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

JUL 13 2007

In response refer to:
2005/00122

Alan Candlish
United States Bureau of Reclamation
Mid-Pacific Region
2800 Cottage Way
Sacramento, California 95825

Dear Mr Candlish:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Enclosure 1) based on our review of the Contra Costa Water District's (CCWD) proposed Alternative Intake project in San Joaquin County, California. The biological opinion addresses project effects on Federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), threatened North American green sturgeon (*Acipenser medirostris)*. Also addressed are project effects on designated critical habitat for Central Valley steelhead, Sacramento River winter-run Chinook salmon, and Central Valley spring-run Chinook salmon in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your August 14, 2006, request for formal consultation was received on August 17, 2006. Formal consultation was initiated on September 19, 2006.

This biological opinion is based on information provided in the May 2006, Action Specific Implementation Plan, supplemental information provided in March 2007, and discussions held at meetings with representatives of NMFS, U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Bureau of Reclamation (BOR), and Contra Costa Water District. A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

Based on the best available scientific and commercial information, the biological opinion concludes that the proposed action is not likely to jeopardize the continued existence of the above listed species, nor destroy or adversely modify designated critical habitat for Central Valley steelhead. Due to the likelihood of incidental take of listed species from the proposed construction and operations, NMFS has also included an incidental take statement with the biological opinion.

Also enclosed are Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon and Groundfish as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). This document concludes that the proposed Alternative Intake Project will adversely affect EFH of Pacific Salmon and Groundfish in the action area and adopts certain terms and conditions of the incidental take statement and the ESA conservation recommendations with the biological opinion as the EFH conservation recommendations.

Section 305(b)4(B) of the MSA requires BOR to provide NMFS with a detailed written response to the EFH conservation recommendations within 30 days, and 10 days in advance of any action, including a description of measures adopted by BOR for avoiding, minimizing, or mitigating the impacts of the project (50 CFR §600.920(k)). In the case of a response that is inconsistent with our recommendations, BOR must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

If you have any questions regarding this correspondence please contact Mr. Bruce Oppenheim by telephone at (916) 930-3603 or via email at Bruce.Oppenheim@noaa.gov.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Enclosures: (1) Biological Opinion, (2) Essential Fish Habitat Consultation

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Enclosure 1

BIOLOGICAL OPINION

ACTION AGENCY:	U.S. Bureau of Reclamation Mid-Pacific Region
ACTIVITY:	Contra Costa Water District's Alternative Intake Project
CONSULTATION CONDUCTED BY:	NOAA's National Marine Fisheries Service
DATE ISSUED:	JUL 13 2007

I. CONSULTATION HISTORY

The U.S. Bureau of Reclamation (BOR) initiated formal consultation with NOAA's National Marine Fisheries Service (NMFS) on August 14, 2006, and authorized Contra Costa Water District (CCWD) as the applicant for the proposed Alternative Intake project (AIP). Operations of CCWD's three diversions (Old River, Rock Slough, and Mallard Slough) are currently integrated into BOR's Central Valley Project (CVP).

On March 15, 2005, NMFS provided comments on the "Notice of Preparation" of a joint project environmental impact report/environmental impact statement (EIR/EIS) for BOR and CCWD. At the same time NMFS provided a species list of Federally listed fish species within the action area.

On June 28, 2005, BOR initiated informal consultation and NMFS provided an updated species list.

On January 10, 2006, NMFS provided CCWD with comments on the Administrative Draft EIR/EIS and the Draft Action Specific Implementation Plan (ASIP), which would be used as a biological assessment.

On August 14, 2006, BOR requested formal consultation with NMFS for the AIP in San Joaquin County, California. The request for consultation included the final ASIP (CCWD and BOR 2006a) and a draft EIR/EIS for the proposed action.

On September 19, 2006, NMFS advised BOR that formal section 7 consultation was initiated upon receipt of BOR's August 14, 2006, letter.

On March 8, 2007, CCWD provided updates to the project description based on revisions to the preliminary fish screen design provided by the Anadromous Fish Screen Program (AFSP) Technical Team. At the same time, additions were made to one of the conservation measures in the project description to accommodate sound monitoring. The changes in screen design resulted in fewer shallow water habitat modifications than described in the ASIP and the final EIS/EIR.

This biological opinion is based on information provided in the ASIP and final EIS/EIR (CCWD and BOR 2006a, 2006b). NMFS has met to discuss the project several times with the applicant, consultants, U.S. Fish and Wildlife Service (FWS), and the California Department of Fish and Game (CDFG). In addition, screening criteria were discussed with the Central Valley Project Improvement Act (CVPIA) AFSP Technical Team in three meetings (January 19, 2005; June 8, 2005; and January 25, 2007). A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

II. DESCRIPTION OF THE PROPOSED ACTION

The AIP would include construction of a new CCWD intake structure on Victoria Canal to function as part of the Old River Conveyance System. The new intake would provide for better quality water due to its location compared to the existing intake on Old River, but would not increase CCWD's total diversion capacity (rate or average annual quantity). The new intake would have a capacity of up to 250 cubic feet per second (cfs). The existing Old River intake and pump station, with a current capacity of 250 cfs, would remain in use; however, the combined permitted capacity of the Old River conveyance system would be limited by the 320 cfs pipeline capacity. Rock Slough would continue to provide a portion of CCWD's water supply, but would be used less frequently with the AIP because of the operational flexibility a new intake with better water quality would provide. The Mallard Slough intake would continue to provide a portion of CCWD's water supply in a manner similar to its current operations.

Implementation of the AIP would provide CCWD with the operational flexibility to divert water from either the new intake on Victoria Canal or the existing Old River intake, or to blend waters from Victoria Canal and Old River, to provide the highest water quality for CCWD customers. The AIP would involve adding a new point of diversion to certain existing water rights held by CCWD and by BOR. CCWD and BOR would immediately apply to change their permits to allow diversions of up to 320 cfs through the Old River conveyance system, but would not increase their water rights, CCWD's CVP contract amounts, or permitted Los Vaqueros Reservoir filling rates through this action. BOR will need to approve an additional point of diversion pursuant to CCWD's long-term renewal contract for CVP water service.

A. Proposed Facilities

The AIP would include the following facilities:

- Intake and pump station: a new water intake with a state-of-the-art fish screen, a pump station and ancillary structures, utilities, and access and security features.

- Levee improvements: reinforcement and reconfiguration of the levee at the intake/pump station site.

- Pipeline: a buried conveyance pipeline across Victoria Island, tunneled under Old River, and tying into CCWD's existing Old River conveyance facilities, and associated modifications of the existing agricultural irrigation and drainage system on Victoria Island as needed.

Facility construction is described in section II B, and proposed operations are described in section II C.

1. Intake Structure and Pump Station

a. *Intake and Fish Screen*

The new intake structure would consist of a reinforced concrete structure supported on concrete columns with side retaining walls and a fish screen open to Victoria Canal. The intake structure would be approximately 100 to 200 feet long, depending on the depth of the screen, which is anticipated to be 10 to 15 feet (see Appendix A, Figures 3 and 4). The final sizing will be based on confirmation of fish screen design details with fishery agencies, levee geotechnical design considerations, channel bathymetry, and costs (*e.g.*, it may be preferable to construct a narrower, deeper screen than a shallow, wide screen).

The state-of-the-art fish screen would provide a positive barrier against entrainment of fish and debris into the wet well/pump bays. The fish screen would be cleaned regularly with a mechanical cleaning system. The facility would be designed for a maximum perpendicular flow-through design velocity for the fish screens of 0.2 foot per second (fps) for any flow in Victoria Canal, which is consistent with the most stringent fish screening requirements (*i.e.*, 1.75 millimeter (mm) FWS criteria for delta smelt, *Hypomesus transpacificus*). Design parameters are described in Table 1.

The Victoria Canal channel cross section at the location of the proposed AIP is approximately 2,000 square feet. Site specific flow data confirm that the ambient sweeping velocity in the canal exceeds 0.4 fps greater than 70 percent of the time (*i.e.*, flows in Victoria Canal exceed 800 cfs greater than 70 percent of the time). The exposure time at a sweeping velocity of 0.4 fps is approximately 6.5 minutes.

Since flows in Victoria Canal are subject to tidal conditions, it is not possible to maintain a minimum sweeping velocity during slack tide (*i.e.*, four times per day). This is true of all fish screens in the Sacramento River/San Joaquin River Delta (Delta). The AFSP recommended increasing the minimum screen area by approximately 7-10 percent to offset the lack of the desired sweeping velocity during slack tide periods. This criteria has been incorporated into the proposed fish screen design with final design subject to confirmation with the AFSP (Table 1).

Table 1. Preliminary Alternative Intake Project Fish Screen Design, source: CCWD 2007

Design Requirement	**Units**	**AFSP (1) Requirement**	**Basis of Design**
Design flow	cfs	250	
Approach velocity	ft/sec	0.2	
Minimum effective screen area	ft^2	1,250 (2)	
Sweeping velocity	ft/sec	N/A (3)	
Recommended ratio of screen area provided to minimum effective screen area ($A_{provided}/A_{minimum}$)	ratio	1.07- 1.10 (4)	
Maximum screen opening size	mm	1.75	
Design minimum water surface elevation	ft		0.0
Screen invert elevation	ft		-10.0
Minimum wetted screen height	ft		10.0
Intake inside length	ft		150.0
Total width of supports (continuous screen)	ft		9.0
Panel width	ft		5.6
Total panels	no.		27
Screen width provided	ft		141.0
Wetted screen area provided	ft^2		1,410
Ratio of screen area provided to minimum effective screen area required ($A_{provided}/A_{required}$)	ratio		1.13

(1) CVPIA Anadromous Fish Screen Program, (2) Minimum effective screen area includes 7-10 percent recommended increase, (3) Sweeping velocity is not applicable in a tidal environment under all tidal conditions, (4) Includes AFSP recommendation to increase the screen area 7-10 percent above minimum required due to tidal conditions.

One or two existing agricultural siphons in Victoria Canal and/or agricultural drainage pipes on Victoria Island may need to be temporarily removed or relocated during construction. At the completion of construction, any siphons that have been removed would be replaced and restored to their original operational condition or permanently relocated.

b. *Pump Station and Ancillary Structures*

A pump station would lift water from the new intake and convey it through the pipeline system and to the existing Old River pump station system on Byron Tract. The pump station and associated mechanical piping would occupy a footprint area approximately 140 feet long by 60 feet wide. Normal water surface elevations at the intake would vary with tide; however, the intake pumps would be designed to operate at high and low water levels. The pumps would discharge into a common pipeline.

The intake/pump station facilities would also include a smaller motor control center/maintenance building and an electrical substation. The substation would be an open area measuring approximately 120 feet by 80 feet surrounded by chain-link fencing.

c. *Utilities*

There are no utilities present at the proposed intake site. Electricity, non-potable water, a sanitary holding tank, and a telecommunications system would be provided as part of the proposed AIP.

A new power substation would be constructed on-site. Power transmission lines would be installed from the Western Area Power Administration distribution system to the substation. Power supply to the facility would be transmitted through the distribution system from a combination of available sources, which may include Modesto Irrigation District and/or BOR's CVP. Potential corridors for power lines are the same as for the pipeline, although the pipeline and power lines may not be on the same alignment.

Water from Victoria Canal would be pumped through a screening filter to provide non-potable service water for the pump seals and washrooms.

Sanitary services for CCWD personnel on site for maintenance activities would be provided through the use of a below-ground holding tank that would be regularly maintained.

Antennas would be installed at the site to allow the station programmable logic controller and security system to communicate with CCWD's supervisory control and data acquisition system.

d. *Access and Security*

Site access would be via the existing levee roads or an existing north-south dirt road located off of Highway 4. The levee access roads may be surfaced with aggregate base rock to improve access during all weather conditions, but otherwise would not be modified. The north-south dirt road may be improved to accommodate two-way traffic and to meet anticipated vehicular traffic loadings.

Site security would include chain-link fencing surrounding the pump station and intake, switchyard and ancillary buildings.

2. Levee Improvements

The existing levee would be reinforced and reconfigured to serve as the engineered soil platform for the proposed intake/pump station facilities and to allow installation of the new intake structure (see Figures 3 and 4, Appendix A for proposed levee modifications). The approximate footprint area of the levee improvements (*i.e.*, measured at the base of the side slopes) would be 250 to 300 feet wide by 1,000 to 1,200 feet long. Approximately 6 to 8 acres at the intake site would be removed from agricultural use by the proposed levee modification.

The levee construction would require approximately 140,000 to 170,000 cubic yards of fill material as described below in section II B. The top of the reconfigured levee would be surfaced with aggregate base to maintain vehicular traffic during rain events. A ramp would be provided to allow access to the pump station and ancillary buildings. Slope protection (*i.e.*, riprap) would be installed on the water side of the levee for up to 400 to 500 feet on each side of the intake structure. Specific information on construction of the levee improvements is provided in section II B 2, below.

3. Conveyance Pipeline

The new conveyance pipeline would cross Victoria Island and Old River to tie into CCWD's existing Old River distribution system, as described below.

a. *Buried Pipeline Across Victoria Island*

The new conveyance pipeline would traverse Victoria Island buried within a trench from the new intake and pump facility on Victoria Canal to the Old River levee. The pipeline would transect Victoria Island diagonally and would be approximately 12,000 to 14,000 feet long. The pipeline would be sized to accommodate a flow rate of up to 250 cfs. The pipe diameter would be approximately 6 feet. Pipeline features such as air release, control valves, cathodic protection test stations, and access hatches would be installed in vaults or on pads above ground along the pipeline route.

The proposed pipeline routing may affect existing irrigation and drainage ditches that are used to irrigate existing fields and divert irrigation/storm water drainage from the fields (for discharge to Old River or Victoria Canal). Any ditches that potentially could be affected by the pipeline routing would be siphoned under, rerouted, crossed over, or replaced. The selected method for ditch crossings would be developed based on discussions with the landowner and considerations of both farming operations and construction costs. Nearly all effects on drainages would be temporary, as the ditches would be re-contoured to their pre-project dimensions where possible.

b. *Buried Pipeline Under Old River*

The conveyance pipeline would be tunneled under Old River at an elevation determined to avoid unconsolidated soils and provide for sufficient protection of the pipeline, estimated to be at least 50 feet below ground surface elevation.

c. *Pipeline Connection to the Old River Distribution System*

A new pipeline, approximately 50 to 100 feet long, would connect the pipeline from the Old River crossing to CCWD's existing Old River delivery pipeline within the existing setback levee. The pipeline would be installed using one of the trench construction methods described below in section II B 3.

d. *Easements*

CCWD would acquire land and/or easements as needed for construction and long-term access to the project sites. On Victoria Island, CCWD would purchase or obtain a permanent easement up to 70 feet wide for the pipeline alignment. For the duration of project construction, a total construction easement (including the width of the permanent easement) of approximately 250 feet would also be required. Land and/or easements would also be required for the intake site and the levee crossings.

Additional temporary construction easements of approximately 10 acres would also be required for construction staging areas. Additional temporary construction easements of approximately 25 to 40 acres for site access would be required on Victoria Island (*e.g.*, range includes on-island road access and potential levee road access).

B. Project Construction

1. Intake Structure

a. *Foundation Preparation*

Soil densification may be required beneath the intake and levee to reduce the liquefaction potential of the soil and to improve its lateral strength during seismic events. Preloading of the soils beneath the levee may also be required to reduce long-term settlement of the levee.

b. *In-Water Construction Activities*

In-water construction activities for installation of the intake and fish screen would be conducted either from a barge or from the top of the levee road. Most of the construction activities would be conducted in a dewatered cofferdam and would be isolated from Victoria Canal. As part of the construction of the new intake structure, a sheet pile cofferdam would be installed in Victoria Canal to isolate the work area from the canal water and provide a means to conduct construction work in a dewatered environment. Following installation of the cofferdam, the water in the cofferdam enclosure would be treated (as necessary) and discharged back to Victoria Canal, and the remaining intake construction work would be conducted in a dewatered environment.

If material needs to be removed for bed preparation at the cofferdam site, this excavated material would be contained within a designated containment area or areas on the land side of the levee. An earthen dike or siltation fences would enclose the containment area(s). Retention of the excavated materials would promote settling of the suspended sediments. Any excess water (desilted supernatant) would be returned back into Victoria Canal or Old River.

To provide additional depth for the fish screen, excavation may be required in Victoria Canal in the immediate vicinity of the intake, in an area up to 50,000 square feet, to depths one to two feet below the existing channel bottom. The need for excavation would be determined during final design based on the results of field data. Excavated materials would be transferred to the designated containment or disposal areas on the land side of the levee.

2. <u>Levee Improvements</u>

Construction of levee improvements would occur in two phases. First, an earthen setback levee would be constructed on the landward side of the existing levee (see Figures 3 and 4, Appendix A for proposed levee modifications). The setback levee would be integrated with the existing levee to provide continuity of the land/water barrier. Construction activities for the new intake would be initiated along the existing levee edge after the setback levee is completed. All new construction for the setback levee would incorporate modern techniques for soil compaction.

The new levee configuration would consist of additional earthen fill placed approximately 1,000 to 1,200 feet longitudinally and 250 to 300 feet laterally on the land side of the existing levee. Sheet piles would also be longitudinally placed approximately 320 feet upstream and downstream of the new intake, and would be integrated into the new setback levee to serve as a seepage barrier. Slope protection in the form of riprap would be installed on the water side of the existing levee for a distance of approximately 400 to 500 feet both upstream and downstream of the new intake. The new fill behind the existing levee would be constructed to maintain continuity of the existing road system along the existing levee crest. The elevation along the top of the new embankment fill would match the existing levee top elevation. Erosion control measures such as hydro seeding would be used on the landward side of the new setback levee.

See "Borrow Areas" below regarding the source of fill material for the proposed levee improvements.

3. <u>Pipeline Construction</u>

a. *Pipeline Installation on Victoria Island*

The conveyance pipeline will be constructed across Victoria Island using a conventional trench design. Because the conveyance pipeline likely will be installed below the groundwater table, the trench is designed to provide enough earthen cover over the pipe to counter any buoyant forces that may occur. The pipeline will be buried in a trench that would be excavated to maintain a minimum cover of five feet over the pipeline. The as-built surface elevation generally will match the original ground surface elevation.

Dewatering likely will be required for construction of the pipeline across Victoria Island. Discharge of dewatering water could be to land or to Old River. See "Borrow Areas" below regarding the placement of spoils from trenching operations.

b. *Pipeline Crossing Under Old River*

The pipeline would be installed under Old River using standard micro tunneling techniques. A large pit would be excavated on Byron Tract, west of the existing levee. A similar pit would be excavated on Victoria Island. One pit would operate as a launching pit while the other acts as a receiving pit, functioning as a drop shaft for the completed pipeline. The pit dimensions would be approximately 30 feet long by 15 feet wide by 80 feet deep. Once the new pipe is in place, concrete access vaults would be constructed within both the launching and receiving pits, prior to backfilling of the pits. The pipeline would be connected to the Old River Distribution System on Byron Tract using the same method described above for Victoria Island.

c. *Borrow Areas*

Borrow areas are sites where native materials are obtained for required construction activities. Borrow material would be required for both the construction of the setback levee and backfill for the pipeline trench. Approximately 140,000 to 170,000 cubic yards of borrow material would be required to construct the new setback levee. The amount of material needed for pipeline backfill depends on pipeline length, material, and depth of burial. An estimated 120,000 to 170,000 cubic yards of high-quality material would be required for the pipeline backfill. Depending on local soil conditions, this material may be available from the excavation of the pipeline trench itself, or may need to be borrowed from another location to backfill the pipeline. The excavation and backfill of the pipeline trench would result in a net excess of 20,000 to 60,000 cubic yards.

Preliminary soils data confirms that on-site soils are suitable for levee and pipeline backfill. Accordingly, an option for new embankment and trench fill would be to select native material obtained from Victoria Island. Based on preliminary field work, it is expected that select soils for the setback levee could be obtained by on-site shallow excavation (*e.g.*, "land leveling") to depths of approximately 1 to 1.5 feet in an area of up to 135 acres.

If on-site borrow activity is not used, the contractor would obtain borrow material from an off-site borrow location. The contractor typically would select a source of off-site borrow. Potential borrow areas have been identified within 20 miles of the project site.

d. *Construction Access and Staging*

Construction staging areas would be located on both Victoria Island and Byron Tract. Staging areas for construction parking and the temporary stockpiling of excavated soils and storage of construction equipment and materials are expected to occupy approximately 10 acres on Victoria Island. Pipeline materials (*e.g.*, piping, backfill material, and geogrids) would be stored along the pipeline route within the temporary easement. A smaller staging area would be located on Byron Tract.

e. *Construction Workforce, Equipment, and Schedule*

The total construction duration is estimated at 36 months. There would be overlap in the timing of construction of some of the components. Table 2 below, summarizes the duration of the major construction components.

At the construction sites, typical heavy construction equipment that may be used includes excavators, backhoes, bulldozers, scrapers, graders, sheepsfoot or tamping foot rollers, water trucks, a front-end loader, several dump trucks, a drill rig, a pump truck, truck-mounted cranes, pile drivers, pickup trucks, and other miscellaneous equipment.

Table 2. Anticipated duration of major construction components from the EIR/EIS.

Construction Phase	Anticipated Duration
Existing Victoria Canal Levee Improvements	6–8 months
New Victoria Canal Intake Structure/Fish Screen and Pump Station Installation	24 months
New Pipeline Installation	6–18 months
Old River Pipeline Crossing	7–9 months
New Pipeline Connection at the Existing Old River Pump Station	1 month
Total Construction Duration	36 months

It is anticipated that approximately 50 to 75 truck round trips would be required to transport the contractor's equipment to the site. A similar number of round trips would be needed to remove the equipment from the site as the work is completed. About 200 to 300 highway truck trips would be needed to bring the riprap to the site from the quarry of origin. An additional 1,000 to 1,500 trips would be needed to bring aggregate surfacing to the site from the quarry of origin. About 300 to 400 concrete loads, transported by transit mixer truck, are also likely. About 150 trailer truck loads would be required to bring other permanent materials, such as geogrid, fish screens, sheet piles, masonry, piping, structural steel, utility poles, and ancillary equipment, to the site. In addition, about 50 highway truckloads may be needed to carry construction debris and waste dump materials to a suitable landfill. If off-site borrow material is used to provide fill for the setback levee construction, up to an additional 11,500 trips may be needed. This would total about 14,000 total round trips during the construction period of approximately 30 to 36 months, or an average of about 15 round trips per day. The actual round trips per day during construction may range between 8 and 100 to meet specific construction sequencing needs. The construction labor force is estimated to average about 75 to 100 people over the total construction period. Peak staffing could be close to 125 people if major construction components are conducted simultaneously (*e.g.*, if the intake and the conveyance pipeline are constructed at the same time).

Typical construction would occur during daylight hours Monday through Friday. However, the construction contractor may extend the hours and may schedule construction work on weekends if necessary to complete aspects of the work within a given timeframe. An exception to the typical construction timing would be tunneling to install the pipeline under Old River, which would not depend on daylight and may be conducted around the clock.

C. Operations and Maintenance

CCWD currently delivers water using the three Delta intakes based on a goal of delivering water with chloride concentrations of 65 milligrams per liter (mg/l) or better to its untreated- and treated-water customers. With implementation of the proposed action, CCWD would have the flexibility to relocate some of its pumping from the existing Old River intake to the new location during certain periods of the year to obtain better water quality. In general, Old River water quality is best in late spring and early summer. Victoria Canal water quality is better than Old River water quality in late summer and fall.

The proposed action (*i.e.*, Alternative 3, Modified Operations in the EIS/EIR) would relocate a portion of the current Rock Slough pumping as well as some of the Old River pumping to the new intake on Victoria Canal. CCWD would immediately apply to change its permits to allow diversions of up to 320 cfs through the Old River conveyance system rather than in the future, as planned. Combined diversions from the 250 cfs Old River pump station and the proposed 250 cfs alternative intake would be limited to 320 cfs by the capacity of the pipeline connecting the Old River pump station to CCWD's transfer station that routes water either into Los Vaqueros Reservoir or the Contra Costa Canal. CCWD would not increase the average total annual quantity diverted from the Delta. This change would enable CCWD to relocate up to half of the currently unscreened Rock Slough diversions to the screened Old River conveyance system in the near-term. Rock Slough would continue to provide a portion of CCWD's water supply, but would be used less frequently under the proposed action because of the operational flexibility that would be provided by a new screened intake with better water quality. Mallard Slough intake would continue to provide a portion of CCWD's water supply in a manner similar to its current operations.

The pump station for the new intake on Victoria Canal would be operated similarly to the existing Old River pump station. The Old River pump station typically is operated remotely from the Bollman Water Treatment Plant but can be locally operated at the pump station itself. CCWD personnel sequentially start the Old River pumps to initiate diversion from Old River. The number of pumps operating at any given time depends on CCWD's flow requirements and diversion strategy. When the pump station is taken off line, the pumps are turned off and the wet well remains flooded.

Maintenance activities at the proposed new intake and pump station would be similar to maintenance activities currently conducted at the Old River pump station, including pump and equipment inspections and maintenance, water quality monitoring, and fish monitoring activities. Periodic maintenance dredging may also be required at the new intake facility. The existing Old River facility has not required any maintenance dredging to date, but an intake on Victoria Canal could experience different sedimentation conditions. Because the new pump station would be unstaffed, CCWD personnel would monitor the station via telemetry as well as through regular inspections.

Operation and maintenance activities will be necessary to maintain function of the fish screen and the pumping plant for the life of the facility. The fish screen structure will be constructed to permit vehicle access for screen panel removal and maintenance. The fish screen will be operated and maintained to reduce debris and sediment accumulation that will adversely affect the magnitude and uniformity of approach velocities by creating turbulence in front of the screen.

The fish screen will be mechanically cleaned using a traveling rake. The cleaning system will operate continuously to reduce and avoid accumulation of debris so that the screen operates in accordance with the approach velocity design criteria. Each screen panel will be removable to allow for annual pressure washing, cleaning and maintenance, as well as inspections of screen integrity. A portable, high pressure wash water system will be used for the panel cleaning. Screen panels will be removed annually (at a minimum) for inspection, repair, and high pressure washing. Back-up panels would be available on-site to replace screen panels that require maintenance or repair. A floating log-boom will be provided in Victoria Canal to deflect floating debris that may otherwise impinge on the screen, damage screen panels, or damage the traveling rake cleaning system.

The intake structure top elevation would be two feet higher than the 100 year floodwater surface elevation in Victoria Canal. The facility is designed to withstand flood events, with water draining naturally into the canal as flows recede.

D. Proposed Conservation Measures

Conservation measures incorporated into the project design to avoid or minimize impacts to listed species as described in Chapter 5 of the ASIP, include:

1. <u>Minimize Turbidity, Sedimentation, and Water Quality Impacts During Construction</u>

Turbidity will be monitored twice daily during the construction period while any visible plume exists in the surface waters to meet Central Valley Regional Water Quality Control Board (Regional Board) section 401 requirements, CDFG Streambed Alteration permit requirements, and U.S. Army Corps of Engineers (Corps) section 404 permit requirements. Water quality surveys will be conducted during the dredging operations and during installation/removal of the cofferdam to comply with the hazardous materials plan approved by the Regional Board for fish screen projects. To reduce turbidity in Victoria Canal during project-related construction activities, CCWD shall:

- Install a silt curtain to reduce the dissipation of suspended sediments during dredging and cofferdam installation, and

- Install and remove the cofferdam between August 1 and November 30 to avoid impacts to Chinook salmon, steelhead, and delta smelt unless modified by written agreement with NMFS, FWS, and CDFG.

