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

In Your Response, Please Refer To:

AUG 22 2000 F-SA-00-4:DES

Mr. Ronald Brockman
Fishery Program Manager
United States Bureau of Reclamation
2800 Cottage Way
Sacramento, California 95825-1898

SUBJECT: Sacramento Water Treatment Plant Fish Screen Project Section 7 Formal Consultation

Dear Mr. Brockman:

The enclosed biological opinion was prepared by the National Marine Fisheries Service (NMFS) based on NMFS' review of the proposed City of Sacramento Water Treatment Plant Fish Screen Replacement Project, and its effects on the Federally endangered Sacramento River winter-run chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), and threatened Central Valley spring-run chinook salmon (*O. tshawytscha*) and their designated critical habitat pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et sq.*) (Act). The City of Sacramento proposes to design and install replacement fish screens at the E.A. Fairbairn Treatment Plant on the Lower American River and at the Sacramento River Water Treatment Plant on the lower Sacramento River. The Bureau of Reclamation's (Reclamation) October 2, 1998, request for formal consultation was received on October 5, 1998.

The biological opinion is based on information provided in: (1) EIR Notice of Preparation information packet from the City of Sacramento dated March 26, 1998; (2) the City of Sacramento Fish Screen Replacement Project Environmental Assessment (EA) and Biological Assessment (BA) dated February 1999; a site visit by United States Fish and Wildlife Service (FWS), Reclamation, NMFS, and consultants from Surface water Resources, Inc.; (4) additional information provided by the City of Sacramento in response to NMFS March 22, 1999 request for additional information (received August 13, 1999); (5) the Fairbairn Water Treatment Plant Expansion Project Draft Environmental Impact Report and Biological Assessment dated November 1990; and (6) an American River temperature assessment and summary briefing and briefing package prepared by Surface water Resources, Inc., dated November 3, 1999. A complete administrative record of this consultation is on file in the Sacramento NMFS Office.

Based upon the best available scientific and commercial information, this biological opinion concludes that construction and operation of the E.A. Fairbairn Treatment Plant and Sacramento River Water Treatment Plant fish screens are not likely to jeopardize the continued existence of Federally endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon or result in the destruction or adverse modification of designated critical habitat.

Minimal incidental take of endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon is expected, provided that the fish screens are properly installed and maintained according to NMFS and California Department of Fish and Game anadromous fish screen criteria. An incidental take statement is, therefore, included in this biological opinion.

As set forth in the enclosed biological opinion consultation must be reinitiated if :(1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action may affect listed species in a way not previously considered; (3) the action is modified in a way that causes an effect on listed species that was not previously considered; or (4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR § 402.16).

If you have any questions concerning the enclosed biological opinion, please contact Michael Aceituno at (916) 498-6498.

Sincerely,

Rebecca Lent, Ph.D.
Regional Administrator

Enclosure

cc: Bill O'Leary, BOR Sacramento
Jim Sequeira, City of Sacramento
Cay Goude, FWS
Deborah McKee, CDFG
Bill Snider, CDFG
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BIOLOGICAL OPINION

AGENCY: United States Bureau of Reclamation

ACTIVITIES: City of Sacramento Water Treatment Plant Fish Screen Replacement Project

CONSULTATION CONDUCTED BY: National Marine Fisheries Service/Southwest Region

DATE ISSUED: AUG 22 2000

I. CONSULTATION HISTORY

On March 30, 1998, NMFS received the Environmental Impact Report (EIR) Notice of Preparation information packet from the City of Sacramento dated March 26, 1998.

On October 5, 1998, section 7 consultation was requested by the Bureau of Reclamation (Reclamation) regarding the potential effects of the proposed City of Sacramento Water Treatment Plant Fish Screen Replacement Project on Federally endangered Sacramento River winter-run chinook salmon and threatened Central Valley steelhead. Conferencing was also requested on Central Valley spring-run and Central Valley fall/late fall-run chinook salmon. Since that time, Central Valley spring-run chinook salmon have been listed as threatened and Central Valley fall/late fall-run chinook salmon have been designated as a candidate species (64 FR 50394). Critical habitat has also been designated for Central Valley steelhead and Central Valley spring-run chinook salmon (65 FR 7764).[1]

On December 10, 1998, NMFS received a letter from the City of Sacramento requesting a variance from NMFS and California Department of Fish and Game (CDFG) fish screen criteria for the project. In response to this request, Mr. Steve Thomas from the NMFS Santa Rosa office responded by correspondence dated January 4, 1999, stating that the design parameters proposed were consistent with NMFS fish screening criteria and that a variance was not required.

On February 16, 1999, NMFS received a copy of the City of Sacramento Fish Screen Replacement Project Environmental Assessment (EA) and Biological Assessment (BA) and attended a tour of the E.A. Fairbairn Water Treatment Plant (FWTP) and Sacramento River Water Treatment Plant (SRWTP) facilities.

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[1]Critical Habitat for Winter-run chinook salmon was designated on June, 16, 1993 (58 FR 33212).

On March 16, a meeting was held between Reclamation, the City of Sacramento, Surface Water Resources, Inc. (SWRI), and NMFS to discuss cumulative effects associated with proposed increased diversion rates at the FWTP and SRWTP. On March 17, Steve Thomas was contacted by Gary Gosse of the City of Sacramento and provided an overview of the current and future water treatment plant design parameters.

On March 22, 1999, NMFS sent a letter to Reclamation requesting additional information including: (1) maximum proposed diversion rates through the proposed screens; (2) existing and future capacities of the FWTP and SRWTP; (3) daily, seasonal and annual diversion rates; (4) an analysis of those water diversion rates on anadromous fish and critical habitat, including direct and indirect effects of the proposed action together with interrelated and interdependent effects of other activities; and (5) an analysis of cumulative effects associated with the proposed project.

On April 14, 1999, Steve Thomas participated in a conference call with Gary Gosse, Don Spiegel, Ron Bachman and Ron Brockman to discuss costs associated with the project that the Central Valley Project Improvement Act (CVPIA) will fund and to discuss NMFS concerns with the EA.

During June and July of 1999, NMFS and Reclamation staff discussed the additional information that was requested by the NMFS March 22, 1999, correspondence. A June 22, 1999, meeting was held between Reclamation, the City of Sacramento, and NMFS to discuss California Environmental Quality Act (CEQA) and ESA regulations as they apply to the proposed project. A formal reply to the NMFS request for additional information was received from Reclamation by NMFS on August 13, 1999.

