pages 17386-17401.

70 FR 52488: National Marine Fisheries Service. Final Rule: Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionary Significant Units of Pacific Salmon and Steelhead in California. Federal Register, Volume 70 pages 52488-52586. September 2, 2005.

71 FR 17757. April 7, 2006. Final Rule: Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Federal Register, Volume 71 pages 17757-17766.

71 FR 834: National Marine Fisheries Service. Final Listing Determinations for Ten Distinct Population Segments of West Coast Steelhead; Final Rule. Federal Register, Volume 71 pages 834-862. January 5, 2006.

73 FR 52084: National Marine Fisheries Service. Proposed Rulemaking To Designate Critical Habitat for the Threatened Southern Distinct Population Segment of North American

Green Sturgeon; Proposed Rule. Federal Register, Volume 73 pages 52084-52110. September 8, 2008.

XIV. PERSONAL COMMUNICATIONS

Michael Fawcett, Fawcett Consulting, personal communication with Dave Walsh, October 15, 2007, and October 3, 2008.

Michael Fawcett, Fawcett Consulting, email communication with Dave Walsh, January 20, 2009.

David Woodbury, NMFS, personal communication with Dave Walsh, October 2008.

Bill Cox, California Department of Fish and Game, personal communication with Caltrans on June 29, 2002.

Bill Cox, California Department of Fish and Game, personal communication with Dave Walsh via email, October 2, 2008.