Additionally, the AIP has integrated the following measures for dredging and spoil disposal:

- Monitor construction-related dredging activities, especially for any contaminated sediments and regularly report effects to NMFS. Re-evaluate activities based on monitoring results,

- Employ best engineering and best management practices (BMPs) for all project-related dredging to minimize water-column discharges,

- Consider upland disposal sites as an alternative to open water disposal. Dredged sediments removed during intake construction will be used on-site or disposed at an upland site,

- The discharge of petroleum products or other excavated materials to surface waters is prohibited,

- Project construction activities shall minimize substrate disturbances,

- Project construction activities shall not cause turbidity increases in surface waters as follows:

  Where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases will not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases will not exceed 20 percent. Where natural turbidity is between 50 and 100 NTUs, increase will not exceed 10 NTUs. Where natural turbidity is greater than 100 NTUs, increases will not exceed 10 percent. These limits will be eased during in-water working periods to allow a turbidity increase of 15 NTU over background turbidity as measured in surface waters 300 feet downstream from the working area. In determining compliance with above limits, appropriate averaging periods may be applied provided that beneficial uses would be protected,

- In the event that project construction activities create a visible plume in surface waters, CCWD will initiate monitoring of turbidity levels at the discharge site and 300 feet downstream, taking grab samples for analysis of NTU levels twice per day during the work period while the visible plume persists,

- Project construction activities will not cause settleable matter to exceed 0.1 milliliters per liter in surface waters as measured in surface waters 300 feet downstream from the project

- Project construction activities shall not cause visible oil, grease, or foam in the work area or downstream,

- All areas disturbed by project construction activities shall be protected from washout or erosion,

- CCWD shall notify the Regional Board, CDFG, FWS, and NMFS immediately of any spill of petroleum products, organic material, earthen material or if the above criteria for turbidity, oil/grease, or foam are exceeded,

- CCWD shall prepare a soil erosion control plan and stormwater pollution prevention plan prior to project grading and excavation activities to minimize potential construction-related silt from entering waterways. The plans would include, but would not be limited to the following measures:

    - Use of sedimentation basins and straw bales or other measures to trap sediment and prevent sediment and silt loads to waterways during project construction,

    - Cover graded areas adjacent to levees and in other areas subject to erosion with protective material, such as mulch, and re-seed with adapted native plant species after construction is completed,

    - Incorporate bank stabilization (riprap) into the project design on both the east and west sides of the intake to minimize channel margin erosion of soils into Victoria Canal. To the extent practicable, the aerial extent of riprap will be minimized and small (<8 inch diameter) riprap will be used for levee protection,

- Minimize construction-related surface disturbance of soil and vegetation and restore terrestrial habitats immediately after construction to the extent feasible,

- Place construction-related stockpiled soils where it would not be subject to accelerated erosion,

- Re-vegetate with grasses native to the Delta and placement of erosion control devices, such as crushed rock, as soon as graded area has attained finish grade,

- CCWD shall ensure a certified erosion control specialist or California-registered civil engineer prepare the plans. A project field manager would be responsible for monitoring and compliance. If needed, Regional Board staff would review the plans prior to project construction to verify that BMPs have been incorporated, and

- Effects associated with periodic maintenance dredging in front of the fish screen are not covered in these conservation measures, but would be addressed at such time in the future that maintenance dredging is needed, as recommended by CDFG.

2. Implement Measures to Reduce and/or Avoid Underwater Sound Impacts

Potential adverse impacts and incidental take of Sacramento River winter-run Chinook salmon (SR winter-run Chinook salmon), Central Valley spring-run Chinook salmon (CV spring-run Chinook salmon), Central Valley steelhead (CV steelhead), and North American green sturgeon shall be avoided by installing the sheet pile cofferdam using a vibration hammer that minimizes underwater sound pressure levels to the greatest extent feasible to minimize effects to sensitive fish species. Installation of the cofferdam is expected to occur during the designated in-water work window in the summer and early fall when water temperatures are generally considered unsuitable for salmonids. Chinook salmon and CV steelhead avoid habitats, including Victoria Canal, when seasonal water temperatures increase above 25 °C. Installation of the cofferdam using percussion hammers during the summer and early fall would reduce or avoid potential adverse effects to Chinook salmon and CV steelhead, but not green sturgeon, which rear year-round in the central and south Delta. Should percussion hammers be used, underwater acoustic monitoring will confirm that the sound pressure levels are below levels of concern. If underwater sound pressure levels due to pile driving exceed 180 decibels (dB), several methods can be used to reduce or minimize potential impacts to aquatic species, including:

- Reduce hammer drop height or force
- Use hammer buffers
- Use vibratory hammer
- Work at low tide or at times when flows in Victoria Canal are reduced

Once the cofferdam has been installed and dewatered, pile driving that is interior to the cofferdam would not be expected to result in adverse underwater sound pressure levels that would impact fish. The applicant has indicated that implementation of this measure would minimize otherwise adverse effects related to underwater sound pressure and reduce the risk of incidental take of listed fish species.

3. <u>Develop Hazardous Materials Control and Spill Prevention and Response Plan</u>

CCWD shall prepare and implement a hazardous materials control and spill prevention and response plan prior to start of construction. Measures that would be included in the plan to minimize construction-related effects will include the following:

- Establish a spill prevention and countermeasure plan before the commencement of project construction that includes strict on-site handling rules to keep construction and maintenance materials out of drainages and waterways,

- Prevent project-related raw cement, concrete, or concrete washings; asphalt, paint or other coating material; oil or other petroleum products; or other substances that could be hazardous to aquatic life from contaminating the soil or entering watercourses, including Victoria Canal,

- Clean up all project-related spills immediately according to the spill prevention and countermeasure plan, and notify Regional Board immediately of spills and clean up procedures,

- Locate staging and storage areas for construction equipment, materials, fuels, lubricants, solvents, and other possible contaminants away from watercourses,

- Conduct periodic inspections during the construction period, and

- FWS, NMFS, CDFG, and the Regional Board shall review the plan prior to construction to verify that hazardous material control and spill response measures have been incorporated to the maximum extent possible. FWS, NMFS, and CDFG shall have access to inspect construction activities to ensure compliance.

The implementation of a hazardous materials control and spill prevention and response plan prior to the start of construction should reduce the risk of incidental take of listed fish species related to potential chemical spills during construction.

4. Implement Fish Rescue Plan Inside Cofferdam

Installation of the cofferdam and dewatering of the proposed intake structure site during fish screen construction may result in fish stranding. CCWD will develop and implement a Fish Rescue Plan acceptable to CDFG, FWS, and NMFS (see draft Fish Rescue Plan included as Appendix B). CCWD shall ensure that a qualified fishery biologist with a current CDFG collection permit conducts the fish rescue and relocation efforts behind the cofferdam. The fish rescue effort would be implemented during the dewatering of the area behind the cofferdam and would involve capture and return of those fish to suitable habitat within Victoria Canal. A fisheries biologist shall be present on-site during initial pumping (dewatering) to ensure compliance with the plan.

- CCWD shall monitor the progress of dewatering and allow for the fish rescue to occur prior to completely closing the cofferdam and again when water depths reach approximately 2 feet. FWS, NMFS, and CDFG shall be notified at least 48 hours prior to the start of fish rescue efforts. Information on the species, number, and sizes of fish collected would be recorded during the fish rescue and provided in a letter report to be submitted within 30 days after the fish rescue to FWS, NMFS, and CDFG.

- The Fish Rescue Plan developed as part of the ASIP shall contain methods for minimizing the risk of stress and mortality due to capture and handling of fish removed from the construction site and returned to Victoria Canal.

Implementation of the Fish Rescue Plan would minimize potential adverse effects to listed fish species (if present), associated with fish stranding during dewatering activities related to the construction of the AIP.

5. Compensate for the Permanent Loss of Critical Habitat at Victoria Canal Intake Site

Construction of the proposed intake structure and fish screen in Victoria Canal would result in the modification of shallow-water aquatic habitat estimated as follows (Note that the areas of habitat modifications have been reduced from those estimated in the ASIP due to design improvements based on input from the AFSP Technical Team.):

- 0.3 acre of existing riprap shallow water tidal freshwater emergent habitat along the existing shoreline of the levee would be replaced by 0.3 acre of new riprap habitat immediately in front of the fish screen and along each side of the fish screen along the existing levee,

- 0.3 acre of shallow-water tidal freshwater emergent habitat presumed to be earthen bottom would be replaced by 0.3 acre of new riprap habitat,

- 0.2 acre of shallow-water tidal freshwater emergent habitat presumed to be earthen bottom would be excavated to a depth of 10 to 15 feet deeper than existing, but would retain the same substrate characteristics. The resulting new depth would not constitute shallow-water habitat but would provide habitat complexity in the existing channel, and

- 0.2 acre of existing riprap shallow water tidal freshwater emergent habitat along the existing shoreline of the levee would be replaced by 0.2 acre of modified levee section.

These habitats that are being replaced or modified are considered marginal, low-quality habitats for CV steelhead and Chinook salmon. They are classified as shallow-water tidal freshwater emergent habitat based on physical characteristics that could potentially support emergent vegetation; however, the intake has been sited to avoid existing emergent vegetation to the degree possible. CCWD would mitigate for these existing habitats with high-quality emergent marsh habitat at an approved mitigation/conservation bank. The purchased mitigation habitat would be for emergent marsh habitat that is far superior to the habitat being disturbed in Victoria Canal. The amount of mitigation, determined in consultation with NMFS, FWS, and CDFG is calculated as follows:

- 0.3 acre – no mitigation is necessary as the existing habitat would not be modified in a manner that adversely affects available habitat in Victoria Canal. The existing riprap would be replaced with similarly sized riprap.

- 0.3 acre – a 3:1 mitigation ratio is used because a presumed earthen bottom is being replaced with riprap. Over time, the riprap will quickly silt over and be replaced by a natural earthen bottom in the long-term. CCWD would purchase 0.9 acre of shallow-water emergent marsh habitat at an approved mitigation bank.

- 0.2 acre – a 3:1 mitigation ratio is used because the shallow-water habitat would be replaced with open-water habitat. CCWD would purchase 0.6 acre of shallow-water emergent marsh habitat at an approved mitigation bank.

- 0.2 acre – a 3:1 mitigation ratio is used because the shallow-water habitat would be replaced with a modified levee section. CCWD would purchase 0.6 acre of shallow-water emergent marsh habitat at an approved mitigation bank.

To fully compensate for physical habitat modifications (*i.e.*, critical habitat as defined by NMFS is applicable for CV steelhead only in this area) at the Victoria Canal intake site, CCWD will purchase mitigation credits for a total of 2.1 acres of shallow-water emergent marsh aquatic habitat. With this measure, there is no loss in aquatic habitat associated with the AIP.

CCWD considered several other potential measures for bank stabilization including: (1) incorporating a floodplain terrace or bench, (2) use of smaller rock less than 8 inches in diameter for riprap, (3) covering riprap with soil and planting with willows, and (4) designing bank slopes greater than a 3:1 ratio. These measures are not consistent with the design standards for levees in Reclamation District (RD) 2040 and could compromise levee integrity. Based on input from the RD 2040 engineer these measures were eliminated from further consideration. CCWD did remove the concrete apron, originally proposed as part of the project design, in order to minimize effects on habitat.

Application of the Standard Assessment Methodology (SAM) developed by the Corps for quantifying habitats and fish behavior on modified riprapped banks was not applicable because the site-specific hydraulic characteristics would be substantially changed, and this methodology has not been used to evaluate conditions at fish screens and water intakes in the Delta.

6. Minimize Fish Entrainment and Impingement at the New Victoria Canal Intake

As part of the proposed action, CCWD would install a state-of-the-art positive barrier fish screen that would minimize fish entrainment and impingement at the new Victoria Canal intake. To insure compliance with the ESA, long-term monitoring of operations and maintenance of the fish screen will be conducted. Monitoring at the onset of water diversions through the Victoria Canal intake would include approach velocity measurements immediately after initiation of fish screen operations, with fine-tuning of velocity control baffles or other modifications as necessary, to achieve uniformity of velocities in conformance with fish screen criteria (*i.e.*, 0.2 fps). Long-term velocity tests would be scheduled for 5-year intervals, similar to monitoring requirements at the Old River Fish Screen Facility.

CCWD will monitor the condition of the fish screen on an annual basis for as long as diversions are occurring at Victoria Canal. Visual inspections will be conducted monthly, during periods of operation, to remove accumulated debris and repair screen panels as necessary. NMFS, FWS, and CDFG will have access to the fish screen for underwater inspections following completion of the construction period. The standards for success will be long-term reliable operation of the fish screen, and conformance with fish screen design criteria.

- CCWD will operate the proposed Victoria Canal intake consistent with the existing Los Vaqueros Project Biological Opinion operational restrictions on filling Los Vaqueros Reservoir, and diverting Delta water, and any future changes to that opinion.

- CCWD will incorporate entrainment monitoring for fish eggs, larvae, and juveniles at the Victoria Canal Intake consistent with the on-going fishery monitoring program being conducted at the Old River Fish Facility. Entrainment monitoring will be conducted at least for the first year of operation. Following one year of monitoring, CCWD will issue a performance report within 60 days to NMFS, FWS, and CDFG as a cumulative record of monitoring and communications with the regulatory agencies. Using the results from the one year of monitoring, CCWD will recommend continuation, modification, or discontinuation of the monitoring program. At that time an assessment will be made by NMFS, FWS, and CDFG on whether further sampling is necessary, or should be integrated with the current Old River intake sampling.

Implementation of a positive barrier fish screen, designed to meet lower approach velocities than required for salmonids (*i.e.*, 0.2 fps rather than 0.33 fps), will minimize adverse effects and the risk of incidental takes related to fish losses through entrainment and impingement.

E. Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The immediate action area, for the purposes of this biological opinion, is located along the southern and western portion of Victoria Island, and 1,000 feet upstream and downstream of the proposed site within Victoria Canal (see Appendix, Figure 2a). Additional areas of impact, based on modeling related to changes in the hydrology and water quality characteristics of instream flows, include: CCWD's Old River Intake, Mallard Slough Intake, Rock Slough Intake, those reaches of rivers below state and Federal water supply reservoirs, and in the conveyance channels leading to the state and Federal water diversions facilities in the south Delta. Project related operations and maintenance activities could extend to any affected aquatic areas within the Sacramento-San Joaquin Delta region, especially near CCWD's three water intakes. Small indirect effects of project operations as modeled could extend as far upstream as the CVP and State Water Project (SWP) reservoirs. Therefore, all listed salmonid populations in the Central Valley have the potential to experience the effects of the proposed AIP during their movements in the Delta and mainstems of the Sacramento and San Joaquin Rivers.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

NMFS recently has completed an updated status review of 16 salmon Evolutionarily Significant Units (ESUs), including Sacramento River winter-run Chinook salmon and Central Valley (CV) spring-run Chinook salmon, and concluded the species' status should remain as previously listed (70 FR 37160). On January 5, 2006, NMFS published a final listing determination for 10 steelhead Distinct Population Segments (DPSs), including CV steelhead (71 FR 834). The new listing determinations became effective on February 6, 2006, and concluded that CV steelhead will remain listed as threatened.

This biological opinion analyzes the effects of the proposed AIP on the following threatened and endangered species and designated critical habitat:

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
endangered (June 28, 2005, 70 FR 37160)
Sacramento River winter-run Chinook salmon designated critical habitat
(June 16, 1993, 58 FR 33212)
CV spring-run Chinook salmon ESU (*O. tshawytscha*)
threatened (June 28, 2005, 70 FR 37160)
CV spring-run Chinook salmon designated critical habitat
(September 2, 2005, 70 FR 52488)
CV steelhead DPS (*O. mykiss*)
threatened (January 5, 2006, 71 FR 834)
CV steelhead designated critical habitat
(September 2, 2005, 70 FR 52488)
Southern DPS of North American green sturgeon (*Acipenser medirostris*)
threatened (April 7, 2006, 71 FR 17757)

A. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

1. Sacramento River winter-run Chinook salmon

Sacramento River winter-run Chinook salmon were first listed as threatened in August 1989 (54 FR 32085). Their status was reclassified as endangered in January 1994 (59 FR 440) due to continued decline and increased variability of run sizes since their listing as a threatened species, expected weak returns as a result of two small year classes in 1991 and 1993, and continued threats to the population. In the proposed rule to reclassify the winter-run Chinook salmon as endangered, NMFS recognized that the population had dropped nearly 99 percent between 1966 and 1991, and despite conservation measures to improve habitat conditions, the population continued to decline (57 FR 27416). In June 2004, NMFS proposed to reclassify Sacramento River winter-run Chinook salmon as threatened (69 FR 33102). This determination was based on three main points: (1) harvest and habitat conservation efforts have increased the abundance and productivity of the ESU over the past decade; (2) artificial propagation programs that are part of the ESU, the Captive Broodstock Programs at Livingston Stone National Fish Hatchery (LSNFH) and at the University of California Bodega Marine Laboratory contribute to the ESU's viability; and (3) ecosystem restoration plans underway in Battle Creek should provide the opportunity to establish a second winter-run Chinook salmon population. However, on June 28, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of Sacramento River winter-run Chinook salmon as endangered (70 FR 37160). This decision was based on the continued threats to Sacramento River winter-run Chinook salmon and the continued likelihood of this ESU becoming extinct throughout all or a significant portion of its range. A draft recovery plan was published in August 1997 (NMFS 1997a).

Winter-run Chinook salmon historically spawned in the headwaters of the McCloud, Pit, and Little Sacramento Rivers and Hat and Battle Creeks. Construction of Shasta Dam in 1943 and Keswick Dam in 1950 blocked access to all of these waters except Battle Creek, which has been severely impacted by hydroelectric facilities and the Coleman National Fish Hatchery (Moyle *et al.* 1989, NMFS 1997a). The majority of the current winter-run Chinook salmon spawning and rearing habitat exists on the mainstem Sacramento River between Keswick Dam and Red Bluff Diversion Dam (RBDD). Although a small, unknown, number of winter-run Chinook salmon occasionally spawn in Battle and Clear Creeks, the ESU is widely considered to be reduced to a single naturally spawning population in the mainstem Sacramento River below Keswick Dam.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. This initial recovery was followed by a steady decline from 1969 through the late 1980s (FWS 1999).

Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past RBDD from mid-December through early August (NMFS 1997a). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). Generally, winter-run Chinook salmon spawn from near Keswick dam downstream to Red Bluff, California. The largest concentrations of spawning fish occur in the first five to ten miles below Keswick Dam. Spawning occurs from late April through mid-August with peak activity between May and June. Eggs and pre-emergent fry require water temperatures at or below 56 °F for maximum survival during the spawning and incubation period (FWS 1999). Fry emerge from mid-June through mid-October and move to river margins and tributary streams to rear. Emigration past RBDD may begin in mid-July and typically peaks in September and can continue through March in dry years (Vogel and Marine 1991, NMFS 1997a, FWS 1999). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001).

Construction of RBDD in 1966 enabled improved accuracy of population estimates as salmon passed through fish ladders. From 1967 to 2000, winter-run Chinook salmon estimates were extrapolated from adult ladder counts at RBDD. Recent operational changes at RBDD have allowed a majority of the winter-run Chinook salmon population to bypass the ladders and counting facilities, and have increased the error associated with extrapolating the population estimate. In order to reduce the error associated with estimating the run, carcass counts replaced the ladder counts beginning in 2001.

Since 1967, the estimated adult winter-run Chinook salmon population ranged from 186 in 1994 to 117,808 in 1969 (CDFG 2002). The estimate declined from an average of 86,000 adults in 1967-1969 to only 2,000 by 1987-1989, and continued downward to an average 830 fish in 1994-1996. Since then, estimates have increased to an average of 3,136 fish for the period of 1998-2001. Winter-run abundance estimates and cohort replacement rates since 1986 are shown in Table 3. Although the population estimates display broad fluctuation since 1986 (186 in 1994 to 17,205 in 2006), there has been an increasing trend in the average population since 1995, and a generally stable trend in the five-year moving average of cohort replacement rates. The 2006 run was the highest since 1981, when an estimated 20,041 adults passed RBDD.

Table 3. Winter-run Chinook salmon population estimates from RBDD ladder counts, and corresponding cohort replacement rates for years since 1986. Population estimates include both adult and grilse. Source: CDFG 2006, Grand Tab.

Year	Population Estimate	5-Year Moving Average of Population Estimate	Cohort Replacement Rate	5-Year Moving Average of Cohort Replacement Rate
1986	2,596	-	-	-
1987	2,186	-	-	-
1988	2,886	-	-	-
1989	697	-	0.3	-
1990	431	1,759	0.2	-
1991	211	1,282	0.1	-
1992	1,241	1,093	1.8	-
1993	387	593	0.9	0.6
1994	186	491	0.9	0.8
1995	1,297	664	1.1	0.9
1996	1,337	890	3.5	1.6
1997	880	817	4.7	2.2
1998	3,002	1,340	2.3	2.5
1999	3,288	1,961	2.5	2.8
2000	1,352	1,972	1.5	2.9
2001*	8,224	2,809	2.7	2.7
2002	7,464	4,467	2.3	2.3
2003	8,218	5,818	6.0	3.0
2004	7,869	6,625	0.9	2.7
2005	15,839	9,522	2.1	2.8
2006	17,205	11,319	2.0	2.6

* In 2001 estimates changed from RBDD ladder counts to carcass surveys

2. <u>Central Valley Spring-Run Chinook Salmon</u>

NMFS listed the CV spring-run Chinook salmon ESU as threatened on September 16, 1999 (64 FR 50394). In June 2004, NMFS proposed that CV spring-run Chinook salmon remain listed as threatened (69 FR 33102). This proposal was based on the recognition that although CV spring-run Chinook salmon productivity trends are positive, the ESU continues to face risks from having a limited number of remaining metapopulations (*i.e.*, 3 existing populations from an estimated 17 historical populations), a limited geographic distribution, and potential hybridization with Feather River Hatchery (FRH) spring-run Chinook salmon, which until recently were not included in the ESU and are genetically divergent from other metapopulations in Mill, Deer, and Butte Creeks. On June 28, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of CV spring-run Chinook salmon as threatened (70 FR 37160). This decision included the FRH spring-run Chinook salmon population as part of the CV spring-run Chinook salmon ESU.

The decision to include the FRH population was based on several factors: (1) FRH spring-run Chinook salmon are no more divergent from the naturally spawning population in the Feather River than would be expected between two closely related populations in the ESU; (2) NMFS believes the early run timing of spring-run Chinook salmon in the Feather River represents the evolutionary legacy of the populations that once spawned above Oroville Dam, and that the extant population in the Feather River may be the only remaining representative of this ESU component; (3) the California Department of Water Resources (CDWR) is planning to construct a weir to create geographic isolation for spring-run Chinook in the Feather River to minimize future hybridization with fall-run Chinook salmon, and to preserve the early run timing phenotype; and (4) the FRH population may play an important role in the recovery of spring-run Chinook salmon populations in the Feather and Yuba Rivers.

Historically, spring-run Chinook salmon were the dominant run in the Sacramento River basin, occupying the middle and upper elevation reaches (1,000 to 6,000 feet) of most streams and rivers with sufficient habitat for over-summering adults (Clark 1929). Clark estimated that there were 6,000 miles of salmon habitat in the Central Valley basin (much of which was high elevation spring-run Chinook salmon habitat) and that by 1928, 80 percent of this habitat had been lost. Yoshiyama *et al.* (1996) determined that, historically, there were approximately 2,000 miles of salmon habitat available prior to dam construction and mining and that only 18 percent of that habitat remains.

Adult CV spring-run Chinook salmon enter the Delta from the Pacific Ocean beginning in January and enter their natal streams from March to July. In Mill Creek, Van Woert (1964) noted that of 18,290 adult CV spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30.

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows also are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 °F to 56 °F (Bell 1991, CDFG 1998).

Upon entering freshwater, spring-run Chinook salmon are sexually immature and must hold in cold water for several months to mature. Typically, spring-run Chinook salmon utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering. Spring-run Chinook salmon also may utilize tailwaters below dams if cold-water releases provide suitable habitat conditions. Spawning occurs between

September and October and, depending on water temperature, emergence occurs between November and February.

CV spring-run Chinook salmon emigration is highly variable, some begin outmigrating soon after emergence, whereas others oversummer and emigrate as yearlings with the onset of increased fall storms (CDFG 1998). The emigration period for CV spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year (YOY) outmigrants passing through the lower Sacramento River/Delta between mid-November and early January (Snider and Titus 2000). Outmigrants also are known to rear in non-natal tributaries to the Sacramento River and the Delta (CDFG 1998).

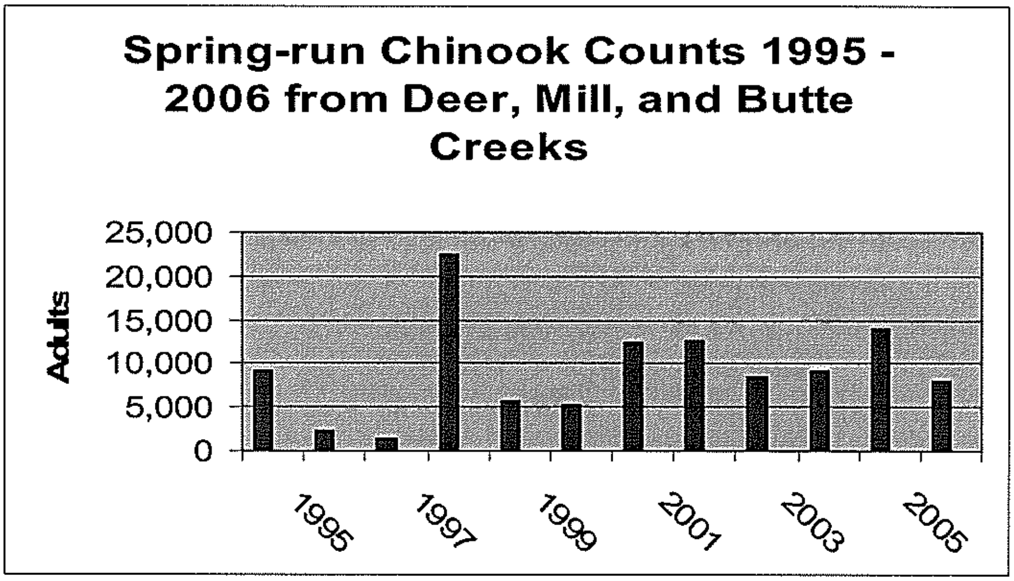
Chinook salmon spend between 1 and 4 years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998). Fisher (1994) reported that 87 percent of Chinook salmon trapped and examined at RBDD between 1985 and 1991 were 3-year olds.