On August 17, 1999, NMFS attended a meeting that was held at the FWTP to specifically discuss the City of Sacramento's current and proposed pumping operations at the FWTP and the associated effects on lower American River water temperature.

On September 28, 1999, Reclamation, the City of Sacramento, U.S. Fish and Wildlife (FWS) and NMFS attended a meeting at FWS to discuss the FWS Draft Biological Opinion for the Project. Revisions to the project description were discussed and NMFS received revisions to the project description by email on October 18, 1999.

On November 3, 1999, NMFS attended a meeting at SWRI with representatives from the City of Sacramento and was provided a temperature assessment for the lower American River that modeled increased diversions associated with expansion of the pumping and treatment capacity at the FWTP.

II. DESCRIPTION OF THE PROPOSED ACTION

The intakes and fish screens that are in place at the FWTP Intake Pump Station on the American River and the intake pier on the Sacramento River for the SRWTP were constructed in 1964 and 1924 respectively. As a result of the antiquity of the existing screens, Reclamation, under the authority of the CVPIA, has agreed to cost share a project to replace the fish screens to meet the current criteria established by the FWS, NMFS and CDFG. Thus the proposed federal action is the provision of funds to the City of Sacramento. The City of Sacramento intends to replace the screens at both locations with facilities that meet current fish screen criteria while maintaining the current capacities of the intakes.

A. Description of Activities to be Undertaken by the City of Sacramento

1. E.A. Fairbairn Water Treatment Plant

The FWTP is located on the south bank of the lower American River, approximately seven miles upstream from its confluence with the Sacramento River. The City of Sacramento is proposing to expand the current intake structure, retrofit the existing fish screens and install new fish screens. The FWTP was designed to accommodate a 200 million gallon per day (mgd) diversion rate but the current plant treatment capacity is limited to 90 mgd. An expansion to allow a treatment capacity of up to 200 mgd is currently being planned. The current screening criteria established by FWS, NMFS, and CDFG require a larger screen area for this diversion facility in order to pass the full FWTP design flow of 200 mgd. Therefore, the size of the intake must also be increased to accommodate the larger screens.

The expanded portion of the intake structure will consist of three new pump bays, separated from the existing six pump bays, connected to existing common plant influent channels. The new bays proposed to be added to the intake structure will add an additional 80 feet to the structure's existing length. The operational length of the FWTP intake structure will be approximately 193 feet (96 and 65 linear feet sections of screen, with a 32 foot center divider between the two sections).

The new screens at the FWTP will be nine feet high, approximately five feet, nine inches wide, and constructed of stainless steel wedge-wire, with 1.75 mm rectangular openings. All of the new screens, including the retrofitted screens, will be bolted to and flush with the face of the structure. The approach velocity at the new screen facility will be 0.33 feet per second (fps) and will meet both CDFG and NMFS fish screen criteria. The new screen will be cleaned with a high pressure water, spray backwash system, to loosen any impinged debris at the screen. An estimated total of 165 cubic yards (cy) of rock riprap will be placed around the downstream end of the intake structures.

2. Sacramento River Water Treatment Plant

Water is currently diverted for the SRWTP by an intake structure located on the Sacramento River approximately one-half mile downstream of the river's confluence with the American River. The existing facility for the SRWTP consists of an intake pier on the Sacramento River and a pump station located on the treatment plant site. Water is siphoned from the river to the pumping station where it is lifted to two parallel treatment trains. The SRWTP, as currently installed, has a total pumping capacity of approximately 158 mgd and a reliable treatment capacity of 110 mgd.

The new intake structure will consist of an intake pier with a pump station located on top of the pier. The intake structure will be located approximately 700 feet downstream of the existing intake structure, but upstream of the I street bridge. The existing intake will no longer be used as an intake after the new intake is completed.

The new screens at the SRWTP will be placed on a intake structure substructure measuring 180 feet in length and 34 feet in width. The operational length of the SRWTP intake structure will be approximately146 linear feet, comprised of 58 feet of linear screen, a 30 linear foot center divider, and an additional 58 linear feet of screen. The substructure will house two pumping bays; each bay will be equipped with eight fish screens (sufficient to pass 91.4 mgd at a 0.2 fps approach velocity). Initially, each bay will be equipped with three 22.8 mgd vertical turbine pumps and one 11.4 mgd vertical turbine pump. Ultimately, when the City's water needs require pumping at the maximum diversion rate, the 11.4 mgd pumps will be replaced with 22.8 mgd pumps. This configuration will allow the City to maintain one pump in standby mode, which will greatly increase the reliability and redundancy of the 160 mgd capacity replacement intake structure.

The new intake structure will be equipped with sixteen fish screens sufficient to pass 160 mgd at a 0.2 fps approach velocity (with two screens serving a standby pump.) The fish screens installed in the replacement intake structure will be 7 feet high and 13 feet wide. The new screens will be constructed of steel wedge-wire, and will have 1.75 mm openings. The screens will be installed as above in the FWTP description.

An estimated total of 450 cubic yards of rock riprap will be placed at the intake structure. Also, 150 linear feet of riparian habitat will be removed along the bank of the Sacramento River for the new intake structure. A revegetation plan will be developed and will be implemented to mitigate for any loss of shoreline vegetation that will occur. The revegetation plan will take into account new rip-rap placed or replaced along the shoreline as part of construction of the access bridge. Riparian habitat values will be replaced on a 1:1 basis to compensate for any disruption of vegetation.

3. Water Rights

The City of Sacramento diverts water from the Sacramento River based upon a pre-1914 appropriative right for 75 cubic feet per second and a post-1914 appropriative right known as State Water Resources Control Board (SWRCB) Permit No. 992. The City also holds four post-1914 permits to appropriate water from the American River: Permit Nos. 11358, 11359, 11360 and 11361. In 1957 the City and Reclamation entered into a water rights settlement contract. In that contract, the City agreed to limit its diversion of American River water to a maximum of 675 cubic feet per second, up to a maximum annual amount of 245,000 acre feet per year in the year 2030, and to limit its diversions of Sacramento River water to a maximum of 225 cubic feet per second, up to a maximum annual amount of 81,800 acre feet per year. Reclamation agreed to make available in the rivers enough water to enable the agreed upon diversions by the City, to be diverted pursuant to the City's water rights. In critically dry years the City agreed to not divert more than 75 percent of its surface water from any point of diversion on the American River; the difference can be diverted from the Sacramento River downstream of the confluence of the two rivers.

4. Construction Sequence

The proposed project will require concurrent construction activities at two separate sites: the FWTP intake structure located on the south bank of the American River and at the SRWTP intake structure. A sixteen month construction schedule is anticipated for the FWTP intake structure, including 3 months to conduct the initial in-river work, 11 months to conduct the work inside the cofferdams, and 2 months of final in-river work to remove the cofferdams and construction equipment. A 30-month construction schedule is anticipated for the SRWTP intake structure, including three months to conduct the initial in-river work, 20 months to conduct the work inside the cofferdams, and seven months of final in-river work to remove the cofferdams and construction equipment. Construction at both WTPs is anticipated to begin in April of 2001 and is expected to consist of the following components:

- Establish Staging Areas;
- Construct a pile supported access roadway to the pump station sites in the river;
- Install cofferdams and piles to enclose bridge supports;
- Excavate the river channel approximately 12 feet below the existing river bottom elevation;
- Drive structural support/friction piles;
- Pour tremie seal concrete to seal off the bottom of construction areas;
- Construct shoring to stabilize enclosed sheet pile areas;
- De-water the enclosed sheet pile area;
- Frame and pour concrete structure;
- Install mechanical and screen equipment;
- Remove sheet piles around structure and bridge supports; and

- Remove pile supported roadway.

5. Diversions

The FWTP currently has a pumping capacity of approximately 135 mgd and a reliable water treatment capacity of approximately 90 mgd. The SRWTP currently has a pumping capacity of approximately 158 mgd and a reliable water treatment capacity of approximately 110 mgd. These capacities will not increase as a result of the fish screen replacement project. Accordingly, the amount of water that the City can divert and treat at the FWTP and SRWTP will be limited until the City undertakes a separate project to increase these capacities at the two plants. Upon completion of the FWTP and SRWTP treatment plant expansions, water treatment capacities will increase from the current 90 mgd to 200 mgd and 110 mgd to 160 mgd, respectively. The City cannot and will not exceed a combined diversion rate of 200 mgd (310 cfs) at the two treatment plants prior to the expansion of treatment capacity beyond 200 mgd.

Reclamation is in the process of developing the scope and schedule of completing a new comprehensive analysis of the cumulative effects of additional American River (and other system-wide) diversions. This analysis will be completed in the context of a reinitiation of consultation pursuant to the Endangered Species Act on the Central Valley Project Operation Criteria and Plan (CVP-OCAP). This analysis is anticipated to be completed in the calendar year 2000, or in early 2001. Further details on the scope of this consultation is provided in the following section. Due to the lead time needed to construct expanded treatment facilities and other factors, additional City of Sacramento diversions beyond those discussed in the preceding paragraph will not occur prior to 2003, well after Reclamation's completion of the comprehensive analysis as described above.

6. Aquatic Issues and Scope of Consultation

Reclamation recognizes that future increases in diversions after the City fish screen replacement project is undertaken will occur in the context of a suite of activities and actions that must be fully addressed in a comprehensive consultation covering instream flow in the American River, Sacramento River, and the Delta, in light of any new diversions from either the Sacramento or the American Rivers. Therefore Reclamation plans to re-initiate consultation on the CVP-OCAP and complete associated modeling and analysis, and has agreed to conduct an analysis and modeling of the cumulative actions' effects on listed salmonids for all of the water contracts coming up for renewal, and related activities, in the American River Basin. These analyses will demonstrate how the diversions of water will affect CVP and State Water Project (SWP) operations and how these actions will affect their ability to meet the existing environmental requirements in the Central Valley. They will be comprehensive and will analyze all of the direct, indirect, and cumulative effects including effects of interrelated and interdependent actions.

As previously noted, the City's diversions from the FWTP and SRWTP will not increase as a direct result of the fish screen replacement project, because the FWTP and SRWTP pumping and treatment capacities will not be increased by the fish screen replacement. The existing pumping and treatment capacities of the FWTP and SRWTP may be used to serve City water to potential new growth areas, but this will not be made any more or less likely by replacement of the fish screens to improve passage for juvenile fish.

However, the capacity of the FWTP and SRWTP screening facilities are being sized to accommodate planned treatment plant expansions. The expanded FWTP will be operated in response to the water demands of the City, and will work in conjunction with other City facilities (e.g., the SRWTP) to provide up to 130,600 acre feet annually (AFA) of water within the City limits, by the year 2030. The proposed FWTP Expansion Project will involve treatment of up to 96,300 AFA at the expanded FWTP. As part of the treatment expansion project, it is currently proposed that diversion of American River water at the FWTP will be restricted in accordance with the Water Forum Proposal to minimize environmental concerns regarding fish and aquatic habitat in the Lower American River. The proposed restrictions are as follows:

1. Diversions of up to 310 cfs (200 mgd) will be allowed as long as the flow bypassing the diversion at the FWTP exceeds the Hodge flow criteria[2];

2. Whenever flow bypassing the diversion at the FWTP is less than the Hodge flow criteria, diversions no greater than the following will be allowed:

January through May	120 cfs (78 mgd)
June through August	155 cfs (100 mgd)
September	120 cfs (78 mgd)
October through December	100 cfs (65 mgd)

In extremely dry years, the City will limit its diversions of City water at the FWTP to not greater than 155 cfs (100 mgd) and not greater than 50,000 AFA.[3]

[2] The "Hodge" flow criteria are flow levels established by Judge Richard Hodge in his 1990 decision rendered in *Environmental Defense Fund et al. v. East Bay Municipal District*. These minimum flow levels in the Lower American River defined the flow threshold below which parties to the litigation would not be allowed to divert water. Specifically, parties to the litigation could not divert water from the American River unless instream flows measured at least 2,000 cfs from October 15 through February, 3,000 cfs from March through June, and 1,750 cfs from July through October 14. The City of Sacramento was not a party to the litigation.

[3] For the purposes of the Water Forum Agreement, driest years (conference years) are defined as years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 400,000 acre feet. Conference years are those years which require diverters and others to meet and confer on how best to meet demands and protect the American River.

For purposes of this Opinion, the action area is the reach of the American River between RM 22.9 (Nimbus Dam) and RM 0, and Sacramento River reaches downstream of this area, including and beyond the SRWTP, that may be affected by the proposed City of Sacramento Fish Screen Replacement Project and Water Treatment Plant Expansion Project activities. An 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).