Spring-run Chinook salmon were once the most abundant run of salmon in the Central Valley (Campbell and Moyle 1992) and were found in both the Sacramento and San Joaquin drainages. More than 500,000 CV spring-run Chinook salmon were caught in the Sacramento-San Joaquin commercial fishery in 1883 alone (Yoshiyama *et al.* 1998). The San Joaquin populations were essentially extirpated by the 1940s, with only small remnants of the run that persisted through the 1950s in the Merced River (Hallock and Van Woert 1959, Yoshiyama *et al.* 1998). Populations in the upper Sacramento, Feather, and Yuba Rivers were eliminated with the construction of major dams during the1950s and 1960s. Naturally spawning populations of CV spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Mill Creek, Feather River, and the Yuba River (CDFG 1998).

Since 1969, the CV spring-run Chinook salmon ESU has displayed broad fluctuations in abundance, ranging from 1,403 in 1993 to 25,890 in 1982 (CDFG 2003). The average abundance for the ESU was 12,590 for the period of 1969 to 1979, 13,334 for the period of 1980 to 1990, and 6,554 from 1991 to 2001. Evaluating the abundance of the ESU as a whole, however, complicates trend detection. For example, although the mainstem Sacramento River population appears to have undergone a significant decline, the data are not necessarily comparable because coded wire tag (CWT) information gathered from fall-run Chinook salmon returns since the early 1990s has resulted in adjustments to ladder counts at RBDD that have reduced the overall number of fish that are categorized as CV spring-run Chinook salmon.

Sacramento River tributary populations in Mill, Deer, and Butte Creeks are probably the best trend indicators for the CV spring-run Chinook ESU as a whole. These streams have shown positive escapement trends since 1991. Recent escapements to Butte Creek, including 20,259 in 1998, 9,605 in 2001 and 8,785 in 2002 (CDFG 2002, 2003), represent the greatest proportion of the ESU's abundance. Although recent trends are positive (Figure 1), annual abundance estimates display a high level of fluctuation, and the overall number of CV spring-run Chinook salmon remains well below estimates of historic abundance. Additionally, in 2003, high water temperatures, high fish densities, and an outbreak of Columnaris Disease (*Flexibacter Columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis*) contributed to the pre-spawning mortality of an estimated 11,231 adult spring-run Chinook salmon in Butte Creek. Because the CV spring-run Chinook salmon ESU is confined to relatively few remaining streams; continues to display broad fluctuations in abundance; and a large proportion of the population (*i.e.*, in Butte Creek) faces the risk of high mortality rates, the population is at a moderate to high risk of extinction.

Figure 1. Recent CV spring-run Chinook abundance for 3 independent populations combined.



3. Central Valley Steelhead

NMFS listed CV steelhead as threatened on March 19, 1998 (63 FR 13347). The ESU includes all naturally produced CV steelhead in the Sacramento-San Joaquin River basin. On September 2, 2005, NMFS designated critical habitat for CV steelhead in areas of the central and south Delta including Victoria Canal (70 FR 52488). Based on policy review and shared jurisdiction with FWS over resident forms of *O. mykiss*, NMFS adopted DPS criteria instead of ESUs for steelhead. On January 5, 2006, NMFS issued final determinations on 10 West Coast steelhead populations and concluded that CV steelhead should remain listed as threatened (71 FR 834).

NMFS Pacific Salmonid Biological Review Team (BRT) reviewed the viability and extinction risks of the 10 steelhead DPSs (Good *et al.* 2005). The BRT concluded that the contribution of the resident life-history form is unknown and may not substantially reduce extinction risks. In the final rule two artificial propagation programs were considered to be part of the CV steelhead

DPS; the Coleman National Fish Hatchery, and the FRH steelhead programs.

All steelhead stocks in the Central Valley are considered to be winter-run steelhead (McEwan and Jackson 1996). Steelhead are similar to other Pacific salmon in their life-history requirements. They are born in freshwater, emigrate to the ocean, and return to freshwater to spawn. However, unlike other Pacific salmon, steelhead are capable of spawning more than once before they die.

The majority of the CV steelhead spawning migration occurs from October through February and spawning occurs from December to April in streams with cool, well oxygenated water that is available year-round. Van Woert (1964) and Harvey (1995) observed that in Mill Creek, the CV steelhead migration is continuous, and although there are two peak periods, 60 percent of the run is passed by December 30. Similar bimodal run patterns have also been observed in the Feather River and the American River (Hannon and Deason 2005).

Incubation time is dependent upon water temperature. Eggs incubate for 1.5 to 4 months before emerging. Eggs held between 50 °F and 59 °F hatch within 3 to 4 weeks (Moyle 1976). Fry emerge from redds within about 4 to 6 weeks depending on redd depth, gravel size, siltation, and temperature (Shapovalov and Taft 1954). Newly emerged fry move to shallow stream margins to escape high water velocities and predation (Barnhart 1986). As fry grow larger they move into riffles and pools and establish feeding locations. Juveniles rear in freshwater for one to four years (Meehan and Bjornn 1991) emigrating episodically from natal streams during fall, winter and spring high flows. Steelhead typically spend 2 years in freshwater. Adults spend 1 to 4 years at sea before returning to freshwater to spawn as 4 or 5-year olds (Moyle 1976).

Steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems south to the Kings and possibly the Kern River systems and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles. The California Fish and Wildlife Plan (CDFG 1965) estimated there were 40,000 steelhead in the early 1950s. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River.

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998-2001 to estimate that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the latest status review of West Coast salmon and steelhead (Good *et al.* 2005), the BRT calculated the following estimates of steelhead juveniles based on midwater trawling data from Chipps Island (Table 4).

Table 4. Estimated natural production of CV steelhead (Good *et al.* 2005).

				Wild female spawners		
Year	**C_w/C_h[a]**	**Hatchery**	**Natural**	**1% ESS**	**5% ESS**	**10% ESS**
1998	0.300	1,120,000	336,000	6,720	1,344	672
1999	0.062	1,510,000	94,000	1,872	374	187
2000	0.083	1,380,000	115,000	2,291	458	229
Average	0.148	1,340,000	181,000	3,628	726	363

[a] C_w/C_h = ratio of unclipped wild to clipped hatchery steelhead
ESS = egg-to-smolt survival

From the calculations in Table 4, the BRT made the following conclusion:

> "It appears that about 100,000-300,000 steelhead juveniles (roughly, smolts) are produced naturally each year in the Central Valley. If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s."

Existing wild steelhead stocks in the Central Valley mostly are confined to upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks, and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). The only consistent data available on wild steelhead numbers in the San Joaquin River basin come from CDFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate a decline in steelhead numbers in the early 1990s, which have remained low through 2002 (CDFG 2003). Typically, in most years less than 12 steelhead smolts are observed in the Mossdale trawl (CDFG, unpublished data).

Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other streams previously thought to be devoid of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al.* 2000). After 5 years of operating a fish counting weir on the Stanislaus River only nine adult steelhead have been observed moving upstream, although several large rainbow trout have washed up on the weir in late winter (Cramer 2007). It has been shown that steelhead will spawn with resident *O. mykiss* populations, where naturally occuring steelhead populations are non-existent, creating a polymorphic population that may be necessary for long-term survival (McEwan 2001).

Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced Rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread, if not abundant, throughout accessible streams and rivers in the Central Valley (Good *et al.* 2005).

Reliable estimates of CV steelhead abundance for different basins are not available (McEwan 2001); however, McEwan and Jackson (1996) estimate the total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults. Steelhead counts at the RBDD have declined from an average of 11,187 adults for the period of 1967 to 1977, to an average of approximately 2,000 adults through the early 1990s (McEwan and Jackson 1996, McEwan 2001).

Both the BRT (Good *et al.* 2005) and the Artificial Propagation Evaluation Workshop (69 FR 33102) concluded that the CV steelhead DPS presently is "in danger of extinction". CV steelhead have been extirpated from most of their historical range in this region. Habitat concerns in the Central Valley focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, and water allocation problems. Widespread hatchery steelhead production within this DPS also raises concerns about the potential ecological interactions between introduced stocks and native stocks. Because the CV steelhead population has been fragmented into smaller isolated tributaries without any large source population and the remaining habitat continues to be degraded by water diversions, the population remains at an elevated risk for future population declines.

4. <u>North American Green Sturgeon</u>

The Southern DPS of North American green sturgeon was listed by NMFS as threatened on April 7, 2006 (71 FR 17757). The final rule became effective on July 6, 2006. The southern DPS of North American green sturgeon consists of only one known spawning population in the Sacramento River from Keswick Dam to GCID (Israel *et al.* 2004). Estimates of spawning green sturgeon above RBDD ranged from 30 adults in 2002 to 124 in 2006 (Israel 2006). Assuming 50 percent passage at RBDD (Hueblin 2006), approximately 142 adults may spawn every year and assuming green sturgeon return every five years to spawn there, a maximum of 712 adults may exist in the Southern DPS (Adams, et al. 2006). Critical habitat for the southern DPS of North American green sturgeon has not yet been designated.

a. *General Life History*

North American green sturgeon have morphological characteristics of both cartilaginous fish and bony fish. The fish has some morphological traits similar to sharks, such as a cartilaginous skeleton, heterocercal caudal fin, spiracles, spiral valve intestine, electro-sensory pores on its snout and an enlarged liver. However, like more modern teleosts, it has five gill arches contained within one branchial chamber, covered by one opercular plate and a functional swim bladder for bouyancy control. Adult green sturgeon have a maximum fork length of 2.3 meters and 159 kg body weight (Miller and Lea 1972, Moyle *et al.* 1992). It is believed that green sturgeon can live at least 60 years, based on data from the Klamath River (Emmett *et al.* 1991).

The green sturgeon is the most widely distributed of the *acipenseridae*. They are amphi-Pacific and circumboreal, ranging from the inshore waters of Baja California northwards to the Bering Sea and then southwards to Japan. They have been recorded from at least six different countries: Mexico, United States, Canada, Russia (Sakhalin Island), Japan, and Korea (Emmett *et al.* 1991, Moyle *et al.* 1992). Although widely distributed, they are not very abundant in comparison to the sympatric white sturgeon (*Acipenser transmontanus*).

In North America, spawning populations of green sturgeon currently are found in only three river systems: the Sacramento and Klamath Rivers in California and the Rogue River in southern Oregon. Spawning has only been reported in one Asian river, the Tumin River in eastern Asia. Green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. Data from commercial trawl fisheries and tagging studies indicate that the green sturgeon occupy waters within the 110 meter contour (NMFS 2005a). During the late summer and early fall, subadults and nonspawning adult green sturgeon frequently can be found aggregating in estuaries along the Pacific coast (Emmett *et al.* 1991). Particularly large concentrations occur in the Columbia River estuary, Willapa Bay, and Grays Harbor, with smaller aggregations in San Francisco and San Pablo Bays (Emmett *et al.* 1991, Moyle *et al.* 1992, Beamesderfer *et al.* 2004). Recent acoustical tagging studies on the Rogue River (Erickson *et al.* 2002) have shown that adult green sturgeon will hold for as much as 6 months in deep (> 5m), low gradient reaches or off channel sloughs or coves of the river during summer months when water temperatures were between 15 °C and 23 °C. When ambient temperatures in the river dropped in autumn and early winter (<10 °C) and flows increased, fish moved downstream and into the ocean.

Adult green sturgeon in the Delta are believed to feed primarily upon benthic invertebrates such as clams, mysid and grass shrimp, and amphipods (Radtke 1966). Adult sturgeon caught in Washington state waters were found to have fed on Pacific sand lance (*Ammodytes hexapterus*) and callianassid shrimp (Moyle *et al.* 1992).

Adult green sturgeon are gonochoristic (sex genetically fixed), oviparous, and iteroparous. They are believed to spawn every 3 to 5 years and reach sexual maturity only after several years of growth (10 to 15 years based on sympatric white sturgeon sexual maturity). Younger females may not spawn the first time they undergo oogenesis and subsequently they reabsorb their gametes. Adult female green sturgeon produce between 60,000 and 140,000 eggs, depending on body size, with a mean egg diameter of 4.3 mm (Moyle *et al.* 1992, Van Eenennaam *et al.* 2001). They have the largest egg size of any sturgeon, and the volume of yolk ensures an ample supply of energy for the developing embryo. The eggs themselves are slightly adhesive, much less so than the sympatric white sturgeon, and are more dense than than those of white sturgeon (Kynard *et al.* 2005). Adults begin their upstream spawning migrations into freshwater in late February with spawning occuring between March and July. Peak spawning is believed to occur between

April and June in deep, turbulent, mainstem channels over large cobble and rocky substrates with crevices and interstices. Females broadcast spawn their eggs over this substrate, and the fertilized eggs sink into the interstices of the substrate where they develop further (Kynard *et al.* 2005).

Green sturgeon larvae hatched from fertilized eggs after approximately 169 hours at a water temperature of 15 °C (Van Eenennaam *et al.* 2001, Deng *et al.* 2002), which is similar to the sympatric white sturgeon development rate (176 hours). Studies conducted at the University of California, Davis by Van Eenennaam *et al.* (2005) indicated that an optimum range of water temperature for egg development ranged between 14 °C and 17 °C. Temperatures over 23 °C resulted in 100 percent mortality of fertilized eggs before hatching. Eggs incubated at water temperatures between 17.5 °C and 22 °C resulted in elevated mortalities and an increased occurrence of morphological abnormalities in those eggs that did hatch. At incubation temperatures below 14 °C, hatching mortality also increased significantly, and morphological abnormalities increased slightly, but not statistically so.

Newly hatched green sturgeon are approximately 12.5 to 14.5 mm in length and have a large ovoid yolk sac that supplies nutritional energy until exogenous feeding occurs. The larvae are less developed in their morphology than older juveniles and external morphology resembles a "tadpole" with a continuous fin fold on both the dorsal and ventral sides of the caudal trunk. The eyes are well developed with differentiated lenses and pigmentation.

Olfactory and auditory vesicles are present while the mouth and respiratory structures are only shallow clefts on the head. At 10 days of age, the yolk sac has become greatly reduced in size and the larvae initiates exogenous feeding through a functional mouth. The fin folds have become more developed and formation of fin rays begins to occur in all fin tissues. By 45 days of age, the green sturgeon larvae have completed their metamorphosis, which is characterized by the development of dorsal, lateral, and ventral scutes, elongation of the barbels, rostrum, and caudal peduncle, reabsorption of the caudal and ventral fin folds, and the development of fin rays. The juvenile fish resembles the adult form, including the dark olive coloring, with a dark mid-ventral stripe (Deng *et al.* 2002).

Green sturgeon larvae do not exhibit the initial pelagic swim–up behavior characteristic of other *acipenseridae*. They are strongly oriented to the bottom and exhibit nocturnal activity patterns. After 6 days, the larvae exhibit nocturnal swim-up activity (Deng *et al.* 2002) and nocturnal downstream migrational movements (Kynard *et al.* 2005). Juvenile fish continue to exhibit nocturnal behavior beyond the metamorphosis from larvae to juvenile stages. Kynard *et al.* (2005) laboratory studies indicated that juvenile fish continued to migrate downstream at night for the first 6 months of life. When ambient water temperatures reached 8 °C, downstream migrational behavior diminished and holding behavior increased. This data suggests that 9 to 10 month old fish would hold over in their natal rivers during the ensuing winter following hatching, but at a location downstream of their spawning grounds. The most important food of juvenile green sturgeon caught in the Delta appears to be amphipods such as Corophium and

Neomysis based on fish caught in the spring and summer (Radtke 1966).

Green sturgeon juveniles tested under laboratory conditions had optimal bioenergetic performance (*i.e.*, growth, food conversion, swimming ability) between 15 °C and 19 °C under either full or reduced rations (Mayfield and Cech 2004). This temperature range overlaps the egg incubation temperature range for peak hatching success previously discussed. Ambient water temperature conditions in the Rogue and Klamath River systems range from 4 °C to approximately 24 °C. The Sacramento River has similar temperature profiles, and, like the previous two rivers, is a regulated system with several dams controlling flows on its mainstem (Shasta and Keswick dams), and its tributaries (Whiskeytown, Oroville, Folsom, and Nimbus dams).

Larval and juvenile green sturgeon are subject to predation by both native and introduced fish species. Smallmouth bass (*Micropterus dolmoides*) have been recorded on the Rogue River as preying on juvenile green sturgeon, and prickly sculpin (*Cottus asper*) have been shown to be an effective predator on the larvae of sympatric white sturgeon (Gadomski and Parsley 2005). This latter study also indicated that the lowered turbidity found in tailwater streams and rivers due to dams increased the effectiveness of sculpin predation on sturgeon larvae under laboratory conditions.

b. *Population Trends –Southern population of North American Green Sturgeon*

Known historic and current spawning occurs only in the Sacramento River (Adams *et al.* 2002, 2006; Beamesderfer *et al.* 2004, Heublein *et al.* 2006). Currently, upstream migrations of sturgeon are halted by Keswick and Shasta Dams on the mainstem of the Sacramento River. Although no historical accounts exist for identified green sturgeon spawning occuring above the current dam sites, suitable spawning habitat existed, and based on habitat assessments done for Chinook salmon, the geographic extent of spawning has been reduced due to the impassable barriers constructed on the river.

Spawning on the Feather River is suspected to have occurred in the past due to the continued presence of adult green sturgeon in the river below Oroville Dam. This continued presence of adults below the dam suggests that fish are trying to migrate to upstream spawning areas now blocked by the dam which was constructed in 1968.

Spawning in the San Joaquin River system has not been recorded historically or observed recently, however white sturgeon are routinely caught by poachers as far upstream as Laird County Park, river mile 90.2 (Beamesderfer *et al.* 2004). During the later half of the 1800s impassable barriers were built on these tributaries where the water courses left the foothills and entered the valley floor. Therefore, these low elevation dams have blocked potentially suitable spawning habitats located further upstream for approximately a century. Additional destruction of riparian and stream channel habitat by industrialized gold dredging further disturbed any valley floor habitat that was still available for sturgeon spawning. It is likely that both white and green sturgeon utilized the San Joaquin River basin for spawning prior to the onset of european influence, based on past use of the region by populations of CV spring-run Chinook salmon and CV steelhead. These two populations of salmonids have either been extirpated or greatly diminished in their use of the San Joaquin River basin over the past two centuries.

The size of the population of green sturgeon is difficult to estimate due to a lack of data specific for this fish. However, inferences from the commercial and sport fisheries harvest can be used to estimate population trends over time. Based on the harvest numbers, green sturgeon catch has decreased from a high of 9,065 in 1986 to 512 in 2003 (Adams *et al.* 2006). The greatest decreases in harvest were for commercial gears in the Columbia River, Willapa Bay, and Greys Harbor. The decrease was attributed to changes in the regulatory statutes for sturgeon harvest. Catch rates for the Hoopa and Yurok tribal harvests remained unchanged during this same period and accounted for approximately 59 percent of the total harvest in 2003 (NMFS 2005a). Entrainment numbers at the SWP and CVP pumping facilities in the south Delta have been consistently lower than their levels in the mid-1970s (SWP) and the mid-1980s (CVP). Prior to 1986, the SWP (1968 -2001) averaged 732 green sturgeon salvaged per year, which dropped to 47 per year after 1986. The CVP (1980-2001) showed similar declines in its salvage rate for green sturgeon, 889 per year prior to 1986 and 32 per year after 1986 (Adams *et al.* 2006).

c. *Status –Southern population of North American Green Sturgeon*

The southern population of green sturgeon historically was smaller than the sympatric population of white sturgeon in the San Francisco Bay estuary and its associated tributaries. The population apparently has been declining over the past several decades based on harvest numbers from sport and commercial fisheries and the entrainment rates at the CVP and SWP (Adams *et al.* 2002, 2006). The principle factor for this decline is the reduction of green sturgeon spawning habitat to a limited area below Keswick Dam on the Sacramento River. The construction of impassable barriers, particularly large dams, has greatly reduced the access of green sturgeon to their historical spawning areas. These barriers and their manipulation of the normal hydrograph for the river also have had detrimental effects on the natural life history of green sturgeon. Reduced flows have corresponded with weakened year-class recruitment in the sympatric white sturgeon population and it is believed to have the same effect upon green sturgeon recruitment. Obstruction of natural sediment recruitment below large impoundments potentially has increased predation on larval and juvenile sturgeon due to a reduction in turbidity and loss of larger diameter substrate. In addition to the adverse effects of impassable barriers, numerous agricultural water diversions exist in the Sacramento River and the Delta along the migratory route of larval and juvenile sturgeon. Entrainment or, if equipped with a fish screen, impingement are considered serious threats to sturgeon during their downstream migration. Fish screens have not been designed with criteria that address sturgeon behavior or swimming capabilities. The benthic-oriented sturgeon are also more susceptible to contaminated sediments through dermal contact and through their feeding behavior of ingesting prey along with contaminated sediments. Their long life spans allow them to accumulate high body burdens of contaminants, that potentially will reach concentrations with deleterious physiological effects.

The most recent review of the status of green sturgeon concluded that the Southern DPS is at substantial risk and likely to become an endangered species in the foreseeable future (Adams *et al.* 2006). Threats included vulnerability due to concentration of spawners, smaller population size, lack of population data, growth-limiting temperatures, harvest concerns, loss of habitat, entrainment by water projects, and influence of toxic material and exotic species.

B. Critical Habitat Condition and Function for Species' Conservation

The freshwater habitat of salmon, steelhead, and sturgeon in the Sacramento River, San Joaquin River, and Suisun Marsh watershed drainages varies in function depending on location. Spawning areas are located in accessible, upstream reaches of the Sacramento or San Joaquin Rivers and their watersheds where viable spawning gravels and water quality are found. Spawning habitat condition is strongly affected by water flow and quality, especially temperature, dissolved oxygen (DO), and silt load, all of which can greatly affect the survival of eggs and larvae. High-quality spawning habitat is now inaccessible behind large dams in these watersheds, which limits salmonids to spawning in marginal tailwater habitat below the dams. Despite often intensive management efforts, the existing spawning habitat below dams is highly susceptible to inadequate flows and high temperatures due to competing demands for water, which impairs the habitat function.

Migratory corridors are downstream of the spawning area and include the Delta and Suisun Marsh. These corridors allow the upstream passage of adults and the downstream emigration of juveniles. Migratory habitat conditions are impaired in each of these drainages by the presence of barriers, which can include dams, unscreened or poorly screened diversions, inadequate water flows, and degraded water quality.

Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing by salmonids, but such use has not been documented for green sturgeon. Rearing habitat condition is strongly affected by habitat complexity, food supply, and presence of predators of juvenile salmonids and sturgeon. Some complex, productive habitats with floodplains remain in the Sacramento and San Joaquin River systems (*e.g.*, the lower Cosumnes River, Sacramento River reaches above Colusa, and the Yolo and Sutter bypasses). However, the channelized, leveed, and rip-rapped river reaches and sloughs that are common in the Delta and Suisun Marsh systems typically have lower habitat complexity, lower abundance of food organisms, and offer little protection from either fish or avian predators.

C. Factors Affecting the Species and Critical Habitat

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley and Suisun Marsh. For example, NMFS prepared range-wide status reviews for West coast Chinook salmon (Myers *et al.* 1998), steelhead (Busby *et al.* 1996), and green sturgeon (Adams *et al.* 2002, 2006; NMFS 2005a). Also, the NMFS BRT published a final updated status review for West Coast salmon and steelhead in June 2005 (Good *et al.* 2005). Information also is available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (*e.g.*, 58 FR 33212, 59 FR 440, 62 FR 24588, 62 FR 43937, 63 FR 13347, 64 FR 24049, 64 FR 50394, 65 FR 7764, 70 FR 52488, 71 FR 834, 71 FR 17757). The Final Programmatic EIS/EIR for the CALFED Bay-Delta Program (CALFED 1999), and the Final Programmatic EIS for the CVPIA U.S. Department of Interior (DOI 1999), provide an excellent summary of historical and recent environmental conditions for salmon and steelhead in the Central Valley.

The following general description of the factors affecting Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, green sturgeon and their habitat is based on a summary of these documents.

In general, the human activities that have affected the listed anadromous salmonids and their habitats consist of: (1) dam construction that blocks previously accessible habitat; (2) water development and management activities that affect water quantity, flow timing, quality, and stream function; (3) land use activities such as agriculture, flood control, urban development, mining, road construction, and logging that degrade aquatic and riparian habitat; (4) hatchery operation and practices; (5) harvest activities; and (6) ecosystem restoration actions.

1. <u>Habitat Blockage</u>

Hydropower, flood control, and water supply dams of the CVP, SWP, and other municipal and private entities permanently block or hinder salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 linear miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 linear miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and the Delta block salmon, and steelhead access to the upper portions of the respective watersheds. On the Sacramento River, Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud, and Pit Rivers. Whiskeytown Dam blocks access to the upper watershed of Clear Creek. Oroville Dam and associated facilities block passage to the upper Feather River watershed. Nimbus Dam blocks access to most of the American River basin. Friant Dam construction in the mid-1940s has been associated with the elimination of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River (DOI 1999). On the Stanislaus River, construction of Goodwin Dam in 1912, Tulloch Dam in 1957, and New Melones Dam in 1979, completely blocked both spring- and fall-run Chinook salmon, as well as CV steelhead (Yoshiyama *et al.* 2001). Similarly, construction of La Grange Dam in 1893 and

New Don Pedro Dam in 1971 blocked upstream access to salmonids on the Tuolumne River. Upstream migration on the Merced River was blocked in 1910 by the construction of Crocker-Huffman Dam and later by New Exchequer Dam and McSwain Dam in 1967. These dams also had the potential to block any spawning populations of green sturgeon in these tributaries.

As a result of the dams, winter-run Chinook salmon, spring-run Chinook salmon, and steelhead populations on these rivers have been confined to lower elevation mainstems that historically only were used for migration. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. Higher temperatures at these lower elevations during late-summer and fall are a major stressor to adults and juvenile salmonids. Green sturgeon populations would be similarly affected by these barriers and alterations to the natural hydrology.

In the Delta, migratory pathways are temporarily blocked by the Delta Cross Channel Gates at Walnut Grove on the Sacramento River, the Head of Old River Barrier on the San Joaquin River, and three agricultural barriers in the south Delta (*i.e.*, Old River near Tracy, Grant Line Canal, and Middle River near Victoria Canal). The Suisun Marsh Salinity Control Gates (SMSCG), located on Montezuma Slough, were installed in 1988, and are operated with gates and flashboards to decrease the salinity levels of managed wetlands in Suisun Marsh. The SMSCG have delayed or blocked passage of adult Chinook salmon migrating upstream (Edwards *et al.* 1996, Tillman *et al.* 1996, CDWR 2002). The effects of the SMSCG on green sturgeon are unknown at this time.

2. <u>Water Development</u>

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted streamflows and altered the natural cycles by which juvenile and adult salmonids base their migrations. As much as 60 percent of the natural historical inflow to Central Valley watersheds and the Delta have been diverted for human uses. Depleted flows have contributed to higher temperatures, lower DO levels, and decreased recruitment of gravel and large woody debris (LWD). More uniform flows year-round have resulted in diminished natural channel formation, altered food web processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Mount 1995, Ayers 2001), caused spawning gravels to become embedded, and decreased channel widths due to channel incision, all of which has decreased the available spawning and rearing habitat below dams.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, and their tributaries. Although efforts have been made in recent years to screen some of these diversions, many remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile salmonids. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (USFWS 2003).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP/SWP pumps. Specifically, juvenile salmonid survival has been reduced by the following: (1) water diversion from the mainstem Sacramento River into the Central Delta via the Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River, Old and Middle Rivers and southern Delta waterways; (3) entrainment at the CVP/SWP export facilities and predation in Clifton Court Forebay; and (4) increased exposure to introduced, non-native predators such as striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui)* and sunfishes (*Centrarchidae* spp.).