7. Incorporated Best Management Practices And Minimization Measures

a. Increased Turbidity and Suspended Sediment

Compliance with section 401 of the Clean Water Act through issuance of a water quality certification from the Regional Water Quality Control Board will ensure adequate protection of listed anadromous fishery resources from potential increases in suspended sediment and water turbidity. These measures include use of best management practices for stormwater runoff for landside erosion products, implementation of a detailed erosion control and restoration plan before and after construction, and the use of desilting basins for cofferdam dewatering operations. Monitoring and inspection for water quality problems will also be instituted.

b. Cofferdam De-watering Operations

The cofferdam will be constructed via the sequential placement of sheetpiles from the upstream to the downstream end of the portion of the intake structure to be enclosed by the cofferdam. Prior to completion of the downstream end of the cofferdam, seining will be conducted within the cofferdam with a small mesh seine to remove as many fish as possible. This method will be used to primarily herd fish out of the cofferdam. Once seining is completed, exclusionary nets will be placed in the river to prevent fish from entering the cofferdam during the final stages of cofferdam placement prior to dewatering. Once the cofferdam has been completed, pumps will be used to dewater the cofferdam. When the cofferdam is partially dewatered, a final seining effort will be conducted within the cofferdam.

In addition to the above dewatering operations, only low flow pumps with screened intakes will be used during dewatering operations. If fish are still present after partial dewatering of the cofferdam and further seining cannot rescue all listed species, then electrofishing (using NMFS electrofishing guidelines) shall be used by a qualified fisheries biologist to capture any remaining fish. All salmonids captured shall be released unharmed into the American or Sacramento rivers downstream of the construction area.

c. Water Temperature Management

NMFS and the City of Sacramento have agreed that, in cooperation with Reclamation[4], the City of Sacramento will contribute funds to assist in water temperature management for the Lower American River. Specifically, the temperature shutters on the Folsom penstocks can be made more efficient. Leakage along the guidance structure associated with the shutters does not currently permit the most effective management of the coldwater pool at Folsom Reservoir. The leakage, in effect, may produce a "flow net" drawing water throughout the vertical profile in Folsom Reservoir, rather than at specified vertical locations which provides the most effective tool for coldwater pool management. The funding to be provided by the City will be used to assist in modifying or replacing the shutters.

III. STATUS OF LISTED SPECIES AND CRITICAL HABITAT

This Opinion analyzes the effects of the City of Sacramento Water Treatment Plant Fish Screen Replacement Project on the Federally endangered Sacramento River winter-run chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), threatened Central Valley spring-run chinook salmon (*O. tshawytscha*), and their designated critical habitat.

A. Sacramento River Winter-run Chinook Salmon - Endangered: Population Trends, Life History, and Biological Requirements

The Sacramento River winter-run chinook salmon is a unique population of chinook salmon in the Sacramento River. It is distinguishable from the other three Sacramento chinook runs by the timing of its upstream migration and spawning season. NMFS listed winter-run chinook salmon as threatened (54 FR 10260) under emergency provisions of the ESA in August 1989 and the species was formally listed as threatened in November 1990 (55 FR 46515). The State of California listed winter-run chinook salmon as endangered in 1989 under the California State Endangered Species Act (CESA). On June 19, 1992, NMFS proposed that the winter-run chinook salmon be reclassified as an endangered species (57 FR 27416). NMFS finalized its proposed rule and re-classified the winter-run as an endangered species on January 4, 1994 (59 FR 440).

Prior to construction of Shasta and Keswick Dams in 1945 and 1950, respectively, winter-run chinook salmon were reported to spawn in the upper reaches of the Little

[4]Reclamation has agreed to manage and expend these funds in furtherance of temperature improvements in the Lower American River, and anticipates doing so in a time frame preceding the City's utilization of the full treatment capacity to be provided by the water treatment expansion project. NMFS, Reclamation, and the City recognize that Reclamation is not hereby agreeing to or being required to augment the funding being provided by the City.

Sacramento, McCloud, and lower Pitt Rivers (Moyle et al. 1989). Specific data relative to the historic run sizes of winter run chinook prior to 1967 are sparse and mostly anecdotal. Numerous fishery researchers have cited Slater (1963) to indicate that the winter-run chinook salmon population may have been fairly small and limited to the spring fed areas of the McCloud River before the construction of Shasta dam. However, recent CDFG research in California State Archives has cited several fisheries chronicles that indicate the winter-run chinook salmon population may have been much larger than previously thought. According to these qualitative and anecdotal accounts, winter-run chinook salmon reproduced in the McCloud, Pit and Little Sacramento Rivers and may have numbered over 200,000 (Rectenwald 1989). Construction of Shasta and Keswick Dams blocked access to all of the winter-run chinook salmon's historic spawning grounds.

The first winter-run chinook salmon migrants appear in the Sacramento-San Joaquin delta during the early winter months (Skinner 1972). On the upper Sacramento River, the first upstream migrants appear during December (Vogel and Marine 1991). Due to the lack of fish passage facilities at Keswick dam, adults tend to migrate to and hold in deep pools between RBDD and Keswick before initiating spawning activities. The upstream migration of winter-run chinook salmon typically peaks during the month of March, but may vary with river flow, water-year type, and operation of RBDD.

Since the construction of Shasta and Keswick dams, winter-run chinook salmon spawning has primarily occurred between RBDD and Keswick Dam. The spawning period on winter-run chinook salmon generally extends from mid-April to mid-August with peak activity occurring in June (Vogel and Marine 1991). Aerial surveys of spawning redds have been conducted annually by the CDFG since 1987. The surveys have shown that the majority of winter-run chinook salmon spawning in the upper Sacramento River has occurred between the Anderson-Cottonwood Irrigation District (ACID) dam at RM 298 and the upper Anderson Bridge at RM 284. However, significant numbers of winter-run chinook salmon may also spawn below Red Bluff (RM 245) in some years. In 1988, for example, winter-run chinook salmon redds were observed as far downstream as Woodson Bridge (RM 218).

Winter-run chinook salmon eggs hatch after an incubation period of about 40-60 days depending on ambient water temperatures. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 40°F and 56°F. Mortality of eggs and pre-emergent fry commences at 57.5°F and reaches 100 percent at 62°F (Boles 1988). Other potential sources of mortality during the incubation period include redd dewatering, insufficient oxygenation, physical disturbance, and water-borne contaminants.

The pre-emergent fry remain in the redd and absorb the yolk stored in their yolk-sac as they grow into fry. This period of larval incubation lasts approximately 2 to 4 weeks depending on water temperatures. Emergence of the fry from the gravel begins during late June and continues through September. The fry seek out shallow nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure.

The emigration of juvenile winter-run chinook salmon from the upper Sacramento River is highly dependent on streamflow conditions and water-year type. Once fry have emerged, storm events may cause en masse emigration pulses. This emigration past Red Bluff may occur as early as late July or August, generally peaks in September, and can continue until mid-March in drier years (Vogel and Marine 1991). Emigration past Glenn Colusa Irrigation District (GCID) at river mile 206 is monitored daily by CDFG with a rotary screw trap in the GCID oxbow. The CDFG trap data show that juvenile winter-run chinook salmon emigration past GCID begins as early as mid-July and may continue through April (HDR Engineering Inc. 1993). Data combined from 1981-1992 trapping and seining efforts show that winter-run chinook salmon outmigrants occur between early July and early May from Keswick to Princeton (RM 302 to RM 158), and data combined from trawling, seining and State and Federal water project fish salvage records in the Delta show that winter-run chinook salmon outmigrants occur from October to early May in the Sacramento-San Joaquin Delta (CDFG 1993).

Completion of the Red Bluff Diversion Dam (RBDD) in 1966 enabled accurate estimates of all salmon runs to the upper Sacramento River based on fish counts at the fish ladders. Since the 1989 emergency listing of Sacramento River winter-run chinook, the population has been very low but has recently shown some improvements. Escapement declined from 533 in 1989, to 441 and 191 fish in 1990 and 1991, respectively. In 1992, the population rebounded to 1180 fish, but declined again in 1993 and 1994 to 341 and 189, respectively, before rebounding again in 1995 to 1361 fish. Returns from the 1993 and 1994 cohorts have increased considerably to 940 and 841 fish. Returns in 1998 were estimated at between 2,500 and 2,600 fish. If only spawning adults, which contribute the most to production, are considered, these numbers are close or above the threshold escapement level of 500 spawning adults.

To evaluate whether these population abundances represent an increasing or decreasing trend, the cohort survival of several year classes can be examined based on the winter-run chinook population's age structure. To estimate cohort survival, two assumptions are made: 1) consider only adult returns (exclude jacks), and 2) all females mature at age three (R. Kope, pers. comm.). Cohort survival can be represented as a cohort replacement rate (CRR), or the ratio between the number of spawning adults in one generation to the number of spawning adults in the next generation.

For the years since listing, approximate calculations of CRR are shown in Table 1. The geometric mean of the CRR's since listing is 1.49. This estimated CRR suggests an overall increase in the population since listing, but the estimate is uncertain because it is based on only six samples. The geometric mean for the three most recent year classes (1993-1995 brood years) is 2.02. Considering cohort survival in brood years preceding the listing, it appears that the steep downward trend observed in the population before listing may be stabilizing.

Table 1. Estimates of winter-run chinook salmon run-size, spawning adults and corresponding cohort replacement rates.

Broodyear	Total Run-size	Number of Adults	CRR
1985	3962	3633	0.38
1986	2464	2013	0.24
1987	1997	1761	0.34
1988	2094	1386	0.10
1989	533	480	2.34
1990	441	435	0.63
1991	191	133	1.15
1992	1180	1122	1.16
1993	341	267	1.97
1994	189	153	3.24
1995	1361	1296	1.29
1996	940	527	-
1997	841	496	-
1998	~2500	1683	-
1999	3208	-	-

An important aspect contributing to uncertainty is the accuracy of escapement estimates. Prior to 1986, the entire winter-run chinook population was monitored during the course of their upmigration past RBDD. Beginning in 1986, the gates at RBDD have been raised for various time periods during their migration to enable freer passage to spawning grounds. Since 1990, the gates have been raised for up to 85% of the winter-run upmigration period, such that about 15% of the run has been monitored rather than the entire run. This monitoring level equates to a sampling accuracy with a variance of 1.0 (in logarithms), such that the ratio of estimated to actual values varies between 0.36 and 2.72 (± 1 standard deviation)(L. Botsford, per. Comm.). For example, the 1994 year class had an escapement estimate of 189 spawning adults, but the accuracy of this estimate is fairly low, such that the actual run-size may have varied between 68 and 514 adults.

B. Sacramento River Winter-run Chinook Salmon Critical Habitat

Critical habitat for Sacramento River winter-run chinook salmon was designated on June 16, 1993 (58 FR 33212). Critical habitat is designated to include: the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay to the Golden Gate Bridge north of the San Francisco/Oakland Bay Bridge. Within the Sacramento River, this designation includes the river water column, the river bottom (including those areas and the associated gravel used by Sacramento River winter-run chinook salmon for spawning substrate), and the adjacent riparian zone used by fry and juveniles for rearing. In the areas westward from Chipps Island, including San Francisco Bay to the Golden Gate Bridge north of the San Francisco/Oakland Bay Bridge, this designation included the estuarine water column and essential foraging habitat and food resources utilized by Sacramento River winter-run chinook salmon as part of their juvenile emigration or adult spawning migration.

C. Central Valley Steelhead - Threatened: Population Trends, Life History, and Biological Requirements

On March 19, 1998, NMFS listed Central Valley steelhead as threatened under the Endangered Species Act (63 FR 13347). Central Valley steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin basins prior to dam construction, water development, and watershed perturbations of the 19th and 20th centuries (McEwan and Jackson 1996). Historical documentation exists that show steelhead were once widespread throughout the San Joaquin River system (CALFED 1999). In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley including San Francisco Bay (DFG 1965). The annual run size for this ESU in 1991-92 was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

Estimates of steelhead historical habitat can be based on estimates of salmon historical habitat. The extent of habitat loss for steelhead is probably greater than losses for salmon, because steelhead go higher into the drainages than do chinook salmon (Yoshiyama et al. 1996). Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82% of what was present is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of the former steelhead range remain accessible today in the Central Valley.

As with Central Valley spring-run chinook, impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley steelhead. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screen water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and SRA cover.

At present, wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River (McEwan and Jackson 1996). Naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento, Feather, American, Mokelumne, and Stanislaus rivers (CALFED 1999). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring or research programs (IEP Steelhead Project Work Team 1999).