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley watershed. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for 4 or 5 miles (California Resources Agency 1989). By 1979, riparian habitat along the Sacramento River diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The degradation and fragmentation of riparian habitat had resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture. Removal of snags and driftwood in the Sacramento and San Joaquin River basins has reduced sources of LWD needed to form and maintain stream habitat that salmon depend on in their various life stages.

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is one of the primary causes of salmonid habitat degradation (NMFS 1996). Sedimentation can adversely affect salmonids during all freshwater life stages by: clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and DO levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through the alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation, resulting in increased streambank erosion (Meehan 1991). Urban stormwater and agricultural runoff may be contaminated with herbicides and pesticides, petroleum products, sediment, *etc.* Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NMFS 1998). LWD influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979, Bilby 1984, Robison and Beschta 1990).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Conomos *et al.* 1985, Nichols *et al.* 1986, Wright and Phillips 1988, Monroe *et al.* 1992, Goals Project 1999). Prior to 1850, approximately 1400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin Rivers, and another 800 km^2 of saltwater marsh fringed San Francisco Bay's margins. Of the original 2,200 km^2 of tidally influenced marsh, only about 125 km^2 of undiked marsh remains today. In Suisun Marsh, saltwater intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs, which first were established in the 1870s in western Suisun Marsh (Goals Project 1999).

Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has significantly and detrimentally altered the natural hydrology and function of the river systems in the Central Valley. Starting in the mid-1800s, the Corps and other private consortiums began straightening river channels and artificially deepening them to enhance shipping commerce. This has led to declines in the natural meandering of river channels and the formation of pool and riffle segments. The deepening of channels beyond their natural depth also has led to a significant alteration in the transport of bedload in the riverine system as well as the local flow velocity in the channel (Mount 1995). The Sacramento Flood Control Project at the turn of the nineteenth century ushered in the start of large scale Corps actions in the Delta and along the rivers of California for reclamation and flood control. The creation of levees and the deep shipping channels reduced the natural tendency of the San Joaquin and Sacramento Rivers to create floodplains along their banks with seasonal inundations during the wet winter season and the spring snow melt periods. These annual inundations provided necessary habitat for rearing and foraging of juvenile native fish that evolved with this flooding process. The armored rip rapped levee banks and active maintenance actions of Reclamation Districts precluded the establishment of ecologically important riparian vegetation, introduction of valuable LWD from these riparian corridors, and the productive intertidal mudflats characteristic of the undisturbed Delta habitat.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by CDWR on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and sturgeon and an increase in the clarity of the water due to a reduction in phytoplankton and zooplankton. These conditions have contributed to increased mortality of juvenile Chinook salmon, steelhead, and sturgeon as they move through the Delta.

4. Water Quality

The water quality of the Delta has been negatively impacted over the last 150 years. Increased water temperatures, decreased DO levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids. The Regional Board, in its 1998 Clean Water Act §303(d) list characterized the Delta as an impaired water body having elevated levels of chlorpyrifos, dichlorodiphenyltrichlor (DDT), diazinon, electrical conductivity, Group A pesticides, mercury, low DO, organic enrichment, and unknown toxicities (Regional Board 1998, 2001).

In general, water degradation or contamination can lead to either acute toxicity, resulting in death when concentrations are sufficiently elevated, or more typically, when concentrations are lower, to chronic or sublethal effects that reduce the physical health of the organism, and lessens its survival over an extended period of time. For listed species, these effects may occur directly to the listed fish or to its prey base, which reduces the forage base available to the listed species.

Sediments can either act as a sink or as a source of contamination depending on hydrological conditions and the type of habitat the sediment occurs in. Sediment provides habitat for many aquatic organisms and is a major repository for many of the more persistent chemicals that are introduced into the surface waters. In the aquatic environment, most anthropogenic chemicals and waste materials including toxic organic and inorganic chemicals eventually accumulate in sediment (Ingersoll 1995).

Direct exposure to contaminated sediments may cause deleterious effects to listed salmonids or the threatened green sturgeon. This may occur if a fish swims through a plume of the re-suspended sediments or rests on contaminated substrate and absorbs the toxic compounds through one of several routes: dermal contact, ingestion, or uptake across the gills. Elevated contaminant levels may be found in localized "hot spots" where discharge occurs or where river currents deposit sediment loads. Sediment contaminant levels can thus be significantly higher than the overlying water column concentration maximums specified by the U.S. Environmental Protection Agency (EPA). However, the more likely route of exposure to salmonids or sturgeon is through the food chain, when the fish feed on organisms that are contaminated with toxic compounds. Prey species become contaminated either by feeding on the detritus associated with the sediments or dwelling in the sediment itself. Therefore, the degree of exposure to the salmonids and green sturgeon depends on their trophic level and the amount of contaminated forage base they consume. Response of salmonids and green sturgeon to contaminated sediments is similar to water borne exposures.

5. Hatchery Operations and Practices

Five hatcheries currently produce Chinook salmon in the Central Valley and four of these also produce CV steelhead. Releasing large numbers of hatchery fish can pose a threat to wild Chinook salmon and CV steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, 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 in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (DOI 1999). For example, Nimbus Hatchery on the American River rears Eel River origin steelhead and releases these fish in the Sacramento River basin. One of the recommendations in the Joint Hatchery Review Report (NMFS and CDFG 2001) was to identify and designate new sources of steelhead brood stock to replace the current Eel River origin brood stock.

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring- and fall-run fish have led to the hybridization and homogenization of some subpopulations (CDFG 1998). As early as the 1960s, Slater (1963) observed that early fall- and spring-run Chinook salmon were competing for spawning sites in the Sacramento River below Keswick Dam, and speculated that the two runs may have hybridized. For the last several years zero spring-run Chinook salmon have been observed spawning in the mainstem Sacramento River above RBDD. The FRH spring-run Chinook salmon have been documented as straying throughout the Central Valley for many years (CDFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon, an indication that FRH spring-run Chinook salmon may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and above RBDD on the Sacramento River contain hybridized fish.

The management of hatcheries, such as Nimbus Hatchery and FRH, can directly impact spring-run Chinook salmon and steelhead populations by overwhelming the natural carrying capacity of the limited habitat available below dams. In the case of the Feather River, significant redd superimposition occurs in-river due to hatchery overproduction and the inability to physically separate spring- and fall-run Chinook salmon adults. This concurrent spawning has led to hybridization between the spring- and fall-run Chinook salmon in the Feather River. At Nimbus Hatchery, operating Folsom Dam to meet temperature requirements for returning hatchery fall-run Chinook salmon often limits the amount of water available for steelhead spawning and rearing the rest of the year.

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally-produced fish in the 1950s (McEwan 2001) to an estimated 23 to 37 percent naturally-produced fish currently (Nobriga and Cadrett 2001). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS and CDFG 2001). Thus, the ability of natural populations to successfully reproduce and continue their genetic integrity likely has been diminished.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where fishing regulations are set according to hatchery population. This can lead to over-exploitation and reduction in the size of wild populations existing in the same system as hatchery populations due to incidental bycatch (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown to be effective in bolstering the numbers of naturally spawning fish in the short term under specific scenarios. Artificial propagation programs can also aid in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels, as was the case with the Sacramento River winter-run Chinook salmon population during the 1990s. However, overall abundance is only one component of a viable salmonid population.

6. Commercial and Sport Harvest

a. *Ocean Harvest*

(1) *Chinook salmon*. Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and steelhead. Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement. CWT returns indicate that Sacramento River salmon congregate off the California coast between Point Arena and Morro Bay.

Since 1970, the CVI for winter-run Chinook salmon generally has ranged between 0.50 and 0.80. In 1990, when ocean harvest of winter-run Chinook salmon was first evaluated by NMFS and the Pacific Fisheries Management Council (PFMC), the CVI harvest rate was near the highest recorded level at 0.79. NMFS determined in a 1991 biological opinion that continuance of the 1990 ocean harvest rate would not prevent the recovery of winter-run Chinook salmon. Through the early 1990s, the ocean harvest index was below the 1990 level (*i.e.*, 0.71 in 1991 and 1992, 0.72 in 1993, 0.74 in 1994, 0.78 in 1995, and 0.64 in 1996). In 1996 and 1997, NMFS issued a biological opinion which concluded that incidental ocean harvest of winter-run Chinook salmon represented a significant source of mortality to the endangered population, even though ocean harvest was not a key factor leading to the decline of the population. As a result of these opinions, measures were developed and implemented by the PFMC, NMFS, and CDFG to reduce ocean harvest by approximately 50 percent.

Ocean fisheries have affected the age structure of spring-run Chinook salmon through targeting large fish for many years and reducing the numbers of 4- and 5-year-old fish (CDFG 1998). There are limited data on spring-run Chinook salmon ocean harvest rates. An analysis of 6 tagged groups of FRH spring-run Chinook salmon by Cramer and Demko (1997) indicated that harvest rates of 3-year old fish ranged from 18 percent to 22 percent, 4-year old fish ranged from

57 percent to 84 percent, and 5-year old fish ranged from 97 percent to 100 percent. The almost complete removal of 5-year old fish from the population effectively reduces the age structure of the species, which reduces its resiliency to factors that may impact a particular year class (*e.g.*, pre-spawning mortality from lethal instream water temperatures).

(2) *Green sturgeon*. Ocean harvest for green sturgeon occurs primarily along the Oregon and Washington coasts and within their coastal estuaries. A commercial fishery for sturgeon still exists within the Columbia River, where they are caught in gill nets along with the more commercially valuable white sturgeon. Green sturgeons are also caught by recreational fisherman, and it is the primary bottomfish landed in Willapa Bay. Within the San Francisco Bay estuary, green sturgeons are captured by sport fisherman targeting the more desirable white sturgeon, particularly in San Pablo and Suisun Bays (Emmett *et al.* 1991).

b. *Freshwater Sport Harvest*

(1) *Chinook salmon.* Historically in California, almost half of the river sportfishing effort was in the Sacramento-San Joaquin River system, particularly upstream from the city of Sacramento (Emmett *et al.* 1991). Since 1987, the Fish and Game Commission has adopted increasingly stringent regulations to reduce and virtually eliminate the in-river sport fishery for winter-run Chinook salmon. Present regulations include a year-round closure to Chinook salmon fishing between Keswick Dam and the Deschutes Road Bridge and a rolling closure to Chinook salmon fishing on the Sacramento River between the Deschutes River Bridge and the Carquinez Bridge. The rolling closure spans the months that migrating adult winter-run Chinook salmon are ascending the Sacramento River to their spawning grounds. These closures virtually eliminated impacts on winter-run Chinook salmon caused by recreational angling in freshwater.

In 1992, the California Fish and Game Commission adopted gear restrictions (all hooks must be barbless and a maximum of 5.7 cm in length) to minimize hooking injury and mortality of winter-run Chinook salmon caused by trout anglers. That same year, the Commission also adopted regulations which prohibited any salmon from being removed from the water to further reduce the potential for injury and mortality.

In-river recreational fisheries historically have taken spring-run Chinook salmon throughout the species' range. During the summer, holding adult spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of spring-run Chinook salmon in Mill, Deer, Butte and Big Chico Creeks were added to the existing CDFG regulations in 1994. The current regulations, including those developed for winter-run Chinook salmon; provide some level of protection for spring-run fish (CDFG 1998).

(2) *Steelhead*. There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-1954 through

1958-1959 seasons ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. Staley (1975) estimated the harvest rate in the American River during the 1971-1972 and 1973-1974 seasons to be 27 percent. The average annual harvest rate of adult steelhead above RBDD for the 3-year period from 1991-1992 through 1993-1994 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams (CDFG 2007). Overall, this regulation has increased protection of naturally produced adult steelhead.

(3) ***Green sturgeon.*** Green sturgeon are caught incidentally by sport fisherman targeting the more highly desired white sturgeon within the Delta waterways and in the Sacramento River as far upstream as Hamilton City. As of January 2007, the current fishing regulations allow green sturgeon to be retained by sport fisherman in the San Francisco Bay/Delta waters. Effective March 1, 2007, CDFG will close green sturgeon to take or possession (CDFG 2007). This regulation will afford green sturgeon protection from the sport fishery in California; however, a certain degree of incidental hooking mortality will still exist for those fish caught and released while fishing for white sturgeon.

7. Predation

Accelerated predation also may be a factor in the decline of winter-run Chinook salmon and spring-run Chinook salmon, and to a lesser degree steelhead. Human-induced habitat changes such as alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators (Stevens 1961, Decato 1978, Vogel *et al.* 1988, Garcia 1989).

On the mainstem Sacramento River, high rates of predation are known to occur at: RBDD, Anderson Cottonwood Irrigation District's diversion dam, Glenn Colusa Irrigation District's diversion facility, areas where rock revetment has replaced natural riverbank vegetation, and at south Delta water diversion structures (*e.g.*, Clifton Court Forebay; Tracy Fish Facility; Gingras 1997). Predation at RBDD on juvenile winter-run Chinook salmon is believed to be higher than normal due to factors such as water quality and flow dynamics associated with the operation of this structure (Tucker *et al.* 1998). Due to their small size, early emigrating winter-run Chinook salmon may be very susceptible to predation in Lake Red Bluff when the RBDD gates remain closed in summer and early fall (Vogel *et al.* 1988). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly susceptible to predation by fish or birds. Sacramento pikeminnow (*Ptychocheilus grandis*) and striped bass congregate below the dam and prey on juvenile salmon in the tail waters (Tucker *et al.* 2003).

FWS found that more predatory fish were found at rock revetment bank protection sites between Chico Landing and Red Bluff than at sites with naturally eroding banks (Michny and Hampton 1984). From October 1976 to November 1993, CDFG conducted 10 mark/recapture studies at the SWP's Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile Chinook salmon. Pre-screen losses ranged from 69 percent to 99 percent. Predation by striped bass is thought to be the primary cause of the loss (Gingras 1997). Similar high pre-screen loss was reported for steelhead smolts in Clifton Court Forebay (CDWR 2005).

Other locations in the Central Valley where predation is of concern include flood bypasses (*i.e.*, Yolo, Sutter, Colusa) in wet years, release sites for fish salvaged at the State and Federal fish facilities, the SMSCG, and various agricultural barriers in the Delta. Predation on salmon by striped bass and pikeminnow at the SWP and CVP salvage release sites in the Delta has been documented (Orsi 1967, Pickard *et al.* 1982); however, accurate predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987 to 1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the SMSCG was striped bass, and the remains of juvenile Chinook salmon were identified in their stomach contents (NMFS 1997b).

8. <u>Environmental Variation</u>

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare *et al.* 1999, Mantua and Hare 2002). This phenomenon has been referred to as the Pacific Decadal Oscillation. In addition, large-scale climatic regime shifts, such as the El Niño condition, appear to change productivity levels over large expanses of the Pacific Ocean. A further confounding effect is the fluctuation between drought and wet conditions in the basins of the American west. During the first part of the 1990s, much of the Pacific Coast was subject to a series of very dry years, which reduced inflows to watersheds up and down the west coast.

A key factor affecting many West Coast stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival in the ocean is driven largely by events occurring between ocean entry and recruitment to a subadult life stage.

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Predation rates on juvenile and adult green sturgeon have not been adequately studied to date. Ocean predation may also contribute to significant natural mortality, although it is not known to what extent. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations following their protection under the Marine Mammal Protection Act of 1972 has increased the number of salmonid deaths. Seals have been reported following schools of salmon upstream as far as the City of Sacramento and the Tracy Fish Facility. This may be further exacerbated by the decline of other fisheries stocks (*i.e.*, haddock, pollock, and rockfish) which provided alternative forage resources to marine mammals.

Finally, unusual drought conditions may warrant additional consideration in California. Flows in 2001 were among the lowest flow conditions on record in the Central Valley. The available water in the Sacramento watershed and San Joaquin watershed was 70 percent and 66 percent of normal, according to the Sacramento River Index and the San Joaquin River Index, respectively. Back-to-back drought years could be catastrophic to small single populations of listed salmonids that are dependent upon reservoir releases for their success (*e.g.*, winter-run Chinook salmon). Therefore, reservoir carryover storage (usually referred to as end-of-September storage) is a key element in providing adequate reserves to protect salmon and steelhead during extended drought periods. In order to buffer the effect of drought conditions and over allocation of resources, NMFS in the past has recommended that minimum carryover storage be maintained in Shasta and Folsom reservoirs to help alleviate critical flow and temperature conditions in the fall. Green sturgeon's need for appropriate water temperatures would also benefit from river operations that maintain a suitable temperature profile for this species.

The future effects of global warming are of key interest to salmonid and green sturgeon survival. CDWR (2006) predicts that by 2100 California's snow pack will dwindle, the majority of runoff will shift to more in winter, and sea-level will rise by 2.9 feet. An analysis of a relatively large group of climate models for California projected a central tendency of air temperatures to rise 3°C by 2050 (Dettinger 2005 in CDWR 2006). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt dominated system to a winter rain dominated system. In many of the low to middle elevation Central Valley streams summer water temperatures often come close to the upper tolerance limits for salmon and steelhead. Anticipated climate change that raises air temperatures a few degrees Celsius may be enough to raise water temperatures above the tolerance limits of salmon and steelhead, favoring non-native fishes. Without the necessary cold-water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids (*i.e.*, winter-run and spring-run Chinook salmon) that must hold below the dam over the summer and fall periods. Similar, although potentially to a lesser degree, declines in green sturgeon populations are anticipated with reduced cold-water flows. Green sturgeon egg and larval development are optimized at water temperatures that are only slightly higher than those for salmonids. Lethal temperatures are similar to salmonids, although slightly higher.

9. Ecosystem Restoration

a. *CALFED*

Two programs included under CALFED; the Ecosystem Restoration Program (ERP) and the Environmental Water Account (EWA), were created to improve conditions for fish, including listed salmonids, in the Central Valley. Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these actions address key factors affecting listed salmonids and emphasis has been placed in tributary drainages with high potential for steelhead and spring-run Chinook salmon production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat restoration initiatives sponsored and funded primarily by the ERP Program have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids. Similar habitat restoration is imminent adjacent to Suisun Marsh (*i.e.*, at the confluence of Montezuma Slough and the Sacramento River) as part of the Montezuma Wetlands project, which is intended to provide for commercial disposal of material dredged from San Francisco Bay in conjunction with tidal wetland restoration.

The EWA is designed to provide water at critical times to meet ESA requirements and incidental take limits without water supply impacts to other users. In early 2001, the EWA released 290 thousand acre feet (TAF) of water from San Luis Reservoir at key times to offset reductions in south Delta pumping implemented to protect winter-run Chinook salmon, delta smelt, and splittail. However, the benefit derived by this action to winter-run Chinook salmon in terms of number of fish saved was very small. The anticipated benefits to other Delta fisheries from the use of the EWA water are much higher than those benefits ascribed to listed salmonids by the EWA release.

b. *Central Valley Project Improvement Act*

The CVPIA, implemented in 1992, requires that fish and wildlife get equal consideration with other demands for water allocations derived from the CVP. From this act arose several programs that have benefited listed salmonids: the AFSP, Anadromous Fish Restoration Program (AFRP), and the Water Acquisition Program (WAP). The AFRP is engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines Federal funding with State and private funds in order to fund construction of fish screens on water diversions mainly in the Central Valley. The AFSP also provides technical assistance in the review of fish screen design and criteria. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. The WAP has been used successfully to improve fish habitat for CV spring-run Chinook salmon and CV steelhead by maintaining or increasing instream flows in Butte Creek, Mill Creek, and the San Joaquin River at critical times.

c. *Iron Mountain Mine Remediation*

EPA's Iron Mountain Mine remediation involves the removal of toxic metals in acidic mine drainage from the Spring Creek Watershed with a state-of-the-art lime neutralization plant. Contaminant loading into the Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990s (see Appendix J, BOR 2004). Decreasing the heavy metal contaminants that enter the Sacramento River should increase the survival of salmonid eggs and juveniles. However, during periods of heavy rainfall upstream of the Iron Mountain Mine, BOR substantially increases Sacramento River flows in order to dilute heavy metal contaminants being spilled from the Spring Creek debris dam. This rapid change in flows can cause juvenile salmonids to become stranded or isolated in side channels below Keswick Dam.

d. *State Water Project Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

The Four Pumps Agreement Program has approved about $49 million for projects that benefit salmon and steelhead production in the Sacramento-San Joaquin basins and Delta since the agreement inception in 1986. Four Pumps projects that benefit CV spring-run Chinook salmon and CV steelhead include water exchange programs on Mill and Deer Creeks; enhanced law enforcement efforts from San Francisco Bay upstream to the Sacramento and San Joaquin Rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and screening of diversions in Suisun Marsh and San Joaquin tributaries. Predator habitat isolation and removal, and spawning habitat enhancement projects on the San Joaquin tributaries benefit steelhead (see Chapter 15, BOR 2004).

The Spring-run Salmon Increased Protection project provides overtime wages for CDFG wardens to focus on reducing illegal take and illegal water diversions on upper Sacramento River tributaries and adult holding areas, where the fish are vulnerable to poaching. This project covers Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, and has been in effect since 1996. Through the Delta-Bay Enhanced Enforcement Program, initiated in 1994, a team of 10 wardens focus their enforcement efforts on salmon, steelhead, and other species of concern from the San Francisco Bay Estuary upstream into the Sacramento and San Joaquin River basins. These two enhanced enforcement programs have had significant, but unquantified benefits to spring-run Chinook salmon attributed by CDFG (see Chapter 15, BOR 2004).

10. <u>Non-native Invasive Species</u>

As currently seen in the San Francisco estuary, non-native invasive species (NIS) can alter the natural food webs that existed prior to their introduction. Perhaps the most significant example is illustrated by the Asiatic freshwater clams *Corbicula fluminea* and *Potamocorbula amurensis*. The arrival of these clams in the estuary disrupted the normal benthic community structure and depressed phytoplankton levels in the estuary due to the highly efficient filter feeding of the introduced clams (Cohen and Moyle 2004). The decline in the levels of phytoplankton reduces the population levels of zooplankton that feed upon them, and hence reduces the forage base available to salmonids transiting the Delta and San Francisco estuary. This lack of forage base can adversely impact the health and physiological condition of these salmonids as they emigrate through the Delta region to the Pacific Ocean.

Attempts to control the NIS also can adversely impact the health and well-being of salmonids within the affected water systems. For example, the control programs for the invasive water hyacinth and *Egeria densa* plants in the Delta must balance the toxicity of the herbicides applied to control the plants to the probability of exposure to listed salmonids during herbicide application. In addition, the control of the nuisance plants have certain physical parameters that must be accounted for in the treatment protocols, particularly the decrease in DO resulting from the decomposing vegetable matter left by plants that have died.

11. Summary

For Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead, the construction of high dams for hydropower, flood control, and water supply resulted in the loss of vast amounts of upstream habitat (*i.e.*, approximately 80 percent, or a minimum linear estimate of over 1,000 stream miles), and often resulted in precipitous declines in affected salmonid populations. For example, the completion of Friant Dam in 1947 has been linked with the extirpation of CV spring-run Chinook salmon in the San Joaquin River upstream of the Merced River within just a few years. The reduced populations that remain below Central Valley dams are forced to spawn in lower elevation tailwater habitats of the mainstem rivers and tributaries that previously were not used for this purpose. This habitat is entirely dependent on managing reservoir releases to maintain cool water temperatures suitable for spawning, and/or rearing of salmonids. This requirement has been difficult to achieve in all water year types and for all life stages of affected salmonid species. CV steelhead, in particular, seem to require the qualities of small tributary habitat similar to what they historically used for spawning; habitat that is largely unavailable to them under the current water management scenario. All salmonid species considered in this consultation have been adversely affected by the production of hatchery fish associated with the mitigation for the habitat lost to dam construction (*e.g.*, from genetic impacts, increased competition, exposure to novel diseases, *etc.*).

Land use activities such as road construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for Chinook salmon and steelhead through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation resulting in increased streambank erosion. Human-induced habitat changes, such as: alteration of natural flow regimes; installation of bank revetment (riprap); and building structures such as dams, bridges, water diversions, piers, and wharves, often provide conditions that both disorient juvenile salmonids and attract predators. Harvest activities, declining ocean productivity, and drought conditions provide added stressors to listed salmonid populations. In contrast, various ecosystem restoration activities (*e.g.*, CVPIA and ERP) have contributed to improved conditions for listed salmonids (*e.g.*, fish screens and gravel augmentation). However, the benefits to listed salmonids from the ERP and EWA have been smaller than anticipated.

Similar to the listed salmonids, the Southern DPS of North American green sturgeon have been negatively impacted by hydroelectric and water storage operations in the Central Valley which ultimately affect the hydrology and accesibility of Central Valley rivers and streams to anadromous fish. Anthropogenic manipulations of the aquatic habitat, such as dredging, bank stabilization, and waste-water discharges have also degraded the quality of the Central Valley's waterways for green sturgeon.

IV. ENVIRONMENTAL BASELINE

A. Presence of Listed Salmonids in the Action Area

Based on fish monitoring studies (CDWR 2004/2005, 2005/2006), Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead juveniles and smolts from the Sacramento River watershed enter into the central Delta system depending on river flows and SWP and CVP pumping rates. Fish from the Sacramento River can access the interior of the Delta via the Mokelumne River (*i.e.*, when Delta Cross Channel Gates are open) and Georgiana Slough channels from the north. Three Mile Slough, and the mouth of the San Joaquin River near Antioch and Sherman Island provide access from the west to the interior of the Delta. CV steelhead emigrating downstream in the San Joaquin River system have a high potential to move through the action area due to the flow split at the Head of Old River and the timing of their emigration in relation to the installation of a rock barrier at the Head of Old River.

B. Presence of Green Sturgeon in the Action Area

Although the Sacramento River watershed is the identified migration route and spawning area for green sturgeon, both adult and juvenile green sturgeon are known to occur within the lower reaches of the San Joaquin River and into the interior of the Delta. Juveniles have been captured in the vicinity of Santa Clara Shoals, Brannan Island State Recreational Area, and in the channels of the south Delta (Moyle *et al.* 1992, Beamesderfer *et al.* 2004). Green sturgeon have also been recovered year-round at both the SWP and CVP Fish Salvage Facilities on Old River approximately three miles from the proposed intake site on Victoria Canal, indicating that they must have transited through one of the many channels of the south Delta to reach that location.

Both adult and juvenile green sturgeon may use the Delta as a migratory, resting, or rearing habitat. Occurrence in the Delta could be in any month, as juveniles may reside there year-round during their first few years of growth. Adults are likely to be present in the winter and early spring as they move through the Delta towards their spawning grounds in the upper Sacramento

River watershed. Following spawning, the fish will pass through the Delta again on their way back to the ocean, but the duration and timing of this event is not well understood in the Sacramento River system. Those green sturgeons that make spawning runs up the Sacramento River may experience slight changes in the hydrology of the river due to the proposed project, as indicated by the CALSIM modeling. Likewise, larval and juvenile sturgeon would also experience the effects of the proposed operations through the slight changes in the hydrology of the Sacramento River.