All Central Valley steelhead are currently considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940's (IEP Steelhead Project Work Team 1999). Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954; Hallock et al. 1961). The timing of upstream migration is generally correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The preferred temperatures for upstream migration are between 46° F and 52° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Unusual stream temperatures during upstream migration periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. The minimum water depth necessary for successful upstream passage is 18 cm (Thompson 1972). Velocities of 3-4 meters per second approach the upper swimming ability of steelhead and may retard upstream migration (Reiser and Bjornn 1979).

Spawning may begin as early as late December and can extend into April with peaks from January through March (Hallock et al. 1961). Unlike chinook salmon, not all steelhead die after spawning. Some may return to the ocean and repeat the spawning cycle for two or three years; however, the percentage of repeat spawners is generally low (Busby et al. 1996). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Barnhart 1986; Everest 1973). Gravels of 1.3 cm to 11.7 cm in diameter (Reiser and Bjornn 1979) and flows of approximately 40-90 cm/second (Smith 1973) are generally preferred by steelhead. Reiser and Bjornn (1979) reported that steelhead prefer a water depth of 24 cm or more for spawning. The survival of embryos is reduced when fines of less than 6.4 mm comprise 20 - 25% of the substrate. Studies have shown a survival of embryos improves when intragravel velocities exceed 20 cm/hour (Phillips and Campbell 1961, Coble 1961). The preferred temperatures for spawning are between 39° F and 52° F (McEwan and Jackson 1996).

The length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable; hatching varies from about 19 days at an average temperature of 60° F to about 80 days at an average of 42° F. The optimum temperature range for steelhead egg incubation is 46° F to 52° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986, Leidy and Li 1987). Egg mortality may begin at temperatures above 56° F (McEwan and Jackson 1996).

After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another four to six weeks, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, steelhead fry typically inhabit shallow water along perennial stream banks. Older fry establish territories which they defend. Streamside vegetation is essential for foraging, cover, and general habitat diversity. Steelhead juveniles are usually associated with the bottom of the stream. In winter, they become inactive and hide in available cover, including gravel or woody debris.

The majority of steelhead in their first year of life occupy riffles, although some larger fish inhabit pools or deeper runs. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperatures influence the growth rate, population density, swimming ability, ability to capture and metabolize food, and ability to withstand disease of these rearing juveniles. Rearing steelhead juveniles prefer water temperatures of 45° F to 60° F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Temperatures above 60° F have been determined to induce varying degrees of chronic stress and associated physiological responses in juvenile steelhead (Leidy and Li 1987).

After spending one to three years in freshwater, juvenile steelhead migrate downstream to the ocean. Most Central Valley steelhead migrate to the ocean after spending two years in freshwater (Hallock et al. 1961, Hallock 1989). Barnhart (1986) reported that steelhead smolts in California range in size from 14 to 21 cm (fork length). In preparation for their entry into a saline environment, juvenile steelhead undergo physiological transformations known as smoltification that adapt them for their transition to salt water. These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range during smoltification and seaward migration for steelhead is 44° F to 52° F (Leidy and Li 1987, Rich 1997) and temperatures above 55.4° F have been observed to inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1975). Hallock et al. (1961) found that juvenile steelhead in the Sacramento Basin migrated downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

Steelhead spend between one and four years in the ocean (usually one to two years in the Central Valley) before returning to their natal streams to spawn (Barnhart 1986, Busby et al. 1996).

D. Central Valley Steelhead Critical Habitat

On February 5, 1999, NMFS proposed designation of critical habitat for the Central Valley steelhead (64 FR 5740). The final rule designating steelhead critical habitat was issued on February 16, 2000 (65 FR 7764). Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of steelhead. Inaccessible reaches are those above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU.

Critical habitat for Central Valley steelhead is designated to include all river reaches accessible to listed steelhead in the Sacramento and San Joaquin Rivers and their tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence and areas above specific dams (Black Butte Dam, Centerville Dam, Oroville Dam, Camp Far West Dam, Monticello Dam, Nimbus Dam, Keswick dam, Whiskeytown Dam, Englebright Dam, Crocker Diversion Dam, La Grange Dam, Commache dam, Goodwin Dam, and New Hogan Dam) or above longstanding naturally impassable barriers.

E. Central Valley Spring-run Chinook Salmon - Threatened: Population Trends, Life History, and Biological Requirements

On September 16, 1999, NMFS listed Central Valley spring-run chinook salmon as threatened under the Endangered Species Act (64 FR 50394). Historically, spring-run chinook salmon were predominant throughout the Central Valley, occupying the upper and middle reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit Rivers, with smaller populations in most other tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (DFG 1998). Before the construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries was extirpated. Also, spring-run no longer exist in the American River due to Folsom Dam.

Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80% of this habitat had been lost by 1928. Yoshiyama et al. (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82% is not accessible today. Clark (1929) did not give details about his calculation. Whether Clark's or Yoshiyama's calculation is used, only remnants of their former range remain accessible today in the Central Valley (DFG 1998).

Impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley spring-run chinook salmon. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screen water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and shaded riverine aquatic (SRA) cover.

A significant portion of the Central Valley spring-run chinook salmon ESU spawn and rear in upstream reaches of the Sacramento River. Since the majority of spring-run chinook historical spawning and rearing habitat in the Sacramento and San Joaquin River basins is no longer accessible due to impassable dams, the accessible areas of the Feather River, Clear Creek, and upper Sacramento River represent an essential portion of the remaining range and critical habitat for Central Valley spring-run chinook salmon.

Historically, the Sacramento River downstream of Shasta Dam was used by spring-run as a migration route to and from cooler tributary streams. After the construction of Keswick Dam in May 1942, Moffett (1947) estimated that 25,000 spring-run spawned in this area of the mainstem Sacramento River. From 1947 until 1956, estimates of spring-run abundance in the Sacramento River were based on redd counts and ranged from 27,000 to 4,000 (DFG 1998). No estimates were made from 1957 through 1968. Starting in 1969, spring-run estimates were based on counts made at Red Bluff Diversion Dam (RBDD) which included fish that were destined for Battle and Cottonwood Creeks. Since estimates of spring-run escapements are also separately generated for these drainages, some fish are "double counted" and no analysis has been performed to adjust the RBDD estimates to account strictly for the spawners to the mainstem Sacramento River. From 1991-1997, counts at RBDD have been below 800 spring-run and in 1997 had declined to 189 fish.

Due to poor estimates of run size and large variations in annual escapements between Central Valley streams, the percentage of the ESU spawning and rearing within the Sacramento River cannot be determined. However, the upper Sacramento River, Feather River, and Clear Creek represent approximately one-quarter of the remaining accessible spawning streams in the Central Valley.

Natural spawning populations of Central Valley spring-run chinook salmon are currently restricted to accessible reaches in the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998; FWS, unpublished data). With the exception of Butte Creek and the Feather River, these populations are relatively small ranging from a few fish to several hundred. Butte Creek returns in 1998 and 1999 numbered approximately 20,000 and 3,600, respectively (DFG unpublished data). On the Feather River, significant numbers of spring-run chinook, as identified by run timing, return to the Feather River Hatchery. However, coded-wire-tag information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run chinook populations in the Feather River due to hatchery practices. Over time, the spring-run within the Feather River may become homogeneous with Feather River fall-run fish unless current hatchery practices are changed.

Spring-run chinook salmon adults are estimated to leave the ocean and enter the Sacramento River from March to July (Myers et al. 1998). This run timing is well adapted for gaining access to the upper reaches of river systems, 1,500 to 5,200 feet in elevation, prior to the onset of high water temperatures and low flows that will inhibit access to these areas during the fall. Throughout this upstream migration phase, adults require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows are also necessary to allow adult passage to upstream holding habitat in natal tributary streams. The preferred temperature range for spring-run chinook salmon completing their upstream migration is 38° F to 56° F (Bell 1991; DFG 1998).

When they enter freshwater, spring-run chinook salmon are immature and they must stage for several months before spawning. Their gonads mature during their summer holding period in freshwater. Over-summering adults require cold-water refuges such as deep pools to conserve energy for gamete production, redd construction, spawning, and redd guarding. The upper limit of the optimal temperature range for adults holding while eggs are maturing is 59° F to 60° F (Hinz 1959). Unusual stream temperatures during spawning migration and adult holding periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. Sustained water temperatures above 80.6° F are lethal to adults (Cramer and Hammack 1952; DFG 1998).

Adults prefer to hold in deep pools with moderate water velocities and bedrock substrate and avoid cobble, gravel, sand, and especially silt substrate in pools (Sato and Moyle 1989). Optimal water velocities for adult chinook salmon holding pools range between 0.5-1.3 feet-per-second and depths are at least three to ten feet (G. Sato unpublished data, Marcotte 1984). The pools typically have a large bubble curtain at the head, underwater rocky ledges, and shade cover throughout the day (Ekman 1987).

Spawning typically occurs between late-August and early October with a peak in September. Once spawning is completed, adult spring-run chinook salmon die. Spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995a). Spring-run adults have been observed spawning in water depths of 0.8 feet or more, and water velocities from 1.2-3.5 feet-per-second (Puckett and Hinton 1974). Eggs are deposited within the gravel where incubation, hatching, and subsequent emergence takes place. Optimum substrate for embryos is a mixture of gravel and cobble with a mean diameter of one to four inches with less than 5% fines, which are less than or equal to 0.3 inches in diameter (Platts et al. 1979, Reiser and Bjornn 1979). The upper preferred water temperature for spawning adult chinook salmon is 55° F (Chambers 1956) to 57° F (Reiser and Bjornn 1979).

Length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable, however, hatching generally occurs within 40 to 60 days of fertilization (Vogel and Marine 1991). In Deer and Mill creeks, embryos hatch following a 3-5 month incubation period (USFWS 1995). The optimum temperature range for chinook salmon egg incubation is 44° F to 54° F (Rich 1997). Incubating eggs show reduced egg viability and increased mortality at temperatures greater than 58° F and show 100% mortality for temperatures greater than 63° F (Velson 1987). Velson (1987) and Beacham and Murray (1990) found that developing chinook salmon embryos exposed to water temperatures of 35° F or less before the eyed stage experienced 100% mortality (DFG 1998). After hatching, pre-emergent fry remain in the gravel living on yolk-sac reserves for another two to four weeks until emergence. Timing of emergence within different drainages is strongly influenced by water temperature. Emergence of spring-run chinook typically occurs from November through January in Butte and Big Chico Creeks and from January through March in Mill and Deer Creeks (DFG 1998).

Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum temperature range for rearing chinook salmon fry is 50° F to 55° F (Boles et al. 1988, Rich 1997, Seymour 1956) and for fingerlings is 55° F to 60° F (Rich 1997).

In Deer and Mill creeks, juvenile spring-run chinook, during most years, spend 9-10 months in the streams, although some may spend as long as 18 months in freshwater. Most of these "yearling" spring-run chinook move downstream in the first high flows of the winter from November through January (USFWS 1995, DFG 1998). In Butte and Big Chico creeks, spring-run chinook juveniles typically exit their natal tributaries soon after emergence during December and January, while some remain throughout the summer and exit the following fall as yearlings. In the Sacramento River and other tributaries, juveniles may begin migrating downstream almost immediately following emergence from the gravel with emigration occurring from December through March (Moyle, et al. 1989, Vogel and Marine 1991). Fry and parr may spend time rearing within riverine and/or estuarine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta. In general, emigrating juveniles that are younger (smaller) reside longer in estuaries such as the Delta (Kjelson et al. 1982, Levy and Northcote 1982, Healey 1991). The brackish water areas in estuaries moderate the physiological stress that occurs during parr-smolt transitions. Although fry and fingerlings can enter the Delta as early as January and as late as June, their length of residency within the Delta is unknown but probably lessens as the season progresses into the late spring months (DFG 1998).

In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water (Hoar 1976). These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range for chinook during smoltification and seaward migration is 50° F to 55° F (Rich 1997).

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers et al. 1998). Fisher (1994) reported that 87% of returning spring-run adults are three-years-old based on observations of adult chinook trapped and examined at Red Bluff Diversion Dam between 1985 and 1991.

F. Central Valley Spring-run Chinook Critical Habitat

On March 9, 1998, NMFS proposed designation of critical habitat for the Central Valley spring-run chinook salmon (63 FR 11482). The final rule designating Central Valley spring-run chinook salmon critical habitat was issued on February 16, 2000 (65 FR 7764). Critical habitat consists of the water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the Central Valley spring-run chinook ESU that can still be occupied by any life stage of chinook salmon. Inaccessible reaches are those above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU.

Critical habitat for Central Valley spring-run chinook is designated to include all river reaches accessible to chinook salmon in the Sacramento River and its tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas above specific dams (San Pablo Reservoir, Calavera Reservoir, Nimbus Dam, Camp Far West Dam, Oroville Dam, Englebright Dam, Black Butte Dam, Keswick Dam, Shasta Dam, Whiskeytown Dam) or above longstanding naturally impassable barriers.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species or its habitat and ecosystem within the action area (USFWS and NMFS 1998).