C. Status of the Species and Critical Habitat in the Action Area

The immediate action area lies within designated critical habitat of the CV steelhead. The indirect action area (applies to areas upstream of the Delta) lies within designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead. The action area is within a reach of the Delta that is confined by levees, protected by rock riprap, and lined with sparse amounts of Shaded Riverine Aquatic (SRA) cover. The essential habitat elements in the action area are the water, substrate, and SRA cover.

1. Status of the Species Within the Action Area

The action area functions as a migratory corridor for adult Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead and provides migration and rearing habitat for juveniles of these species. A small proportion of all Federally listed Central Valley salmonids are expected to utilize aquatic habitat within the action area. The action area functions as the primary rearing area for juvenile green sturgeon and may at times be used for a migratory corridor for adults.

a. *Sacramento River Winter-run Chinook Salmon*

Sacramento River winter-run Chinook salmon currently spawn only in the Sacramento River below Keswick Dam, and are composed of a single breeding population (Good 2005; section III, *Status of the Species and Critical Habitat*). The entire population of adults and juveniles migrate through the lower Sacramento River and a small portion of these are misguided by reverse flows (caused by the SWP and CVP export pumps) into the action area.

The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration and protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing. In the areas west of Chipps Island, including San Francisco Bay to the Golden Gate Bridge, this designation includes the estuarine water column, essential foraging habitat, and food resources utilized by winter-run Chinook salmon as part of their juvenile outmigration or adult spawning migrations. As governed by the critical habitat definition for winter-run Chinook salmon, critical habitat does not occur at the project location, however critical habitat is found within the action area as defined by the effects of the computer simulation results performed by the applicant's consultant.

The migration timing of listed salmon and steelhead in the action area can be approximated by assessing studies that examine run timing in the Sacramento River (*e.g.*, Hallock *et al.* 1957, Van Woert 1958, Vogel and Marine 1991, Snider and Titus 2000). Adults enter San Francisco Bay from November through June (Van Woert 1958), and migrate up the Sacramento River from December through early August (Vogel and Marine 1991). Juvenile Chinook salmon emigrate through the action area from late fall to spring. Snider and Titus (2000) observed that juvenile salmon emigrate through the lower Sacramento River, at Knights Landing, in three phases. The first phase is the initiation of emigration that is strongly linked to initial Sacramento River flow increases between mid-November and early January. Approximately 78 percent of winter-run Chinook salmon emigrate during this phase. The second phase is characterized by sustained high Sacramento River flows between early January and early March, and the third phase typically occurs one week after the release of fall-run Chinook salmon from the Coleman National Fish Hatchery. Juveniles start to enter the Delta between November and December and usually spend 3 to 5 months rearing to smolt size. The peak in salvage at the State and Federal Fish Facilities usually occurs in March when juvenile winter-run Chinook salmon begin to leave the Delta. The age structure of emigrating juveniles is dominated by YOY fry, but also may contain some yearlings.

b. *Central Valley Spring-run Chinook Salmon*

CV spring-run Chinook salmon populations currently spawn in the Sacramento River below Keswick Dam, the low-flow channel of the Feather River, and in Sacramento River tributaries including Clear, Antelope, Mill, Deer, and Butte Creeks (CDFG 1998). The entire population of migrating adults and emigrating juveniles must pass through the action area. Critical habitat was designated for spring-run Chinook salmon in the Central Valley on September 2, 2005 (70 FR 52488). Critical habitat does not include the hydrologic unit in which the project is located (San Joaquin Delta), however critical habitat is found within the action area as defined by the effects of the computer simulation results performed by the applicant's consultant.

Adult CV spring-run Chinook salmon enter the mainstem Sacramento River in February and March, and continue to their upstream migration into June and July (CDFG 1998). In the Sacramento River, juveniles may begin migrating downstream almost immediately following emergence from the gravel with most emigration occurring from December through March (Moyle *et al.* 1989, Vogel and Marine 1991). Snider and Titus (2000) observed that up to 69 percent of CV spring-run Chinook salmon emigrate during the first migration phase between November and early January. The remainder of the CV spring-run Chinook salmon emigrate during subsequent phases that extend into early June. The age structure of emigrating juveniles is comprised of YOY and yearlings. The exact composition of the age structure is not known, although populations from Mill and Deer Creek primarily emigrate as yearlings. In the Delta, peak spring-run juvenile emigration is difficult to determine due to overlap in the length-size criteria with juvenile fall-run Chinook salmon. However, yearlings usually start to enter the Delta in the fall following the first significant rainfall event. YOY spring-run Chinook usually enter the Delta during the spring. A few wild YOY from Butte Creek have been observed in March in the Sacramento Trawl and at the Delta Fish Facilities, however, spring-run Chinook usually make up less than one percent of the juvenile Chinook salmon observed in the Delta fish salvage estimates (CDWR annual salvage reports 2004, 2005, 2006).

c. *Central Valley Steelhead*

Critical habitat was designated for Central Valley steelhead on September 2, 2005 (70 FR 52488). Critical habitat includes the stream channels to the ordinary high water line within designated stream reaches such as those of the American, Feather, and Yuba Rivers, and Deer, Mill, Battle, Antelope, and Clear Creeks in the Sacramento River basin; the Calaveras, Mokelumne, Stanislaus, and Tuolumne Rivers in the San Joaquin River basin; and, the Sacramento and San Joaquin Rivers and Delta. The project site is located within the San Joaquin Delta, which is included within the critical habitat designation for CV steelhead.

CV steelhead populations currently spawn in tributaries to the Sacramento and San Joaquin Rivers. The proportion of CV steelhead in this DPS that migrate through the action area is unknown. However, because of the relatively large amount of suitable habitat in the Sacramento River relative to the San Joaquin River, it is likely that small numbers would be present in the action area (*i.e.*, most steelhead smolts would tend to stay in the Sacramento River rather than migrate into the south Delta). A portion of those fish headed for the SWP/CVP pumps would pass through the action area. Although the number varies from year to year, on average less than 3,000 juveniles (*i.e.*, incidental take limit) a year are salvaged at the SWP/CVP Fish Facilities. Since there are three possible routes for steelhead to reach the Delta pumps (*i.e.*, Victoria Canal, Old River, and Grant Line Canal), one can assume that at most one third of the salvage at the Delta pumps must pass through the action area, or roughly 1,000 steelhead/year). Juvenile steelhead can emigrate through the action area from December through June. Snider and Titus (2000) observed that juvenile steelhead emigration primarily occurs between November and June. Salvage of unclipped steelhead from 1981 through 2002 showed that juveniles are present in the action area in every month except September. The majority of juvenile steelhead emigrate as yearlings from 200 to 250 mm in length. Adult CV steelhead may be present in the action area from July through May, with the peak occurring between August and October (Bailey 1954, Hallock *et al.* 1957).

d. *North American Green Sturgeon*

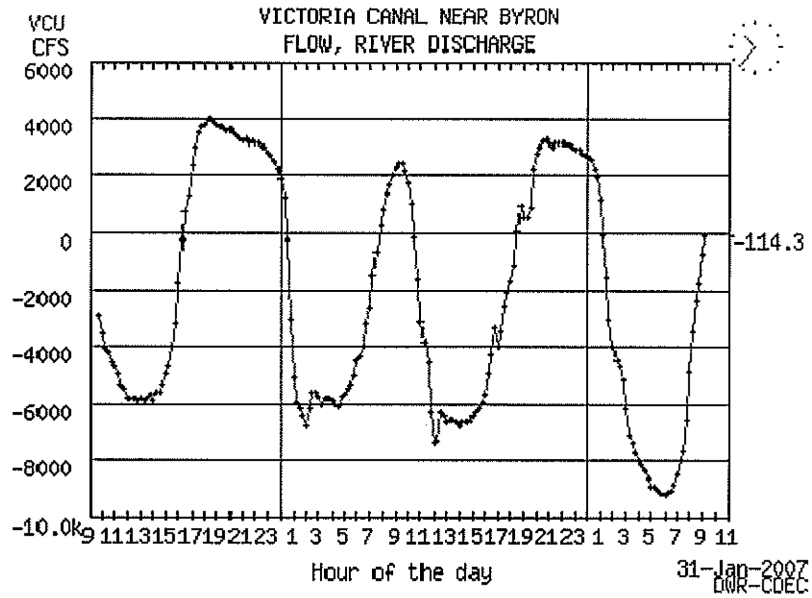
Although the Sacramento River watershed is the identified migration route and spawning area for green sturgeon, both adult and juvenile green sturgeon are known to occur within the lower reaches of the San Joaquin River and into the interior of the Delta. Juveniles have been captured in the vicinity of Santa Clara Shoals, Brannan Island State Recreational Area, and in the channels of the south Delta (Moyle *et al.* 1992, Beamesderfer *et al.* 2004). Green sturgeon also have been recovered at both the SWP and CVP pumping facilities on Old River near Tracy, indicating that they must have transited through one of the many channels of the south Delta to reach that location. Salvage estimates at the SWP/CVP pumping facilities vary dramatically, but have trended downward in recent years from a high of 1,400 juveniles in 1983 to a low of less than 50 in 2005 (CDFG annual salvage reports 2005).

Both adult and juvenile green sturgeon may use the Delta as a migratory, resting, or rearing habitat. Occurrence in the Delta can occur in any month, as juveniles may reside there during their first few years of growth. Adults are likely to be present in the winter and early spring as they move through the Delta towards their spawning grounds in the upper Sacramento River watershed. Following spawning, the fish will pass through the Delta again on their way back to the ocean, but the duration and timing of this event is not well understood in the Sacramento River system.

D. Factors Affecting the Species and Critical Habitat in the Action Area

The dominant features controlling the habitat within the action area are tidal cycles and the influence of the CVP/SWP pumping plants located approximately 3 miles from the proposed intake site. In all but extremely wet years the direction of flow is reversed southward due to the magnitude of diversions (*i.e.*, Clifton Court Forebay takes in up to 10,000 cfs daily on the high tide while average flows in Victoria Canal range from 4,000 cfs to - 8,000 cfs). Therefore, fish that enter the central Delta are drawn southward by reverse flows toward the CVP/SWP pumps. These are the fish that are most likely to come in contact with the proposed project. In addition, the over-arching effect of tides means fish have a tendency to move back and forth within Victoria Canal (Figure 2). In a single 24-hour period there can be up to 4 periods of slack tide when no flow would be moving past the proposed intake site. When water is moving velocities are typically less than 1 f/s.

Figure 2. Tidal flow in Victoria Canal from California Data Exchange Center (CDEC 2007).



Riprapped rock levees represent 100 percent of the current bank habitat in the action area. Levee construction and bank protection have affected salmonid habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA cover. Revetted embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat.

The use of rock armoring in the action area limits recruitment of LWD because the relatively smooth and homogenous surface facilitates the downstream transportation of instream debris, and greatly reduces, if not eliminates, the retention of LWD once it enters Victoria Canal. Riprapping creates a relatively clean, smooth surface which diminishes the ability of LWD to become securely snagged and anchored by sediment. LWD tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological function are thus greatly reduced, because wood needs to remain in place to generate maximum values to fish and wildlife (USFWS 2000). Juvenile salmonids likely are being impacted by reduction, fragmentation, and general lack of connectedness of remaining nearshore refuge areas. Impacts to these refuge areas reduce the amount of high value habitat available for juvenile salmonids to rear and grow, increasing susceptibility to predation in the open water.

Habitat within the action area primarily is used as juvenile rearing habitat and as a migration corridor for adults and juveniles. The condition and function of this habitat has been severely impaired through several factors discussed in the *Status of the Species and Habitat* section of this biological opinion, including agricultural water development and land use practices, predation, and habitat fragmentation. The result has been the reduction in quantity and quality of essential habitat elements that are required by juveniles to survive and grow, such as water contamination and loss of shallow-water rearing and refugia habitat. In spite of the degraded condition, the importance of the area to juvenile salmonids and green sturgeon is high because it is used for extended periods of time by a large number of juveniles. However, due to the currently degraded condition, the function of the habitat is low. Because of the location of the action area (*i.e.*, southern Delta), only a small proportion of each salmonid population utilizes the action area as a migratory corridor or for rearing in any given year, reducing the conservation value of the habitat for the survival and recovery of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead and North American green sturgeon.

V. EFFECTS OF THE ACTION

This section discusses the direct and indirect effects of the construction and operation of the proposed AIP on Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, designated critical habitat for these salmonid species and Southern DPS of North American green sturgeon that are expected to result from the proposed action. Cumulative effects (*i.e.*, effects of future State, local, or private actions on endangered and threatened species or critical habitat) are discussed separately.

A. Approach to the Assessment

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This biological opinion assesses the effects of the construction, and operations and maintenance of CCWD'S proposed AIP on endangered Sacramento River winter-run Chinook salmon, threatened CV spring-run Chinook salmon, threatened CV steelhead, and their designated critical habitat, and threatened green sturgeon. Impacts related to replacement of nearshore aquatic habitat with the fish screen structure also will be assessed. The proposed project is likely to cause adverse short-term effects to listed species and critical habitat during construction, and provide long-term protection from entrainment. The AIP includes integrated design features to avoid and minimize many potential on-site construction impacts. The project also includes off-site conservation measures to compensate for unavoidable loss or modification of critical habitat.

In the *Description of the Proposed Action* section of this biological opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this biological opinion, NMFS provided an overview of the threatened and endangered species and critical habitat that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(b)(2) of the ESA require biological opinions to evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. §1536; 50 CFR 402.02). Section 7 of the ESA and its implementing regulations also require biological opinions to determine if Federal actions would destroy or adversely modify critical habitat (16 U.S.C. §1536).

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species.

NMFS generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to important elements of the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or a detrimental sound). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to reduce a species' reproduction, numbers, or distribution (*e.g.,* by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). We then use the evidence available to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

To evaluate the effects of the proposed action, NMFS examined proposed construction activities, operations and maintenance activities, habitat loss, and conservation measures, to identify likely impacts to listed anadromous salmonids within the action area based on the best available information.

1. Information Available for the Assessment

To conduct the assessment, NMFS examined evidence from a variety of sources. Detailed background information on the status of these species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, governmental and non-governmental reports, scientific meetings, as well as the supporting information supplied with the action's environmental documents.

The primary information used in this assessment includes fishery information previously described in the *Status of the Species* and *Environmental Baseline* sections of this biological opinion, studies and accounts of the impacts of water diversions, previous biological opinions on in-river construction activities, and documents prepared in support of the proposed action, including the ASIP and EIS/EIR (CCWD and BOR 2006a, 2006b).

2. Assumptions Underlying This Assessment

In the absence of definitive data or conclusive evidence, NMFS must make a logical series of assumptions to overcome the limits of the available information. These assumptions will be made using sound, scientific reasoning that can be logically derived from the available information. The progression of the reasoning will be stated for each assumption, and supporting evidence cited.

The applicant and their consultants have made extensive use of computer simulation programs CALSIM II, Delta Simulation Model (DSM2), and the CCWD Solver Model in their analysis of the project's effects on hydrology and water quality. These monthly time-step models are based on a past 72-year hydrologic period which may not represent current climate change trends. CALSIM II uses a comparative analysis between baseline conditions and the AIP for current level of demand and future level of demand (year 2020) to assess changes in potential net entrainment and impingement losses. Modeling output evaluated for the fisheries analysis included:

- Water diversion export operations at the CVP, SWP, Rock Slough, Old River, Mallard Slough, and the proposed AIP,
- Hydrologic conditions in the Delta,
- River flows into the Delta (*i.e.*, Sacramento, Mokelumne, Calavaras, and San Joaquin River above and below the Delta),
- Export/Inflow ratio, and
- Location of X2 (*i.e.*, defined as the two-parts-per-thousand salinity isohaline).

NMFS understands that these models currently are the best available tools for hydrology modeling in the Central Valley, but also recognizes that these models have certain drawbacks and inadequacies in representing hydrological effects on listed salmonids. In particular, the fine temporal and spatial scales frequently needed to make informed decisions on the impacts of projects upon listed fish are not readily available from the computer simulations. The degree of resolution provided by these planning tools in their current configuration represents a homogenized averaging of values. This smoothing of data points starts with the 30-day time step in the CALSIM II modeling approach and is propagated through the DSM2 model where it serves as the delta inflow data point for the subsequent DSM2 calculations for the current month's simulation run. Flow data for Delta channels assumes that the flow value is the same across the entire cross section of the channel (one dimensional) and that water quality constituents, as represented by the electrical conductivity (EC) parameter, behave in the same manner as the salts that compose the EC parameter.

B. Assessment

The assessment will consider the nature, duration, and extent of the proposed action relative to the migration timing, behavior, and habitat requirements of Federally listed anadromous fish. This assessment will consider construction impacts, operations and maintenance impacts, and impacts of habitat modification and loss associated with replacement of nearshore aquatic habitat with the fish screen structure and placement of riprap. The assessment does not consider effects upstream from releasing water to meet CCWD's demands because: (1) upsteam effects have already been analyzed and addressed in the NMFS 2004 biological opinion concerning long-term CVP and SWP Operations, Criteria and Plan (OCAP), and (2) CCWD's total diversions from the Delta are not proposed to increase.

1. Construction Impacts

Potential construction-related impacts include exposure of juvenile and adult salmon, steelhead, and sturgeon to noise and high sound pressure levels and increased turbidity during cofferdam installation and removal, entrainment behind the cofferdam, injury or death during fish rescue and relocation, and permanent loss of nearshore riverine habitat to the fish screen structure. Construction activities that occur behind the cofferdam are not likely to adversely affect salmon, steelhead, and sturgeon because they will be isolated from Victoria Canal, and stabilized prior to cofferdam removal. In water activities (*i.e.*, dredging) also are not likely to adversely affect salmon and steelhead because they will occur at a time of year that avoids peak migration periods.

a. *Cofferdam Installation and Removal*

Installation of sheet pile and beams during construction of the cofferdam will be performed using a vibratory hammer pile driver if feasible. The bottom substrate is expected to be soft, based on results of similar substrate conditions encountered during installation of the cofferdam during construction of the CCWD'S Old River Intake and fish screen, which is located within a few miles of the project. Pile driving will last up to 60 days and will be on an intermittent and short duration basis (*i.e.*, hours or days). If percussion pile driving is used, it will produce underwater sound pressure levels that may cause temporary disturbance within Victoria Canal and affect salmon, steelhead, and sturgeon behavior and physiology through disruption of migration, feeding behavior, and potential increased exposure of juveniles to predation by forcing them from nearshore refugia.

The effect pile driving has on fish depends upon the pressure, measured in decibels (dB), of a sound or compression wave. Rassmusen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels exceeding 204 dB. Sustained sound pressures (four hours) in excess of 180 dB damaged the hair cells in the inner ear of cichlids (Hastings *et al.* 1996). Feist *et al.* (1992) found that pile driving in Puget Sound created sound within the range of salmonid hearing that could be detected at least 600 meters away. Abundance of juvenile salmon near pile-driving rigs was reduced on days when the rigs were operating compared to non-operating days. McKinley and Patrick (1986) found that salmon smolts exposed to pulsed sound (similar to pile driving) demonstrated a startle or avoidance response, and Anderson (1990) observed a startle response in salmon smolts at the beginning of a pile-driving episode but found that after a few poundings of the pilings fish were no longer startled. This suggests that pile driving or associated activity (*e.g.*, human movement, work boat operation, *etc.*) can cause avoidance of habitat in the immediate vicinity of the project site, but that fish also may become acclimated to the noise. If fish move into an area of higher predator concentration (*e.g.*, deeper water), they may experience increased susceptibility to predation and decreased survival. Fish that become acclimated may be exposed to additional project-related impacts. NMFS does not have any data available to determine the hearing sensitivities of green sturgeon, and thus will use the values for salmonids in its analysis of effects.

In order to measure sound levels, NMFS uses two methods. The Peak Sound Pressure Level (SPL) which is the maximum excursion of pressure within the sound. This typically occurs during one strike and varies depending on the substrate, equipment, and type of pile used. The SPL measurement will determine whether the swim bladder and ear are subjected to extreme mechanical stress and injury. As a result of recent ESA consultations and new research, the accumulation of sound energy has been determined to be very important. Therefore, the Sound Exposure Level (SEL) is the metric that NMFS now uses to define sound accumulation lasting for one second. However, it does not indicate the total exposure over a series of strikes. Pile driving that occurs every several seconds does not allow for recovery time and will accumulate. To calculate accumulated SELs, NMFS multiplies the SEL (in dB) by 10*log (# of strikes). Thus we can calculate how many strikes it takes to reach the injury threshold (in salmonids 187 dB for juveniles, and 190 dB for adults). Table 5 shows the distance from pile driving that fish are likely to be exposed to injury given 100 strikes. Sheet pile driving could injure fish within a 100 meter radius of the construction site (Table 5).

Table 5. Calculated accumulated SELs at 100 strikes for various types of piles

Pile Type	Single Strike SEL (dB)	Accumulated SEL (dB)	Injury Radius (meters)
12 inch dia. timber	157	177	< 10
12 inch dia. steel	155	175	< 10
24 inch dia. concrete	165	185	< 10
20 inch dia. steel	175	195	34
24 inch dia. steel	178	198	54
30 inch dia. steel	180	200	74
Sheet pile	182	202	100
66 inc dia. steel	190	210	341
102 inch dia. steel	198	218	1166

Based on information from scientific literature, NMFS believes that the accumulated SEL from percussion pile driving will exceed 180 dB and may result in lethal effects to listed fish species. Data derived from concrete piles driven at the Concord Naval Weapons Depot in Suisun Bay indicated pile driving SELs exceeded 170 to 180 dB 10 meters from the pile at a depth of 3 meters. A report by Burgess and Blackwell (2003) indicated that vibratory installation of a sheet pile wall in an upland location generated sound levels of approximately 140 dB at a distance of 200 feet in the adjacent waterway, indicating that the noise was coupled through the soil to the water column.

At the City of Sacramento Water Treatment Plant Fish Screen Project, engineering analysis anticipated that the use of a smaller pile-driving hammer would generate sound pressure levels of 95 to 120 dB. Actual levels were not monitored. Because of the similarities in channel depth, substrate size, and the expected use of a vibratory hammer in the proposed project, maximum sound levels or SELs should be below the 180 dB threshold known to cause internal tissue damage to fish. However, the levels may be high enough to affect adult and juvenile salmonids by startling fish and causing avoidance of habitats within 600 meters of the noise source. This is a conservative estimate based on observations in Puget Sound and does not take into account specific on-site variables such as channel flow and bank morphology that may reduce the actual distance. At the proposed intake site a mid-channel tule berm or island separates Victoria Canal into two canals and would tend to buffer the SEL for fish in the North Canal.

NMFS anticipates that pile driving will be detectable to salmonids up to 600 meters from the source, and that the sounds generated will harass juvenile salmon, steelhead, and sturgeon by causing injury from temporary disruption of normal behaviors such as feeding, sheltering, and migrating that may contribute to reduced or negative growth. Disruption of these behaviors also may lead to increased predation if fish become disoriented or concentrated in areas with high predator densities. Injury or death could occur within 10 meters of the location where the larger structural piles will be driven based on use of 24 inch diameter concrete piles as described (Table 4), however, the driving of these types of piles will occur "in the dry" more than 10 meters behind the cofferdam, and would therefore not be expected to kill or injure listed fish.

Pile driving effects should be small and short-term in nature because pile driving will occur only during the day, enabling unhindered fish passage at night during peak migration times. Additionally, given the proposed limited and intermittent use of vibratory hammers (*i.e.*, expected to be hours or days) the magnitude of potential adverse effects is expected to be low. If percussion hammers are used, construction work periods will avoid peak migration periods when juvenile salmonids are expected to be present. Therefore, only a small number of individuals in each of the listed ESU/DPS should be affected.

b. *Stranding and Fish Rescue*

Juvenile salmonids may become stranded behind the cofferdam during construction. Cofferdam construction that occurs between August 1 and November 30 would avoid migration periods of adult and juvenile winter- and spring-run Chinook salmon. Some juvenile and adult steelhead could be present during this period, based on salvage data at the CVP/SWP Fish Facilities (BOR 2004), but the numbers are expected to be very low since water temperatures at that time of year are above the preferred level. Adult salmon, steelhead, and sturgeon are strong swimmers, and are likely to avoid construction-related disturbance during sheet pile driving, and avoid being entrained or stranded. Juvenile salmon and steelhead also demonstrate a startle or avoidance response to noise (Anderson 1990). However, some juveniles may follow the contours of the shoreline into the area behind the cofferdam, where they may become stranded during dewatering. We anticipate that stranding in the cofferdam will be low due to work windows that avoid peak migration periods for adult and juvenile salmonids. Sturgeon should avoid the cofferdam since they are known to prefer deeper, mid-channel areas.

As the water level behind the cofferdam is drawn down to allow construction of the fish screen in the dry, salmon, steelhead, and sturgeon if present will be rescued (*i.e.*, netted) and returned to Victoria Canal according to the Fish Rescue Program guidelines (Attachment F, ASIP). Two fish rescue events are anticipated, one prior to closing the cofferdam and again when water depths are approximately two feet. All portable pumps would be equipped with fish screens using a 1.75 mm mesh. The remaining water will be seined or dip-netted to remove any fish. Standard fish handling techniques will be used. Although salmonids recover well from capture, handling, and short relocations, there may be incidental injury and death to individuals during the rescue. We expect that the rescue program will not capture and release every entrained juvenile. Results of a similar fish rescue operation behind the cofferdam installed during construction of a fish screen showed that no salmonids were stranded, and fewer than 10 fish total were collected in the fish rescue. Since construction methods and schedules for the proposed AIP are similar to past construction of cofferdams at City of Sacramento, American River, and Wilkins Slough fish screens, and a similar fish rescue program will be applied when the cofferdams are closed, the loss of sturgeon and salmonids due to stranding is expected to be low to non-existent.

c. *Exposure to Increased Turbidity, Sedimentation and Contaminants*

Cofferdam installation, dredging, and site preparation will result in increased short-term, localized turbidity and suspended sediment concentrations within Victoria Canal. Exposure to increased turbidity and suspended sediment may affect Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and green sturgeon through disruption of normal feeding and migration behavior, and exposure of juveniles to increased predation by forcing them from shallow water refugia into the open water of the river channel. The period of increased turbidity will be limited to pre-project dredging and installation of the cofferdam, which will require up to 60 days. Increased turbidity and suspended sediments will occur intermittently during construction of the cofferdam.

Numerous studies show that suspended sediment and turbidity levels moderately elevated above natural background values can result in non-lethal detrimental effects to salmonids. Suspended sediment affects salmonids by decreasing reproductive success, reducing feeding success and growth, causing avoidance of preferred rearing habitats, and disrupting migration cues (Bash *et al.* 2001). Sigler *et al.* (1984) in Bjornn and Reiser (1991), found that prolonged turbidity between 25 and 50 NTUs reduced growth of juvenile coho salmon and steelhead. MacDonald *et al.* (1991) found that the ability of salmon to find and capture food is impaired at turbidities from 25 to 70 NTUs. Bisson and Bilby (1982) reported that juvenile coho salmon avoid turbidities exceeding 70 NTUs. Increased sediment delivery can also fill interstitial substrate spaces and reduce cover for juvenile fish (Platts *et al.* 1979) and abundance and availability of aquatic invertebrates for food (Bjornn and Reiser 1991). We expect turbidity to affect Chinook salmon and steelhead in much the same way that it affects other salmonids, because of similar physiological and life history requirements between species.

Newcombe and Jensen (1996) believe that impacts on fish populations exposed to episodes of high suspended sediment may vary depending on the circumstance of the event. They also believe that wild fish may be less susceptible to direct and indirect effects of localized suspended sediment and turbidity increases because they are free to move elsewhere in the system and avoid sediment related effects. They emphasize that the severity of effects on salmonids depends not only on sediment concentration, but also on duration of exposure and the sensitivity of the affected life stage.

Suspended sediment from construction activities would increase turbidity at the project site and could continue 1,000 feet upstream and downstream of the new intake site. Although Chinook salmon and steelhead are highly migratory and capable of moving freely throughout the action area, an increase in turbidity may injure juvenile salmonids by temporarily disrupting normal behaviors that are essential to growth and survival such as feeding, sheltering, and migrating. Injury is caused when disrupting these behaviors increases the likelihood that individual fish will face increased competition for food and space, and experience reduced growth rates or possibly weight loss.

The ASIP concludes that the construction of the proposed intake and fish screen are expected to suspend sediment and turbidity at levels below what is reported in the literature as causing adverse effects (*e.g.*, 25 to 70 NTUs). The conservation measures proposed (*i.e.*, Regional Board requirements) are designed to keep turbidity within 10 to 20 percent of the natural turbidity in Victoria Canal. In either case, suspended sediment concentrations are not expected to exceed the Regional Board standard of 260 mg/l, which is well below levels measured in NTUs that cause sublethal physiological effects to salmonids.

Project-related turbidity increases may affect the sheltering ability of some juvenile salmon and steelhead and may cause injury or death by increasing their susceptibility to predation. The extent of these effects is expected to be small for several reasons. First, the highest turbidity levels will occur at the end of the seasonal juvenile migration period and should affect only a small portion of each population. Second, the overall duration of the effect will be temporary, lasting approximately 60 days. Additionally, based on observations during similar construction activities, turbidity plumes are not expected to extend across Victoria Canal (*i.e.*, 500 feet in width), but rather the plumes are expected to extend downstream from the site along the western side of the canal, affecting only a portion of the fish within the action area. Turbidity plumes may be as wide as 100 feet, and extend downstream for up to 1,000 feet. Once construction stops, water quality is expected to return to background levels within hours. Adherence to erosion control measures and BMPs such as use of silt fences, straw bales and straw wattles will minimize the amount of project-related sediment and minimize the potential for post-construction turbidity changes.

As a result of the limited timing and distribution of any sediment plumes generated during construction, salmon and steelhead will have the opportunity to avoid the plume during their upstream or downstream migration. Therefore turbidity-related effects that prevent successful upstream and downstream migration are not anticipated. Using white sturgeon as a surrogate, studies have shown that individuals do not disperse during in-channel dredging and exhibit a high degree of site fidelity (U.S. Geological Survey 2004). Green sturgeon may be attracted to sediment plumes during construction looking for food. However, given the spatial and temporal extent of the disturbance, turbidity and sediments are not expected to adversely effect green sturgeon since a daytime disturbance that occurs in shallow water will have minimal short-term effects on individuals that are likely to be located nearby in deeper water. White sturgeon typically moved to shallower water at night (USGS 2004).

Fuel spills or use of toxic compounds during project construction could release toxic contaminants into Victoria Canal and could injure or kill salmon, steelhead, and sturgeon. Specific contaminant effects to green sturgeon are unknown, however studies on similar surrogate species, Atlantic sturgeon (*Acipenser oxyrhynchus*) and Shortnose Sturgeon (*Acipenser brevirostrum*), found that sturgeon tend to be more sensitive than salmonids in tests for contaminants (Dwyer *et al.*, 2005). Therefore, we will assume that contaminant levels that may effect salmonids will also be likely to effect green sturgeon. NMFS expects that adherence to a Hazardous Materials Control Plan (as described in the conservation measures) and BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak. If the Hazardous Materials Control Plan and BMPs are successfully implemented, NMFS does not expect fuel spills or toxic compounds to cause injury or death to individual fish.

d. *Pipeline Construction*

The proposed pipeline for the AIP will cross Victoria Island and be routed under Old River to connect to CCWD's existing Old River Facility. The pipeline will be constructed by tunneling up to 50 feet under Old River, approximately 1 acre of land near the crossing will be affected during construction on the dry-side of the levee. No freshwater marsh or aquatic habitat will be disturbed and the entire area will be restored to pre-construction conditions. The depth of the tunneling (*i.e.*, 50 feet) under Old River should minimize any chance that accidental frac-outs will leak drilling material into the channel. As above, adherence to a Hazardous Materials Control Plan and BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks. Therefore, no adverse impacts to listed fish species are anticipated from pipeline construction.

2. Operations and Maintenance Impacts

Operations and maintenance activities will be performed to maintain the design criteria of the proposed water intake and fish screen. Operations and maintenance of the fish screen will reduce fish entrainment at the pumping facilities, but also may cause limited adverse effects to fish exposed to the structure and maintenance operations. The facility will not increase water diversions from the Delta and will, therefore, not affect baseline instream flows (see *Assumptions Underlying this Assessment*). The proposed fish screen project will result in a change in the seasonal distribution of diversions between CCWD's Old River, and Rock Slough Intake Facilities. The maximum combined diversions of the existing Old River intake and the proposed Victoria Canal will not exceed 320 cfs. CCWD does not expect overall annual water consumption to increase due to the proposed project, because CCWD is not increasing its CVP contract water or water rights out of the Delta. The new intake on Victoria Island will change CCWD's integrated operations by shifting some pumping from Old River and/or Rock Slough intake to the new intake during periods when water quality is better in Victoria Canal.

Fish exposure to screens and associated features may affect some individuals through direct physical injury or by altering swimming behavior and causing an increased vulnerability to predation. Site-specific flow data collected from the canal and modeling results confirm that the ambient sweeping velocity in the canal exceeds 0.4 fps greater than 70 percent of the time (*i.e.*, flows in the canal exceed 800 cfs greater than 70 percent of the time). The exposure time at a sweeping velocity of 0.4 fps is approximately 6.5 minutes (CCWD fish screen design specs). The anticipated exposure time of 6.5 minutes, and the approach and sweeping velocities at the screen have the potential for fish to be injured or killed along the surface of the screen. Therefore, the size of the fish screen has been increased by 7-10 percent to minimize potential impingement of fish as recommended by the AFSP technical team. The fish screen also has been designed to have a smooth exterior surface and upstream and downstream transition areas that reduce or eliminate areas where juvenile salmonids are concentrated or disoriented to reduce the risk of predation, as well as to reduce or eliminate structural locations offering cover for predatory fish.

Factors that could affect screen performance are debris and sediment accumulation in front of the fish screen structure. Debris and sediment accumulations could result in increased approach velocities and loss of hydraulic uniformity at the screen face. Several operation and maintenance elements have been incorporated in the facility to avoid or minimize this occurrence. The automated traveling rake cleaning system will be used when the facility is operating to remove debris from the face of the fish screen. Pressure washing will be used to clean individual screen panels and periodic maintenance dredging, if necessary, will remove additional accumulations of sediment in Victoria Canal. A floating log boom will be provided in Victoria Canal to deflect floating debris that may otherwise impinge on the screen, damage screen panels, or damage the traveling rake cleaning system. Continuous monitoring of screen condition and performance will insure that the screen is operating to criteria. The long-term use of the automated rake cleaning system, pressure washing, periodic dredging, and maintenance and replacement of fish screen parts is expected to keep the fish screen operating within criteria for the life of the project. Maintenance actions such as dredging and screen replacement will be infrequent (*e.g.*, periodic maintenance dredging at the existing Old River facility has not been required in 10 years of operation) and occur when pumping is non-operational. Maintenance actions, therefore, are not expected to have significant effects or result in appreciable injury or death of individuals.

3. Habitat Impacts

Construction of the new intake and fish screen permanently will alter existing habitat through the use of riprap on the banks and deepening of the shallow water habitat in front of the proposed intake. The amount and type of habitat is described in the *Project Description*. CCWD would mitigate for 0.7 acre of low quality shallow-water habitat by purchasing 2.1 acres (at a 3:1 mitigation ratio) of high quality, freshwater emergent marsh habitat in an approved mitigation/conservation bank. The amount of habitat modified is relatively small, compared to the size of the ESU and designated critical habitat in the Delta. Construction of the fish screen will exclude fish from 100 to 200 feet of shoreline, but since the fish screen will be near the bank, minimal surface area (0.2 acre) of aquatic habitat will be lost. In addition, the location of the fish screen has been designed to create more uniform cross flow in front of the screen, reducing the risk of eddies or irregular hydraulics near the intake that could be detrimental to fish. The change in habitat quality and availability associated with replacing existing riprap will be short-term (see turbidity and sediment disturbances already discussed) and minimal since it would silt over in time. Modification of the habitat in front of the fish screen by deepening the channel to a depth of 10 to 15 feet will be a permanent loss of 0.2 acre of shallow water tidal habitat, but may provide some benefit to green sturgeon by diversifying the channel morphology and providing shelter. Large numbers of juvenile green sturgeon have been observed in association with deep holes behind diversion structures like the radial arm gates at Clifton Court Forebay (CDFG 2002, as cited in Beamesderfer 2004) approximately 3 miles from the proposed intake site.

Anadromous fish are present seasonally in the action area. The surrounding habitat is characterized as a wide shallow tidal channel confined by levees, stabilized with riprap, and having a mid-channel tule island extended the length of Victoria Canal, with no floodplains and sparse riparian vegetation. Because of these habitat conditions, the action area does not provide favorable rearing conditions for salmon or steelhead, and primarily functions as a migration corridor. The area is not used as spawning habitat by salmonids or green sturgeon. Due to the degraded condition of the already modified habitat (*i.e.*, riprap levees) throughout the action area, the impacts of habitat loss on juvenile growth are expected to be small. The function of the action area as a migratory corridor will not be impaired by the loss of habitat behind the fish screen.

The replacement of 15,000 square feet of existing riprap (*i.e.*, 400 to 500 feet on each side of the fish screen structure or 0.3 acre) will maintain predator habitat availability and predation rates throughout the action area. Predation studies indicate that juvenile salmon and steelhead may be exposed to increased susceptibility to predation by native and introduced fish species along riprapped banks (Peters *et al.* 1998, FWS 2000). Predatory fish in the central and south Delta have a broad tolerance of environmental conditions and are well distributed throughout the action area (*i.e.*, making up the majority of fish sampled). Potential predator species include Sacramento pikeminnow, striped bass, largemouth bass, smallmouth bass, and several sunfish species. Recent radio-tagging studies have shown low rates of juvenile Chinook survival in Georgiana Slough and the south Delta attributed to predation (Brandes and McLain 2001, Vogel 2004). Studies on the Sacramento River (Michny and Deibel 1986, Michny 1989) and in several other western states (Peters *et al.* 1998, Tiffan *et al.* 2002) have shown lower salmonid rearing densities and higher predator densities along armored banks. The COE (2004) model also assumes that mortality is highest for juvenile salmonids along armored banks because they provide predator access, and lowest along natural banks with gravel and cobble sized materials because they exclude predators. Although predation is expected to increase with the additional application of riprap, the habitat modification will not be substantial, and any increase in the predation rate should be relatively small (relative to the baseline) since the banks are already rocked. The application of 15,000 square feet (0.3 acre) of additional rock underwater is not expected to affect the overall suitability of nearshore habitat for rearing and migration.

The proposed action would continue to contribute cumulatively to the negative factors affecting pelagic fish species by maintaining the preferred habitat of introduced organisms (*i.e.*, riprap), diverting water from the Delta containing food sources (zooplankton) necessary for survival, and by contributing to changes in the hydrologic conditions (*i.e.*, reverse flows) that confuse migratory fish. In addition, the proposed AIP would contribute incrementally to the cumulative adverse impacts to the quality and quantity of critical habitat available within the Delta for CV steelhead, Sacramento River winter-run Chinook salmon and CV spring-run Chinook salmon. The purchase of mitigation credits in a shallow water emergent marsh may not provide the same migratory function as the habitat along Victoria Canal, but may provide better rearing habitat quality, which is lacking in Victoria Canal.

a. *Hydraulic Changes to Habitat*

The presence of a water intake on Victoria Canal would contribute to localized changes in hydraulic conditions (*e.g.*, water velocities, water depths, and water circulation periods), and the availability of cover habitat utilized by salmon, steelhead, and green sturgeon. Changes in local flow patterns may affect sediment deposition, thereby effecting benthic macroinvertebrates (*i.e.*, food source for listed fish). Changes in local water velocities are not expected to be significant or represent a barrier to either adult or juvenile fish movement due to the proposed intake structure being set back from the existing bank and not extending into Victoria Canal.

Continued operation of the new 250 cfs intake will remove approximately 3-10 percent of the flow down Victoria Canal throughout each diversion season. Flows average about negative 3,500 cfs during August, and range from negative 1,000 cfs to negative100 cfs in April (CCWD and BOR 2006b). Flows that are more negative indicate a larger volume of water moving in the reverse direction (*i.e.*, upstream, towards the CVP/SWP pumps) then flows that are less negative (*i.e.*, -1000 cfs is a larger volume of reverse flows than -100 cfs). Water surface elevation is strongly influenced by tidal changes and can vary by more than five feet during one tidal cycle. Tidal range is about 3.5 feet in Victoria Canal (CDEC 2007).

A reduction in flows of this magnitude would not be significant or have an effect on fish behavior given the much larger tidal variation in flows. Also, there would be no net difference in flows from the baseline conditions, since this amount of water currently is diverted at CCWD's Old River Facility. Changes in flow and water depth may attract predatory fish to the intake structure and may change the distribution of these individuals within Victoria Canal, but are not expected to increase the overall abundance of predatory fish in the action area.

The proposed action would reduce diversions from Rock Slough, where loss of listed salmonids occurs from CCWD's unscreened diversion and predation within the 4-mile-long Contra Costa Canal leading to the pumping plant. Therefore, shifting the unscreened diversions at the Rock Slough intake over to the newly screened diversion in Victoria Canal would have a net beneficial effect on salmon and steelhead (ASIP Table 4.1-3).

Effects on key Delta hydraulic indicators were modeled using a 72-year period of record (CALSIM II) to project the existing, future, and cumulative conditions for the proposed project. These hydrologic indicators are typically used as State Water Quality Control Board standards (*i.e.*, Decision 1641) to control the export of water diversions from the Delta and include: Total Delta Outflow, Total Delta Inflow, Sacramento River Inflow (measured at Rio Vista), San Joaquin River Inflows (measured at Mossdale), the Export-to-Inflow Ratio, and the location of X2 (*i.e.*, defined as the location in the Delta where the 2-part-per-thousand salinity isohaline is established). The proposed project resulted in a less than one percent chance that in any month these hydraulic indicators changed. A change of one percent or less is well within the error of the models.

The proposed AIP would shift the location and timing of a portion of CCWD's diversions from the Old River and Rock Slough intakes to Victoria Canal. Total diversions from CCWD's three intakes are small, approximately 135 TAF, when compared to overall tidal flows in the Delta, and combined CVP/SWP exports which total 6 million acre feet (MAF). Changes in total monthly diversion rates (all intakes) compared to the existing and future condition amounted to 500 acre feet and 300 acre feet, respectively (CCWD and BOR 2006b, EIS/EIR Table 4.2-4). Total CCWD diversions would decrease from December through July, when juvenile salmonids are present, and increase from August through November, when juvenile salmonids are absent. Therefore, future changes in location and timing of CCWD diversions are not expected to affect overall Delta hydraulic conditions as indicated by modeling results.

4. Fish Screen Losses at CCWD Intakes

Construction of the proposed new fish screen on Victoria Canal would result in a limited amount of incidental take associated with the long-term operation of the fish screens. Typically, the performance of a positive barrier fish screen, such as the one proposed, is expected to reduce entrainment and impingement of fish by 95 percent or more when compared to an unscreened diversion. As designed, the proposed screen will exceed the criteria for juvenile salmonids by being protective of delta smelt, a fish with inferior swimming capabilities compared to juvenile salmonids. When taken as a whole, the integrated operation of CCWD's intakes would experience a net reduction in incidental take, due to operating the proposed Victoria Canal intake (Table 6). Increased take associated with the proposed action on Victoria Canal would be offset by decreased take at Rock Slough and Old River. Table 6 is meant to show the proposed action will decrease the overall loss of listed fish due to CCWD's combined diversions. Reduction in take is due to the shifting of diversions away from the unscreened Rock Slough intake and a shift in timing of some CCWD diversions from spring to fall (when listed fish are less vulnerable to entrainment). Historically, peak periods for CVP/SWP salvage of juvenile salmon and steelhead occur in the spring from February through May (CDFG 2005, in CCWD and BOR 2006a).

Table 6. Index of Estimated Annual Average Net Entrainment/Impingement Losses for the Proposed Action (future conditions) Compared to the No-Action Alternative (Hanson 2005, in CCWD and BOR 2006a, Table 4.1-3).

Taxa (Juveniles)	*Rock Slough*	*Old River*	*Victoria Canal (proposed)*	*Overall Net Change*
steelhead	-12	-5	4	-13
Chinook salmon	-207	-77	56	-227
delta smelt	-88	-60	26	-121
larval delta smelt	-250	-1,990	1,032	-1,208
splittail	-1,256	-164	152	-1,268
striped bass	-11,559	-1,394	1,519	-11,434

Note: Negative values under Rock Slough and Old River denote less entrainment/impingement under future conditions than existing conditions based on historic fish densities. Positive values under Victoria Canal denote estimated entrainment into the new diversion.

Previous fish monitoring conducted at CCWD's Old River Fish Screen Facility can be used to compare the expected performance of the proposed screen on Victoria Island because it is similar in size, design, and location. Modeled entrainment in Table 6 is significantly higher than actual observations of entrainment at Old River because modeled numbers are derived from average monthly densities per thousand acre feet of water at CVP over a 73 year historic period of record (1922 through 1994). Since 1998, sampling behind the fish screen with a large sieve net, no salmon or sturgeon were observed, and only one delta smelt was caught (Morinaka 2000). The results of fish sampling demonstrate that the low approach velocities designed for the proposed fish screen at Victoria Island would allow juvenile fish to escape entrainment.

NMFS does not expect juvenile green sturgeon to be entrained at the proposed new fish screen because of their larger size than salmonids in the Delta (*i.e.*, fish screens are designed to protect smaller size fish). Based on CVP/SWP historical salvage from 1981 to 2006, green sturgeon lengths averaged 330 mm with a range of 136 to 774 mm. The screen size opening of 1.75 mm would prevent any green sturgeon from becoming entrained. Recent experiments by Swanson, Young, and Cech (2004) exposed juvenile Chinook salmon and green sturgeon to a simulated fish screen in a large annular flume. The incidence of impingement was very low (< 1 percent) for experimental fish. Therefore, NMFS anticipates that losses due to entrainment and impingement will be minimal. Overall, the proposed AIP is likely to result in a net benefit to listed fish species (Table 6) through the reduction in entrainment and impingement at CCWD's three other diversions.

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.

Non-Federal actions that may affect the action area include ongoing agricultural activities and increased urbanization. Agricultural practices in the Delta may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased sediments and contaminants or reductions in water flow in channels flowing through the Delta. Unscreened agricultural diversions throughout the Delta entrain fish, including juvenile salmonids. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the Delta. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides, herbicides and other contaminants that may adversely affect salmonid reproductive success and survival rates (Dubrovsky *et al.* 1998, 2000; Daughton 2003).

The Delta and East Bay regions, which include portions of Contra Costa, Alameda, Sacramento, San Joaquin, Solano, Stanislaus, and Yolo counties, are expected to increase in population by nearly 3 million people by the year 2020 (California Commercial, Industrial, and Residential Real Estate Services Directory 2002). Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. The general plans for the cities of Stockton, Brentwood, Lathrop, Tracy, Manteca, and their surrounding communities anticipate rapid growth for several decades to come. The anticipated growth will occur along both the I-5 and US-99 transit corridors in the east and Highway 205/120 in the south and west. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions will not require Federal permits, and thus will not undergo review through the section 7 consultation process.

Greater urbanization in and around the Delta will lead to increased recreational boat operation, resulting in more levee erosion from wave action, contamination from the operation of engines, and abandonment of vessels. Commercial vessel traffic is expected to increase with the redevelopment plans of the Port of Stockton. Increased commercial and recreational traffic in the Delta is also anticipated to further the rapid spread of non-native invasive plants and animals (*e.g.*, Asiatic clams, Japanese gobies, Chinese mitten crab, and water hyacinth) that compete with native species for food and space. These physical effects are expected to adversely affect aquatic organisms, including listed salmonids and green sturgeon resulting in lower survival rates in the Delta.

The combined effects of continued land subsidence, sea level rise, increasing seismic risk to levees, and maintaining a homogeneous freshwater environment make the current management of the Delta unsustainable for agencies relying on Delta waters (Lund *et al.* 2007). Evidence from fishery monitoring conducted by CDFG, CDWR, FWS, and others has shown a dramatic decline in indices of abundance for a variety of pelagic fish species such as: delta smelt, longfin smelt (*Spirinchus thaleichthys)*, striped bass, and threadfin shad (*Dorosoma petenense)* that reside in the Delta. The recent pelagic organism decline (POD) has heightened the concern regarding the overall health and condition of these resident and migratory fish, as well as the zooplankton and phytoplankton that make up the basis for the food web and habitat conditions within the Delta. The four primary factors that have been implicated in the POD are: (1) changes in the food web resulting from the introduction of exotic plants and organisms, (2) fish losses associated with greater winter-time diversions from the CVP/SWP export pumps, (3) changes in the timing of hydraulic conditions in the Delta associated with increased export pumping since 1995, and (4) chronic and acute toxicity effects from discharges of contaminants, including pesticides and herbicides associated with land use within the Central Valley (Armour *et al.* 2005, in CCWD and BOR 2006b). Therefore, the likelihood of these issues worsening in the future is considered high.

The effects of climate change are likely to occur within the next 30 years as described in *Status of Species and Critical Habitat.* The corresponding change in fish populations and their habitats could vary considerably. A rise in air temperatures of only a few degrees could have far reaching negative impacts on small populations of listed salmonids and green sturgeon that are entirely dependent on cold-water releases from large storage reservoirs like those found within the Central Valley. Although there is some uncertainty, most models predict average sea levels will rise between 0.3 and 2.9 feet by the year 2100, which is likely to affect Delta water surface elevations and salinity levels (CDWR 2006). Salt water intrusion into the central and south Delta would shift the diversion of water to spring and winter months when water quality is better, negating some of the beneficial effects of the proposed action. Slightly higher Delta water surface elevations or lower summer/fall flows over the next 100 years are expected to have little effect on the proposed project or on fish populations (CCWD and BOR 2006b). However, climate warming is expected to reduce the amount of habitat available to Central Valley salmonids that reside in freshwater during the summer (*i.e.*, CV steelhead, CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon and green sturgeon), since artificial barriers restrict the movement of fish to higher elevations (Lindley *et al.* 2007).

VII. INTEGRATION AND SYNTHESIS

A. Effects on Listed Species

NMFS finds that the proposed action will affect Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and green sturgeon through construction-related impacts, operations, and habitat modification and loss at the project site. Because the proposed project incorporates a suite of impact avoidance and minimization measures, the potential adverse effects of the proposed project are anticipated to be small, limited, or short-term in nature.

Construction-related impacts are limited to cofferdam installation, cofferdam dewatering, and implementation of the fish rescue plan. Cofferdam installation will cause temporary increases in underwater sound pressure and turbidity levels, and may injure or kill juveniles by causing physical trauma or causing increased susceptibility to predation. Cofferdam installation will occur between August 1 and November 30, and the new intake/fish screen will take approximately 24 months to complete. Construction activities would be limited to daylight hours except for the tunneling under Old River, which could occur 24 hours a day. The cofferdam dewatering may isolate and strand juvenile Chinook salmon, green sturgeon and steelhead. Individuals may be entrained into pumps and killed as water is drawn down prior to the fish rescue. The fish rescue may injure or kill fish during capture, transport, and relocation to Victoria Canal. The dewatering and fish rescue are expected to be a one-time occurrence, lasting only 1 to 2 days.

Juveniles are more likely to be affected by the construction activities because of their small size, reliance on nearshore aquatic habitat, and vulnerability to factors that affect their growth and distribution. Adults should not be injured because their larger size, preference for deep water, and crepuscular migratory behavior should enable them to avoid construction-related impacts. Although juveniles exhibit crepuscular behavior, because of their use of near-shore aquatic habitats, they are more susceptible to impacts from daytime construction activities. Construction impacts following the 120-day cofferdam installation period should be small to negligible because most work will be performed "in the dry" behind cofferdams, and other in-channel work will avoid peak juvenile outmigration and adult upstream migration periods.

Turbidity-related injury and predation will be minimized by implementing the proposed conservation measures such as implementation of BMPs, Erosion Control, and adherence to Regional Board standards. Adherence to BMPs is expected to prevent fuel spills and the release of other toxic compounds from causing injury or death to individuals. The fish rescue plan will minimize the mortality of fish that are entrained or stranded within the cofferdam.

Long-term operations and maintenance actions will occur for the lifespan of the project. Conservation measures and integrated design features are expected to minimize or avoid adverse operations and maintenance effects by maintaining the fish screen to NMFS criteria, repairing or replacing damaged parts, and avoiding peak migration periods during maintenance activities. Near-screen conditions are expected to be favorable for survival and because NMFS and CDFG fish screen criteria will be met under a large range of tidal conditions and pumping conditions. Therefore, injury and death rates for operations and maintenance activities should be low.

Maintenance actions such as dredging and screen replacement will be infrequent or occur during periods of non-operation. As an example, CCWD's existing Old River Intake Facility located close by, has not required any maintenance dredging in 10 years of operations. The proposed intake on Victoria Canal may have different sediment conditions, but NMFS expects dredging will be as infrequent as the Old River Facility, and occur only as needed. Maintenance actions, therefore, are not expected to have significant effects or result in appreciable injury or death of individuals.

The addition of a new fish screen on Victoria Canal is expected to provide long-term net benefits to listed fish species by allowing a greater volume of CCWD's current diversions to pass through screened facilities, thus reducing losses at CCWD's unscreened Rock Slough Intake (Table 6).

Overall, NMFS expects that the construction and operation of the proposed AIP will have some minor, short-term effects, but in the long term, given the integrated operation of CCWD's other intakes, the AIP incrementally will reduce juvenile Chinook salmon, steelhead, and green sturgeon entrainment, injury, and mortality from the current baseline condition.

B. Impacts of the Proposed Action on ESU Survival and Recovery

The adverse effects to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and green sturgeon within the action area are not expected to affect the overall survival and recovery of the ESUs. This is largely due to the fact that construction impacts will be temporary, confined to individuals present in the local area, and will be minimized through the implementation of the proposed conservation measures including the purchase of 2.1 acres of shallow water emergent marsh habitat. Construction-related impacts will not impede adult fish from reaching upstream spawning and holding habitat, or juvenile fish from migrating to downstream rearing areas. The number of individuals actually injured or killed is expected to be small compared to the sizes of the respective salmonid and sturgeon populations; therefore, adverse population-level impacts are not anticipated.

The viable salmonid population criteria developed by McElhaney *et al.* (2000) uses four measures of population viability (*i.e.,* abundance, productivity, diversity, and spatial structure) to determine the health of a salmonid ESU. Population viability can be assessed by using two approaches described by Lindley *et al.* (2007); (a) the representation and redundancy rule, and (b) specific sources of threats. The goal of both of these approaches is to spread risk and maximize the future potential for adaptation. The proposed project is not expected to alter the life history or genetic diversity that contribute to the viability of salmonid ESUs. The addition of a new fish screen would not qualify as a specific threat (*e.g.*, a toxic spill, volcanic eruption, wildfire, or drought) that could extirpate a population. Although habitat diversity would be slightly altered, abundance would be increased as shown in the modeled entrainments effects. The impacts of the proposed action are not expected to occur at the scale where any one of these measures would impact listed salmonids at the population level.

The long-term operation of the proposed fish screen will reduce entrainment and related mortality of juvenile Chinook salmon, CV steelhead, and green sturgeon through reduced use of CCWD's unscreened diversion. Since construction impacts are expected to be temporary and avoid peak migration periods, and the integrated operation of CCWD's other diversions will reduce entrainment and increase juvenile survival in the south Delta, the proposed action is not expected to appreciably reduce the likelihood of survival and recovery of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and the Southern DPS of North American green sturgeon within the action area.

C. Impacts of the Proposed Action on Critical Habitat

Impacts to the designated critical habitat of CV steelhead include the replacement of 0.3 acre of existing riprap, the change in water depth of 0.2 acre of shallow water tidal habitat, addition of 0.3 acre of new riprap underwater on either side of the fish screen, and replacement of 0.2 acre of existing riprap with modified levee section. A total of 1.0 acre of modified critical habitat at the Victoria Canal intake site will be fully compensated for with 2.1 acres of shallow water emergent marsh habitat to be purchased and preserved by CCWD. The proposed fish screen will result in a permanent loss of approximately 100 to 200 linear feet of existing nearshore aquatic habitat along the Victoria Canal levee. Habitat elements, or primary constituent elements (PCEs), within the action area (*e.g.*, LWD, SRA cover, shoreline habitat complexity, refugia, and water quality) currently are degraded, fragmented, and do not contribute beneficially to the conservation value of critical habitat. However, NMFS (2005b) in their final assessment of critical habitat for CV steelhead rated the action area (*i.e.*, San Joaquin Delta) as having a high conservation value (ranked 10 out of a possible 18), mainly due to its importance as a migratory corridor. Although the proposed action will maintain these degraded and fragmented habitat conditions, the proposed habitat modifications and loss are relatively small and will result in habitat conditions that are similar to existing site conditions. The action area is expected to continue to function primarily as a migration corridor for listed salmonids and as a rearing area for juvenile green sturgeon. Therefore, we do not expect project-related impacts to result in a reduction in the conservation value of critical habitat for CV steelhead.

Impacts to the designated critical habitat for Sacramento River winter-run Chinook salmon and CV spring-run Chinook salmon are expected to be less than significant based on the CALSIM II modeling performed for potential impacts on CVP and SWP water supply. Impacts to water supply would correspond to impacts to designated critical habitat, since changes in reservoir storage alter flows and water temperatures downstream of project dams. Most of the changes are very small relative to the size of the reservoirs, resulted in less than 1 percent increase or decrease in total reservoir storage. For perspective, storage changes in Shasta Reservoir ranged from 0.7 to 16.5 TAF, while evaporative losses were 94 TAF. The changes caused by the proposed project under future conditions are not large enough to result in operational changes downstream or impact water deliveries, see ASIP Table 4.2-15 (CCWD and BOR 2006).

Project impacts to the cold water pool in Shasta Reservoir were analyzed by looking at exceedences to the 1.9 MAF end of September storage criteria (*i.e.*, temperature criteria required for winter-run Chinook salmon spawning and incubation in the upper Sacramento River). Out of the 73 year period of record from 1922 through 1993, the number of exceedences was the same in the base case as in the future conditions. Under future conditions, the proposed action increased storage slightly in 8 years and decreased storage slightly in 5 years. Therefore, we do not expect project-related impacts to result in a reduction in the conservation value of critical habitat for Sacramento River winter-run Chinook salmon or CV spring-run Chinook salmon.

Critical habitat for green sturgeon has not yet been designated; however, given that most of the PCEs of critical habitat for salmonids within the project site will return to pre-project conditions within two years, NMFS does not expect the function or value of the habitat as a whole will be impaired given the total habitat available.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of the listed species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the Alternative Intake Project, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, or the Southern DPS of North American green sturgeon, and is not likely to destroy or adversely modify designated critical habitat for CV steelhead, Sacramento River winter-run Chinook salmon or CV spring-run Chinook salmon.

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 kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it 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 listing of the Southern DPS of North American green sturgeon became effective on July 7, 2006, and some or all of the ESA section 9(a) prohibitions against take will become effective upon the future issuance of protective regulations under section 4(d). Because there are no section 9(a) prohibitions at this time, the incidental take statement, as it pertains to the Southern DPS of North American green sturgeon does not become effective until the issuance of a final 4(d) regulation.

The measures described below are non-discretionary, and must be undertaken by BOR and CCWD, so that they become binding conditions of any grant or permit, as appropriate, for the exemption in section 7(o)(2) to apply. BOR has a continuing duty to regulate the activity covered by this incidental take statement. If BOR: (1) fails to assume and implement the terms and conditions, or (2) fails to require the contractors 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, BOR or CCWD must report the progress of the action and its impact on the species to NMFS, as specified below in this incidental take statement (50 CFR §402.14(i)(3)).

A. Amount or Extent of Take

NMFS anticipates incidental take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and green sturgeon through construction-related impacts, operations and maintenance impacts, habitat modification and loss of habitat at the project site. Specifically, it is anticipated that construction-related take will be in the form of harm, harassment, or death from physical injury or predation related to increased underwater sound pressure levels and turbidity, entrainment within the cofferdam, stranding, and physical injury or death from cofferdam installation, dewatering, and fish rescue efforts. Long-term operations-related take in the form of injury and death are anticipated from physical injury of individuals that contact the screen face multiple times, and continued exposure to project features such as riprap that contributes to predation of juveniles. NMFS does not anticipate take of adult salmonids or green sturgeon.

NMFS cannot, using the best available information, quantify the anticipated incidental take of individual Sacramento River winter Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and green sturgeon because of the variability and uncertainty associated with the population size of each species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. For example loss of Sacramento River winter-run Chinook salmon at the nearby CVP/SWP pumps varies from 3,000 to 20,000 juveniles per year depending on the water year type, population size, pumping practices and hydrology.

Because we are unable to determine specific numbers of listed species anticipated to be taken by the implementation of the proposed project, NMFS is designating ecological surrogates, or specific, measurable elements of the proposed project that are expected to affect the habitat and ecology of the listed fish and result in the take of those fish. These ecological surrogates will be used to describe the extent of take anticipated to be caused by the proposed project, and to monitor the level of take that is occurring during construction and operation of the facility. The most appropriate ecological surrogates for representing the extent of take caused by the AIP are: (1) construction time-lines and duration, (2) the level of underwater sound exposure generated by pile driving activities, (3) increases in turbidity caused by construction activities, (4) the mortality rate of fish salvaged during the rescue operations, (5) the extent of habitat loss or modification resulting from the project, and (6) the rate of water diversion realized by the operation of the facility.

The following parameters associated with these ecological surrogates are expected to be met and/or maintained to keep the level of incidental take from project activities within the anticipated range:

1. Pile driving will occur between August 1 and November 30 during construction of the cofferdam. Take in the form of injury and death from pile driving is not expected to occur for more than a total of 120 days or more than 10 meters from the sound source. Sound exposure levels are not expected to exceed 180 dB. Any exceedence of these parameters would result in an exceedence of the anticipated take levels.

2. Take in the form of injury and death from predation is expected from turbidity level increases that would exceed the Regional Board standards listed in the *Description of the Proposed Action* section, between August 1 and November 30 of the first construction year, extending 305 meters upstream and downstream of the intake site. Any exceedence of these parameters would result in an exceedence of the anticipated take levels.

3. Take in the form of capture, injury and death is expected from the fish rescue that will occur within enclosed cofferdams between August 1 and November 30 of the first

construction year. Death from fish rescue efforts is not expected to exceed 10 percent of fish captured. Any exceedence of these parameters would result in an exceedence of the anticipated take levels.

4. NMFS estimates that construction and operation of the fish screen will result in the permanent loss of up to 200 linear feet and 1.0 acre of existing nearshore aquatic habitat (*i.e.*, 0.5 acre of shallow water habitat and 0.5 acre of replaced riprap). Any exceedence of these parameters would result in an exceedence of the anticipated take levels.

5. Operations-related take is expected in the form of injury and death of juveniles from exposure to the fish screen and associated in-river project features resulting from a diversion of up to 250 cfs of water from Victoria Canal. Any exceedence of these diversion rates would result in an exceedence of the anticipated take levels.

Anticipated incidental take may be exceeded if these ecological surrogates exceed the criteria described above, or if the project's conservation measures are not implemented as described in the ASIP for the proposed AIP (CCWD and BOR 2006a).

B. Effect of the Take

NMFS has determined that the above level of take is not likely to jeopardize Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, or green sturgeon. The effect of this action will consist of individual fish behavior modifications, loss of habitat value, and potential injury or death of juvenile Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, and green sturgeon. Based on fish salvage data at the CVP/SWP Delta export pumps, only a small fraction of listed salmonid populations would be exposed to the project during construction. For example, incidental take at the CVP/SWP for juvenile winter-run Chinook salmon rarely exceeds one percent of the juvenile production estimate (JPE) entering the Delta. In 2006, an estimated 3.8 million juvenile winter-run Chinook salmon entered the Delta based on the number of adults spawned in the previous year (NMFS 2006). The incidental take for the CVP/SWP is 2 percent of the JPE entering the Delta, or in 2006, 76,626 juveniles. The actual estimated loss for 2006, based on fish salvaged at the CVP/SWP facilities, was 2,601 or 0.067 percent of the JPE. A fraction of that estimated loss at the CVP/SWP facilities would be assumed to be exposed to the AIP intake site in most years, since Victoria Canal is one of three pathways fish can travel through to reach the CVP/SWP fish salvage facilities (*i.e.*, flows are always towards the CVP/SWP Delta pumps except in very wet years). The same analysis would apply for CV steelhead and CV spring-run Chinook salmon. In addition, fish monitoring at CCWD's Rock Slough intake has shown that fewer than 4 juvenile CV steelhead and CV spring-run Chinook salmon enter the unscreened diversion in most years (Tenera 2005).

For green sturgeon, population estimates are not known, however, the latest life-history model (Beamesderfer 2006, in press) indicates that 25 percent of the total population may be represented by juveniles in the size category (*i.e.*, 1-3 year freshwater rearing stage observed in the CVP/SWP fish salvage) found in the Delta. The model suggests that an additional 30 to 60 percent mortality would need to be applied to the first 3 years in freshwater for significant reductions in reproductive potential to occur (*i.e.*, 20 to 50 percent eggs per recruit). Elasticity modeling indicates that a dramatic increase in the survival of YOY sturgeon or annual egg production is required to compensate for relatively low levels of fishing mortality that occur presently (Heppell 2006). Since only indirect effects to individual fish behavior, loss of habitat value, and potential injury are expected to occur from construction-related impacts in a small portion of the Delta where a few individuals occur, NMFS has determined that this level of take is not likely to jeopardize the Southern DPS of North American green sturgeon.

C. Reasonable and Prudent Measures

NMFS has determined that the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of listed anadromous salmonids. They must be implemented as binding conditions for the exemption in ESA section 7(o)(2) to apply. BOR and CCWD have the continuing duty to regulate the activities covered in this incidental take statement. If CCWD fails to adhere to the terms and conditions of the incidental take statement, or fails to retain the oversight of its contractor(s) to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

NMFS has determined that the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead and Southern DPS of North American green sturgeon resulting from implementation of the action. These reasonable and prudent measures would also minimize adverse effects to critical habitat for CV steelhead.

1. BOR and CCWD shall take measures to avoid, minimize, and monitor injury and mortality from project construction, operations, and maintenance upon listed salmonids, green sturgeon and minimize impacts to critical habitat.

2. BOR and CCWD shall take measures to maintain, monitor, and adaptively manage all conservation measures described in the ASIP to ensure their effectiveness throughout the duration of the project.

3. BOR and CCWD shall take measures to minimize the effect of habitat modifications at the project site.

D. Terms and Conditions

1. BOR and CCWD shall take measures to avoid, minimize, and monitor injury and

Appendix B.

Alternative Intake Project Fish Rescue Plan

Source: ASIP Attachment F (CCWD and BOR 2006a)

Approach

Contra Costa Water District (CCWD) proposes to construct the Alternative Intake Project, which includes a water intake and positive barrier fish screen on Victoria Canal. Construction of the intake structure and positive barrier fish screen would require installing a cofferdam and dewatering the area within the cofferdam. Fish inhabiting Victoria Canal would potentially be trapped within the cofferdam and lost as a result of dewatering. To minimize and/or avoid these losses, a Fish Rescue Plan shall be implemented to reduce harm, harassment, and mortality from cofferdam construction and dewatering operations associated with in-water construction activities on listed fish species.

This plan has been developed in conjunction with informal consultations between CCWD and the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and the California Department of Fish and Game (DFG), and is intended to serve as a reasonable and prudent measure to minimize take of listed fish species. The plan is based on those consultations and the fish rescue plan successfully implemented by the City of Sacramento (2001), as recommended by the fisheries agencies. The Alternative Intake Project Fish Rescue Plan may be modified and/or updated pending the issuance of a Biological Opinion and/or during the formal consultation with the fisheries agencies.

Although all fish species trapped by the cofferdam would be rescued and returned back into Victoria Canal, the primary emphasis of this effort focuses on protecting listed and special-status fish species inhabiting Victoria Canal. Special-status fish species potentially inhabiting Victoria Canal are identified below.

Endangered Fish
Winter-run Chinook salmon

Threatened Fish
Delta smelt
Central Valley steelhead
Central Valley Spring-run Chinook salmon
North American green sturgeon

Special-Status Fish Species of Concern

Central Valley fall/late-fall run Chinook salmon
Longfin smelt
River lamprey
Hardhead
Sacramento splittail

Methods

This Fish Rescue Plan is comprised of several phases. The intake and fish screen are to be installed in Victoria Canal within a depth of approximately 10-15 feet of water. The in water construction area is to first be isolated from the canal with a cofferdam (*e.g.*, sheet pile or other barrier) to reduce flows into the area. Before completely closing the cofferdam, the interior area will be swept with a net to herd any fish out of the cofferdam area and remove fish from within the water inside of the cofferdam. During this phase, the cofferdam will remain open at the bottom (see Exhibit I). After the area has been swept through several times to catch or chase out any fish within the cofferdam, the cofferdam will be completely closed and portable pumps would be used to dewater the area enclosed by the cofferdam. The intake on the portable pumps would be equipped with a fish screen constructed using 1.75 mm screen mesh and <0.2 ft/sec calculated average approach velocity. The dewatering pumps would be used to reduce water depths within the cofferdam to a depth of approximately 1.5 to 2 feet to facilitate fish rescue.

The fish rescue team, comprised of a qualified fishery biologist with a valid Scientific Collection Permit from DFG for the fish rescue and field technicians, would then capture fish using a 114-inch beach seine and/or handheld dip nets. Fish collection efforts would continue within the area until multiple pass collections deplete the fish population. Immediately after collection, fish would be placed in aerated 5-gallon buckets and/or coolers filled with Delta water, identified to species and counted, and transported to a location outside of the cofferdam for immediate release back into Victoria Canal.

Installation of the cofferdam would occur within the seasonal work window for in water construction from August 1 through November 30, or any other work window agreed to between CCWD, NMFS, USFWS, and DFG. Once the cofferdam has been installed and the fish rescue competed, construction would continue throughout the year without the risk of adversely affecting fish inhabiting Victoria Canal.

Controls to Prevent Mortality

Specific efforts would be made to reduce collection and handling stress, minimize the time that fish are held in buckets, and minimize handling stress during processing and at release. Chemical additives may be used in the holding buckets to reduce potential bacterial infection.

All captured fish will be handled pursuant to the standard NMFS protocols under the Endangered Species Act (ESA) and presented in City of Sacramento (200 1). Standard protocol for the fish rescue operation follow that no employee is to remove any fish, either dead or alive, from the site for personal use. In addition, all efforts to reduce the time that live fish are out of the water should be maximized so as to reduce the chances of incidental take during the fish rescue. All fish are to be promptly returned to the water with the exception of any Chinook salmon, steelhead, or delta smelt mortality.

Up to 50 each of captured Chinook salmon, steelhead, and delta smelt and up to 30 each of other captured special-status species (*i.e.*, green sturgeon, longfin smelt, river lamprey, hardhead, and Sacramento splittail) will be measured. The use of anesthetics during the handling of these species will help reduce any potential mortality. Dip nets or buckets will be used to remove fish from the beach seine and transferred to buckets or coolers for release.

Fish Identification

In the event that a fish cannot be positively identified, even after consulting on-site reference materials, the fish will be bagged, labeled, and brought to the office for positive identification. Bagged fish, excluding as much water as is possible from the bag, would be kept as cold as possible, and if not identified on the same day, would be put into a freezer box. Large quantities of fish exceeding 30 individuals for all species other than salmon, steelhead, and delta smelt would be "plus counted." Salmon, steelhead, and delta smelt would be plus counted once the number of fish exceeds 50.

Species name, length data, and proper identification information will be recorded onto data sheets and parallel the labeling on each individual fish. Time, date, location, fork length, and gear type will be recorded onto the field sheet, along with any other pertinent observations of the fish.

Dead Fish Handling Procedures

During the fish rescue, there is the potential for some fish mortality despite the precautions taken to rescue all fish. If any special-status species suffer mortality, the individuals should be preserved via freezing or placing in a container with 10% formalin solution. Information on time and exact location of any incidental take, the method of take, length of time from death to preservation, water temperature, and any other relevant information should be recorded in writing. For any incidental take of delta smelt, the written documentation of the incidental take, along with the specimen(s), should then be delivered to the USFWS Law Enforcement Division via the USFWS's Sacramento Fish & Wildlife Office (attn: Chief, Endangered Species), or alternative delivery arrangements made. For any incidental take of Chinook salmon meeting the size-at-date length criteria and identified as either a winter-run or spring-run Chinook salmon, or for any incidental take of steelhead, the specimen will be placed in a cooler with ice and held for pickup by NMFS. The NMFS Sacramento office will he notified via telephone in the event that mortality from project construction, operations, and maintenance upon listed salmonids, green sturgeon and minimize impacts to critical habitat.

a. CCWD shall require its contractors to use low-flow pumps with screened intakes during cofferdam dewatering activities.

b. CCWD shall require its contractors to conduct the Fish Rescue Plan consistent with NMFS Electrofishing Guidelines if applicable (NMFS 2000).

c. Prior to the new intake becoming operational, CCWD shall allow inspections of the intake structure and fish screen by NMFS engineers. Review of the final screen design, 60 percent build out, and final build out will be done in cooperation with NMFS engineers, or the CVPIA Anadromous Fish Screen Program.

d. NMFS staff, including dive team personnel, shall be granted access to the site for inspection and measurements of fish screen performance with a minimum of 72-hours advance notice to CCWD.

e. The fish screen shall be maintained to NMFS operating criteria as long as the diversion is in use. Should the fish screen be damaged or in need of repair, such that the protection of juvenile fish is compromised or screen criteria can not be met, CCWD shall curtail or cease pumping through the damaged or removed screen section and notify NMFS immediately, but no later than 48 hours after the incident.

2. BOR and CCWD shall take measures to maintain, monitor, and adaptively manage all conservation measures described in the ASIP to ensure their effectiveness.

   a. BOR or CCWD shall provide a project summary and compliance report to NMFS within 90 days of initiation of diversions from Victoria Canal. This report shall describe construction dates, implementation of project conservation measures, compliance monitoring, and compliance with the terms and conditions of this biological opinion; observed or other known effects on listed fish species, if any; and any occurrences of incidental take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead, or green sturgeon.

   b. CCWD shall provide a detailed fish screen operations and maintenance plan within 1 year of completion of the initiation of diversions from Victoria Canal. This plan shall conform to the guidelines developed for CVPIA AFSP projects (see Appendix B).

   c. BOR or CCWD shall notify NMFS at least 48 hours prior to closing the cofferdam and again when water depths reach approximately 2 feet. NMFS must be notified immediately by Fax within 48 hours of any listed salmonids or green sturgeon found injured or dead. If incidental take is observed, at a minimum the following information should be reported: date, time, location of dead or injured fish, cause of death, and the name of the person finding the fish.

d. In the event that a percussion hammer is required to install the cofferdam, acoustic monitoring shall be performed using standard protocols and procedures by a qualified acoustics measurement firm over a 2-day period. If underwater acoustic measurements demonstrate that sound pressure levels are consistently below 180 dB, no further monitoring will be required. Should underwater sound pressure levels exceed 180 dB, CCWD shall require the contractor to take measures to reduce the sound pressure level after coordination with NMFS. Monitoring over a second 2-day period would be required to confirm that sound pressure levels are consistently below 180 dB once appropriate measures have been implemented. A qualified acoustics measurement firm would measure underwater sound pressure levels at a minimum of 10 and 100 m from the cofferdam over a 2-day period while pilings are being driven within the cofferdam.

3. BOR and CCWD shall take measures to minimize the effect of habitat modifications at the project site.

   a. To mitigate for the loss of 1.0 acre of shallow water habitat, CCWD shall acquire, conserve, fund and manage at least 2.1 acres of shallow water habitat at a mitigation bank or other location approved by DFG, USFWS and NMFS. If 2.1 acres cannot be acquired prior to project impacts, CCWD shall provide DFG, prior to project impacts, the following:

      (1) an Irrevocable Letter of Credit or other form of Security approved by DFG, USFWS, and NMFS in the amount of $73,500 ($35,000/acre), to cover the costs of land acquisition, land conservation, and land management planning. The Security shall allow DFG to draw on the principal sum if DFG, at its sole discretion, determines that CCWD has failed to acquire the required 2.1 acres of shallow water habitat within 1 year of project impacts;

      (2) payment in the form of a check in the amount of $10,500 ($5000/acre) for use as principal for a permanent capital endowment. Interest from this amount shall be available for the operation, management and protection of the mitigation lands, including reasonable administrative overhead, biological monitoring, improvements to carrying capacity, law enforcement measures, and any other action designed to protect or improve the habitat values of the mitigation lands. The endowment principal shall not be drawn upon unless

such withdrawal is deemed necessary by DFG to ensure the continued viability of the species on the mitigation lands.

(3) The 2.1 acres shall be conserved through fee title transfer or a conservation easement acceptable to DFG, USFWS and NMFS. A management plan acceptable to DFG, USFWS, and NMFS is required for the mitigation site. The management plan shall be developed prior to acquisition of mitigation land and shall include, but not be limited to; description of the habitat, habitat enhancements to site, monitoring and management of invasive aquatic plant species, maintaining shallow water habitat depth criteria, success criteria and adaptive management if not met.

b. If maintenance dredging is necessary in order to keep the fish screen working as designed, maintenance dredging shall be conducted between July 1 and October 30, to reduce potential take of juvenile green sturgeon, Chinook salmon, and steelhead. Emergency dredging can be performed outside of the designated work window with written approval by NMFS and other permitting agencies.

Reports and notifications required by these terms and conditions shall be submitted to:

Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento California 95814-4706
FAX: (916) 930-3629
Phone: (916) 930-3600

X. 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 endangered and threatened species. These conservation recommendations include discretionary measures that BOR or CCWD can implement to avoid or minimize adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. NMFS provides the following conservation recommendations that would avoid or reduce adverse impacts to listed salmonids:

1. Measures should be taken to evaluate and minimize injury and mortality at other diversion points in the Delta that are owned and operated by the CCWD. BOR should integrate the operation of CCWD's diversion into its modeling and project description for OCAP.

2. CCWD should continue to monitor entrainment at the unscreened Rock Slough Intake, and coordinate with BOR on projects to reduce predation within the Contra Costa Canal leading up to Pumping Plant #1.

3. BOR should conduct or fund studies at the Tracy Fish Facility to help quantify fish losses associated with water diversions (*i.e.*, green sturgeon and CV steelhead mortality), and prioritize fish screen projects for future funding.

4. BOR should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the southern Delta.

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

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed AIP. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in any incidental take statement 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 action, including the avoidance, minimization, and compensation measures listed in the *Description of the Proposed Action* section is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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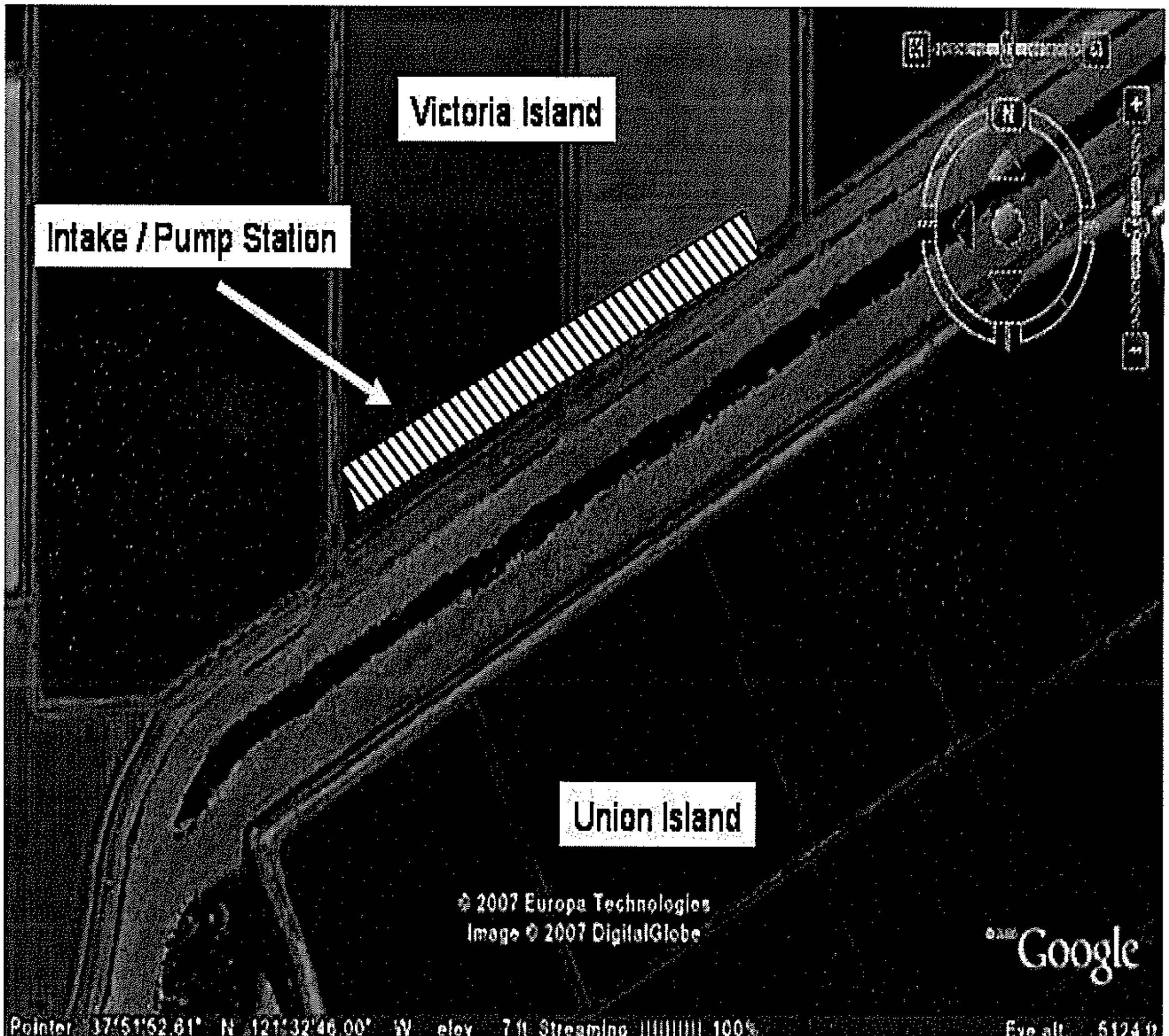
Appendix A.

Figure 2a. Aerial view of CCWD's Alternative Intake site.



Figures 3 and 4. Alternative Intake Project Fish Screen Design and Potential Impact Area.

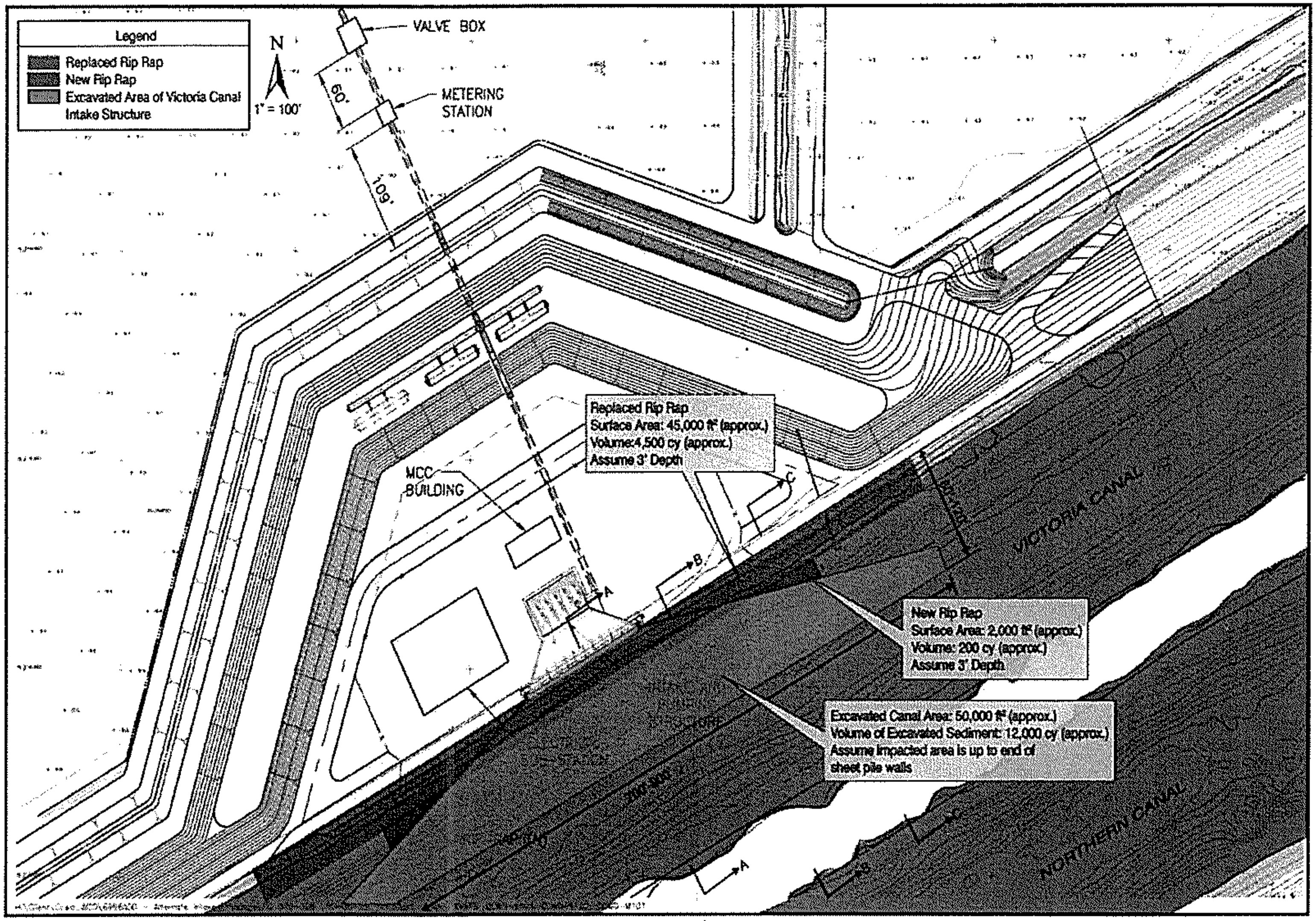


Figure 3
POTENTIAL IMPACTED AREA
VICTORIA CANAL INTAKE: ORIGINAL INTAKE LOCATION
ALTERNATIVE INTAKE PROJECT
CONTRA COSTA WATER DISTRICT

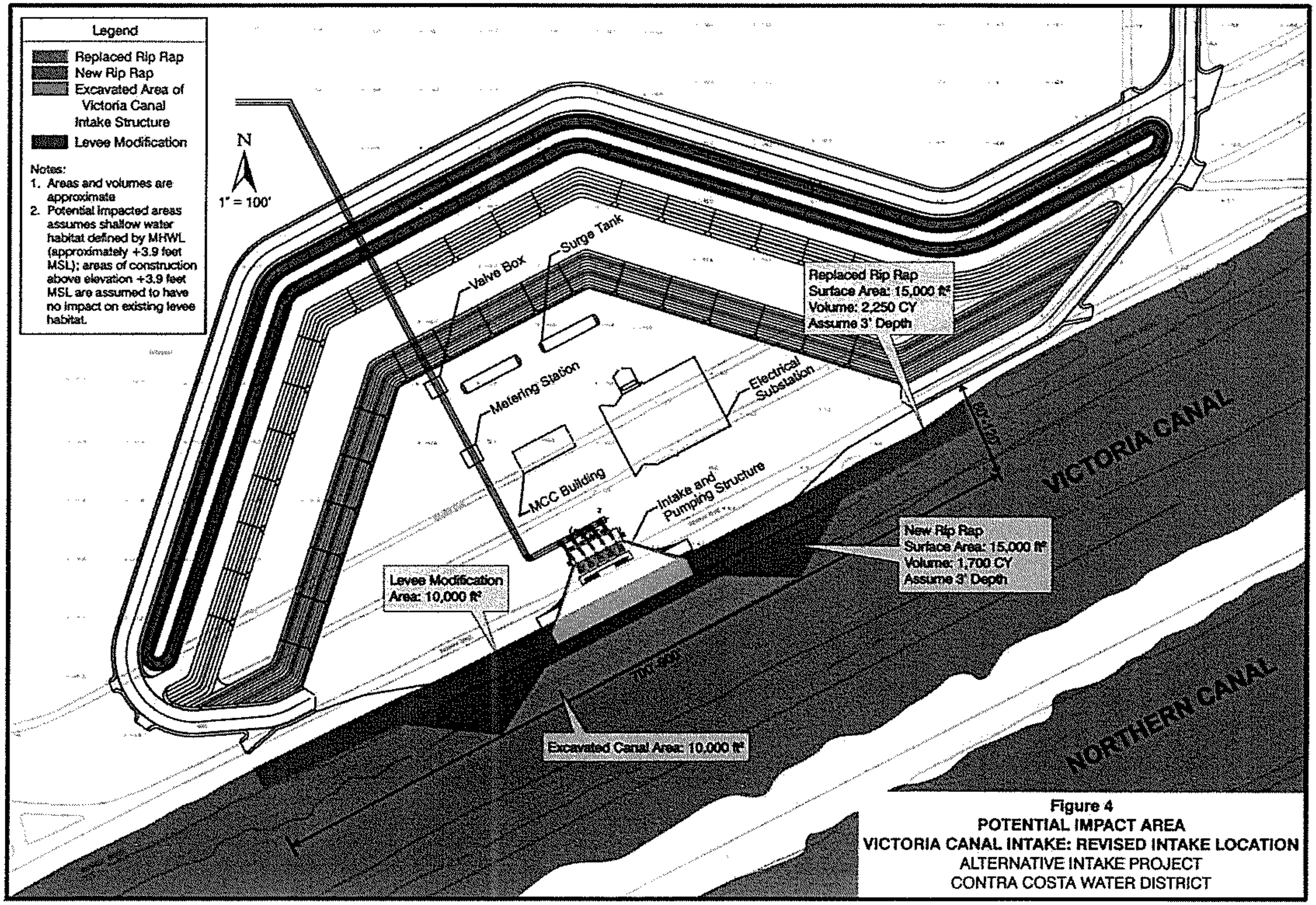


Figure 4
POTENTIAL IMPACT AREA
VICTORIA CANAL INTAKE: REVISED INTAKE LOCATION
ALTERNATIVE INTAKE PROJECT
CONTRA COSTA WATER DISTRICT

take of a protected salmonid occurs during the fish rescue. A follow-up written notification to NMFS shall include the date and location of the carcass or injured fish specimen, a color photograph, a description of the cause of injury or death, and name and affiliation of the person who collected this specimen. All materials would follow procedure, should any incidental take of species occur, and would be kept at the construction area in the trailer located on-site.

Reporting

After completing the fish rescue, a brief documentation report will be prepared. The report will include information on the personnel conducting the fish rescue, methods used, numbers of each species collected and relocated, length information for non-listed species, and an estimate of the survival of fish immediately after release. Photographs showing the site and rescue operation will be included. Any incidental take of a special status species will be documented. The report will he provided by CCWD to NMFS, USFWS, and DFG within 30 days of completing the fish rescue.

References

City of Sacramento. 2001. Sacramento River Water Treatment Plant Intake Structure Fish Screen Replacement Project. Fish Rescue/Salvage Plan, Species Photographs and Handling Protocols. Sacramento, CA.

Enclosure 2

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

Agency:	U.S. Bureau of Reclamation Mid-Pacific Region
Activity:	Contra Costa Water District Alternative Intake Project
Consultation Conducted By:	NOAA's National Marine Fisheries Service

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

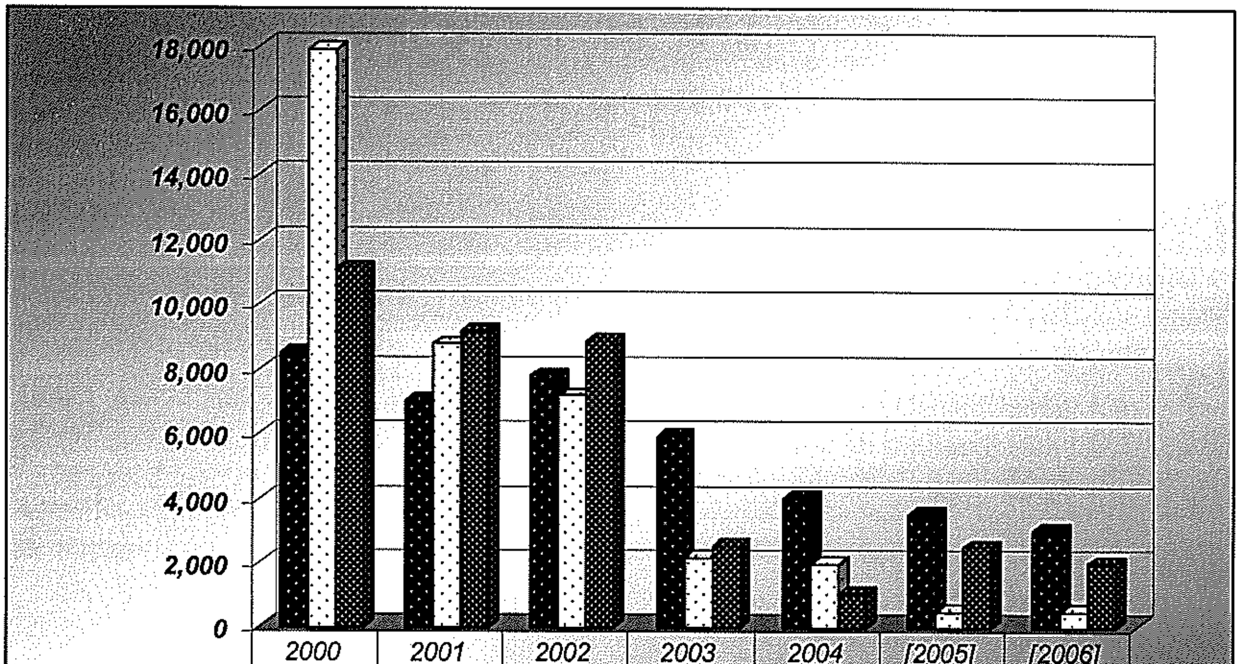
This document represents NOAA's National Marine Fisheries Service's (NMFS) Essential Fish Habitat (EFH) consultation based on our review of information provided by the U.S. Bureau of Reclamation (BOR) and Contra Costa Water District (CCWD) on the proposed Alternative Intake Project (AIP) in San Joaquin and Contra Costa County, California. The Magnuson-Stevens Fishery Conservation Act (MSA) as amended (U.S.C 180 et seq.) requires that EFH be identified and described in Federal fishery management plans. Federal action agencies must consult with NMFS on activities which they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle. The proposed project site is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Coast Salmon Fishery Management Plan and for starry flounder (*Platichthys stellatus*) and English sole (*Parophrys vetulus*) in Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan.

The Pacific Fishery Management Council (PFMC) has identified and described EFH, Adverse Impacts, and Recommended Conservation Measures for salmon in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan (PFMC 1999). The geographic extent of freshwater EFH for Pacific salmon in California includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers *et al.* (1998), and includes not only the watersheds of the Sacramento and San Joaquin River basins but also the San Joaquin Delta (Delta) hydrologic unit (*i.e.*, number 18040003), Suisun Bay hydrologic unit (18050001) and the Lower Sacramento hydrologic unit (18020109). Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), Central Valley spring-run Chinook salmon (*O. tshawytscha*), and Central Valley fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species managed under the Pacific Coast Salmon Fishery Management Plan that occur in the these basins as well as the Delta, Suisun Bay, and Lower Sacramento units.

Historically, the San Joaquin River and its principal tributaries; the Merced, Tuolumne, and Stanislaus Rivers once supported large spring and fall runs of Chinook salmon (Reynolds *et al.* 1993). The spring run, formerly the most abundant salmon in the San Joaquin system, were extirpated in 1942 due to construction of Friant Dam. The fall run, which make up the largest proportion of juvenile Chinook salmon in the south Delta (based on salvage at the CVP/SWP pumps), have been reduced to small remnant populations in the San Joaquin tributaries. Recent estimates of fall run spawning in the San Joaquin basin show a sharp decline in abundance since 2001 (Figure 1).

Figure 1. Trends in San Joaquin Basin fall-run Chinook salmon estimated in-river escapement (CDFG 2006).



	2000	2001	2002	2003	2004	[2005]	[2006]
Stanislaus	8,498	7,033	7,787	5,902	4,015	3,500	3,022
Tuolumne	17,873	8,782	7,173	2,163	1,984	500	500
Merced	11,130	9,181	8,866	2,530	1,050	2,500	2,000

Factors limiting salmon populations in the Delta include: reduced flows from the San Joaquin River due to dams, periodic reversed flows due to high water exports (drawing juveniles into the CVP/SWP diversion pumps), loss of fish into numerous unscreened agricultural diversions, predation by introduced species, and reduction in the quality and quantity of rearing habitat due to channelization, pollution, riprapping, *etc.* (Dettman *et al.* 1987, California Advisory Committee on Salmon and Steelhead Trout 1988, Kondolf *et al.* 1996). Factors affecting salmon populations in Suisun Bay include heavy industrialization within its watershed and discharge of wastewater effluents into the bay. Loss of vital wetland habitat along the fringes of the bay reduce rearing habitat and diminish the functional processes that wetlands provide for the bay ecosystem.

A. Life History and Habitat Requirements

1. Pacific Salmon

General life history information for Central Valley Chinook salmon is summarized below. Information on Sacramento River winter-run and Central Valley spring-run Chinook salmon life histories is summarized in the preceding biological opinion for the proposed project (Enclosure 1). Further detailed information on Chinook salmon Evolutionarily Significant Units (ESU) are available in the NMFS status review of Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NMFS proposed rule for listing several ESU of Chinook salmon (63 FR 11482).

Adult Central Valley fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from July through December and spawn from October through December while adult Central Valley late fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from October to April and spawn from January to April. Chinook salmon spawning generally occurs in clean loose gravel in swift, relatively shallow riffles or along the edges of fast runs (NMFS 1998).

Egg incubation occurs from October through March (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and into the San Francisco Bay and its estuarine waters (Kjelson *et al.* 1982). The remaining fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, aquatic and riparian vegetation, logs, and undercut banks provide habitat for food organisms, shade, and protect juveniles and smolts from predation. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean. Whether entering the Delta or estuary as fry or juveniles, Central Valley fall-run Chinook salmon depend on passage through the Delta for access to the ocean.

2. Starry Flounder

The starry flounder is a flatfish found throughout the eastern Pacific Ocean, from the Santa Ynez River in California to the Bering and Chukchi Seas in Alaska, and eastwards to Bathurst inlet in Arctic Canada. Adults are found in marine waters to a depth of 375 meters. Spawning takes place during the fall and winter months in marine to polyhaline waters. The adults spawn in shallow coastal waters near river mouths and sloughs, and the juveniles are found almost exclusively in estuaries. The juveniles often migrate up freshwater rivers, but are estuarine dependent. Eggs are broadcast spawned and the buoyant eggs drift with wind and tidal currents. Juveniles gradually settle to the bottom after undergoing metamorphosis from a pelagic larva to a demersal juvenile by the end of April. Juveniles feed mainly on small crustaceans, barnacle larvae, cladocerans, clams and dipteran larvae. Juveniles are extremely dependent on the condition of the estuary for their health. Polluted estuaries and wetlands decrease the survival rate for juvenile starry flounder. Juvenile starry flounder also have a tendency to accumulate many of the anthropogenic contaminants found in the environment.

3. English Sole

The English sole is a flatfish found from Mexico to Alaska. It is the most abundant flatfish in Puget Sound, Washington and is abundant in the San Francisco Bay estuary system. Adults are found in nearshore environments. English sole generally spawn during late fall to early spring at depths of 50 to 70 meters over soft mud bottoms. Eggs are initially buoyant, and then begin to sink just prior to hatching. Incubation may last only a couple of days to a week depending on temperature. Newly hatched larvae are bilaterally symmetrical and float near the surface. Wind and tidal currents carry the larvae into bays and estuaries where the larvae undergo metamorphosis into the demersal juvenile. The young depend heavily on the intertidal areas, estuaries, and shallow near-shore waters for food and shelter. Juvenile English sole primarily feed on small crustaceans (*i.e.* copepods and amphipods) and on polychaete worms in these rearing areas. Polluted estuaries and wetlands decrease the survival rate for juvenile English soles. The juveniles also have a tendency to accumulate many of the contaminants found in their environment and this exposure manifests itself as tumors, sores, and reproductive failures.

II. PROPOSED ACTION

The proposed action is described in detail in the *Description of the Proposed Action* section of the preceding biological opinion (Enclosure 1). The following is a brief summary of the proposed action.

The BOR and CCWD propose to construct and operate a new municipal water intake and fish screen, on the southeast end of Victoria Island (west side of Victoria Canal), near State Highway 4 and Clifton Court Forebay. The proposed fish screen project is identified in the California Bay-Delta Program (CALFED) Ecosystem Restoration Program's Draft Stage 1 Implementation Plan as a project that will result in progress towards meeting water quality goals for the Delta. The new pumping plant and fish screen will have a diversion rate of 250 cfs, and will be constructed to meet all California Department of Fish and Game, U.S. Fish and Wildlife Service, and NMFS fish screen criteria. The combined diversion rate for CCWD will not change. The proposed action includes construction of new facilities, modifying operations of existing facilities, operations and maintenance, conservation measures, and monitoring.

In addition to the fish screen and pumping facilities, a new pipeline is proposed to cross Victoria Island and go under Old River to connect to CCWD's existing Old River Pumping Facility. Project elements on the inside of Victoria Island and Byron Tract will have no effect on Chinook salmon, starry flounder or English sole, and will not be considered further in this assessment.

III. EFFECTS OF THE PROPOSED ACTION

The effects of the proposed action on salmonid habitat (*i.e.,* for winter-run and spring-run Chinook salmon) are described at length in Section V (*Effects of the Action*) of the preceding biological opinion, and generally are expected to apply to Pacific salmon EFH. Both the starry flounder and the English sole will spend more time as juveniles rearing in the action area than the Chinook salmon smolts and will therefore be exposed to the effects of the action over longer periods of time. A summary of the effects of the proposed action on Central Valley fall-/late fall-run Chinook salmon, Starry flounder, and English sole are discussed below.

Adverse effects to Chinook salmon habitat will result from construction-related impacts, operations and maintenance impacts, and long-term impacts related to the modification and loss of aquatic and riparian habitat at the project site. Primary construction-related impacts include turbidity and suspended sediment created during cofferdam installation and dredging. Habitat impacts include the permanent loss of approximately 0.4 acre of shallow-water tidal freshwater emergent habitat in front of the fish screen and along each side, and modification of approximately 0.3 acre of shallow-water tidal freshwater emergent habitat to a depth of 10 to 15 feet. An additional 0.3 acre of shallow water habitat presumed to be earthen bottom will be replaced by riprap. These actions will cause an immediate reduction in habitat availability, and nearshore habitat complexity and suitability.

In-channel construction activities such as dredging and cofferdam installation will cause temporary increases in suspended sediment and turbidity. Turbidity will be minimized by implementing the proposed conservation measures such as implementation of best management practices (BMPs) and adherence to Regional Water Quality Control Board water quality standards. Fuel spills or use of toxic compounds during project construction could release toxic contaminants into Victoria Canal and could injure or kill listed fish species. Adherence to BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak.

Operation and maintenance actions will be conducted annually to ensure the performance of the fish screen. Most construction-related impacts are expected to occur during the summer when Chinook salmon are not expected to be present, or behind the fish screen structure, where impacts will not extend into areas of occupied fish habitat.

Starry flounder and English sole are typically only found incidentally in Victoria Canal. Given the decreasing salinity gradient from the Rock Slough intake to the proposed AIP on Victoria Canal, it is highly likely that reduced diversions from Rock Slough and increased diversions from the Victoria Canal intake would be slightly beneficial to these species as their densities would be greater near the Rock Slough intake compared to the proposed Victoria Canal intake.

Entrainment of early life stages of Starry flounder and English sole could occur at the proposed Victoria Canal intake. However, CCWD operates its intakes conjunctively, and the overall net effect is expected to be a reduction in entrainment and impingement (Table 6) losses for all species under future operating conditions.

IV. CONCLUSION

Based on the best available information, NMFS believes that the proposed AIP may adversely affect EFH for Pacific salmon and groundfish during construction and long-term operations due to impingement, loss of eggs and larvae, entrainment of food organisms, and alterations in the hydrology of the Delta.

V. EFH CONSERVATION RECOMMENDATIONS

Considering that the habitat requirements of Central Valley fall-/late fall-run Chinook salmon within the action area are similar to the Federally listed species addressed in the preceding biological opinion (Enclosure 1), NMFS recommends that Terms and Conditions 1 through 3, as well as the conservation recommendations described in the preceding biological opinion prepared for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and the Southern Distinct Population Segment of North American green sturgeon, be adopted as EFH conservation recommendations. In addition, NMFS anticipates that implementing the conservation measures listed below would benefit EFH for groundfish by minimizing disturbances, sedimentation, and pollutants to waterways.

(1) Bank Stabilization

The installation of riprap or other streambank stabilization devices can reduce or eliminate the development of side channels, functioning riparian and floodplain areas and off channel sloughs. In order to minimize these impacts, BOR and CCWD should:

- Use vegetative methods of bank erosion control whenever feasible. Hard bank protection should be a last resort when all other options have been explored and deemed unacceptable, and

- Minimize alterations or disturbance of the bank and existing riparian vegetation.

(2) Construction Impacts

Activities associated with construction (*e.g.*, new buildings, utility installation, road improvements, and storm water discharge) can significantly alter the land surface, soil, vegetation, and hydrology and subsequently adversely impact EFH through habitat loss or modification. In order to minimize these impacts, BOR and CCWD should:

- Plan development sites to minimize clearing and grading,

- Use Best Management Practices in building as well as road construction and maintenance operations such as avoiding ground disturbing activities during the wet season, minimizing the time disturbed lands are left exposed, using erosion prevention and sediment control methods, minimizing vegetation disturbance, maintaining buffers of vegetation around wetlands, streams and drainage ways, and avoid building activities in areas of steep slopes with highly erodible soils. Use methods such as sediment ponds, silt curtains, or other facilities designed to slow water runoff and trap sediment and nutrients, and

- Where feasible, reduce impervious surfaces.

(3) Wastewater/Pollutant Discharges

Water quality essential to Pacific salmon and groundfish can be altered when pollutants are introduced through surface runoff, through direct discharges of pollutants into the water, when sediments are re-suspended (*e.g.*, from dredging), and when flow is altered. Indirect sources of water pollution in EFH includes run-off from streets, yards, and construction sites. In order to minimize these impacts, BOR and CCWD should:

- Monitor water quality discharge following National Pollution Discharge Elimination System requirements from all discharge points,

- Implement all mitigation and conservation measures specified in the proposed AIP Environmental Impact Statement/Environmental Impact Report to minimize pollutant discharges, and

- Establish and update, as necessary, pollution prevention plans, erosion control plans, spill control practices, and spill control equipment for the handling and transport of toxic substances in salmon and groundfish EFH (*e.g.*, oil and fuel, organic solvents, raw cement residue, sanitary wastes, *etc.*). Consider bonds or other damage compensation mechanisms to cover clean-up, restoration, and mitigation costs.

VI. STATUTORY REQUIREMENTS

Section 305 (b)4(B) of the MSA requires that the Federal lead agency provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by the lead agency for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR §600.920(k)). In the case of a response that is inconsistent with our recommendations, BOR must explain its reasons for not following the recommendations, including the scientific justification for any disagreement with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

VI. LITERATURE CITED

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