A. Status of the Listed Species and Critical Habitat in the Action Area

1. Sacramento River winter-run chinook salmon

The action area is located within the critical habitat of the Sacramento River winter-run chinook salmon. Critical habitat within the action area ranges from riverine habitat to estuarine areas. The essential elements of critical habitat in these areas are the water, substrate, and adjacent riparian areas.

Sacramento River winter-run chinook salmon are found in the project area seasonally as adults, fry and juveniles. Adult winter-run enter the San Francisco Bay from November through June (Van Woert 1958, Hallock et al. 1957). They migrate up the Sacramento River from December through early August. Run timing past the SRWTP probably is from December through April. Fry emergence occurs from mid-June through mid-October and the emigration of juvenile winter-run chinook salmon from the Upper Sacramento River is highly dependent on streamflow conditions and water type. The peak emigration of winter-run chinook juveniles past the SRWTP generally occurs from January through April, but the range of emigration may extend from September up to June (Schaffer 1980, Messersmith 1966, California Department of Fish and Game 1989, California Department of Fish and Game Memo 1993, U.S. Fish and Wildlife Service 1992, U.S. Fish and Wildlife Service 1993, U.S. Fish and Wildlife Service 1994). Winter-run juveniles may utilize Sacramento tributary streams as habitat for non-natal rearing habitat but no evidence of winter-run juveniles has been found in the American river in the area of the FWTP.

2. Central Valley Steelhead

A significant portion of the Central Valley steelhead ESU spawn and rear within the action area. Since the majority of Central Valley steelhead historical spawning and rearing habitat in the Sacramento and San Joaquin River basins is no longer accessible due to impassable dams, the accessible areas of the Feather River, Clear Creek, upper Sacramento River, American River and the Stanislaus River represent an essential portion of the critical habitat for this steelhead ESU.

Central Valley steelhead populations within the action area generally show a continuing population decline, an overall low population abundance, and fluctuating return rates. Historical abundance estimates are available for some stocks within the action area but no overall reliable estimates are available. Monitoring of steelhead populations in the Sacramento and its tributaries is limited to the direct counts made at the RBDD, Feather River Fish Hatchery, and Nimbus Fish Hatchery.

Historically, the American River provided over 125 miles of riverine habitat to anadromous fish including CV steelhead. During the period from 1895 to 1939, access to the upper reaches was impaired by the construction of several dams (Yoshima et al. 1996). From 1950 through 1955, anadromous fish access was completely restricted to the lower 27 mile stream reach below the Old Folsom Dam as a result of the destruction of its fish ladder by flood waters (Gerstung 1971). In 1955, completion of the Nimbus Dam eliminated four additional miles of stream habitat resulting in the current restriction of anadromous fish to the lower 23 miles of the American River; however, a remnant population of rainbow trout with steelhead ancestry may continue to exist in the North Fork of the American River above Folsom Dam (Dennis McEwan, CDFG, personal communication, as cited in NMFS 1998).

Annual escapement to the American River has been quite variable since construction of the Folsom and Nimbus Dams. Estimated steelhead run sizes in the American River in 1971-72 and 1973-74 were 19,583 and 12,274, respectively (Staley 1976). Escapement was estimated to have been approximately 17,500 fish during the 1980's (CDFG 1990, as cited in NMFS 1998), but less than 1,000 fish during the 1990's (Reclamation 1998, as cited in NMFS 1998). Recent studies conducted by CDFG indicate that in-river production is quite variable, depending on year-long flow and temperature conditions (Reclamation 1998, as cited in NMFS 1998). The relative contribution of in-river versus hatchery produced steelhead varies accordingly to these conditions, with the majority of juvenile steelhead production coming from Nimbus Hatchery during years when summer rearing temperatures in the lower American River are lethal (Alan Baracco, CDFG, personal communication 1997, as cited in NMFS 1998).

Over the last 40 years, the riparian habitat in this lower reach has been altered in part as a result of changes in the historical, natural hydrograph associated with reservoir management. Lack of scour, build-up of willows, and loss of cottonwoods likely resulted from extended drought conditions experienced in the late 1980's and early 1990's. Recent wet years have resulted in scouring of bars, removal of more persistent vegetation, and have initiated mass recruitment to the cottonwood forests. Flood control activities and levee maintenance activities such as rip-rapping have exacerbated the losses of riparian habitat along the lower American River.

In previous years, juvenile steelhead have been found in habitat units upstream and downstream of the proposed project sites during the months of August and September. Pre-project seining surveys in 1996 and 1998 found juvenile steelhead ranging in fork length from 89 to 154 millimeters in four habitat units within the project reach (Vyverberg 1999a). Three of these habitat units are proximal to, and have water depths and velocities similar to, the proposed project sites.

All emigrating juvenile Central Valley steelhead smolts use the lower reaches of the Sacramento and San Joaquin rivers and the Delta for rearing and as migration corridors to the ocean. Some juveniles may utilize tidal and non-tidal freshwater marshes and other shallow water areas in the Delta as rearing areas for short periods prior to the final portion of their emigration to the sea. All adult steelhead use the Delta and lower reaches of the Sacramento and San Joaquin rivers as upstream migration corridors to return to their natal streams for spawning.

The action area is located within the critical habitat of the Central Valley steelhead. Critical habitat within the action area ranges from riverine habitat to estuarine areas. The essential elements of critical habitat in these areas are the water, substrate, and adjacent riparian areas.

3. Central Valley spring-run chinook salmon

All of the emigrating juvenile sub-yearling and yearling Central Valley spring-run chinook use the lower reach of the Sacramento River and the Delta for rearing and as migration corridors to the ocean. The lower American River may be utilized as non-natal rearing habitat depending on water temperatures. Some juveniles utilize tidal and non-tidal freshwater marshes and other shallow water areas in the Delta as rearing areas for short periods prior to the final portion of their emigration to the sea. All adult spring-run chinook salmon use the Delta and lower Sacramento River as an upstream migration corridor to return to their natal streams for spawning.

Central Valley spring-run chinook populations within the action area generally show a continuing population decline, an overall low population abundance, and fluctuating return rates. These demographics for Central Valley spring-run chinook indicate the long-term viability of the ESU is at risk.

The action area is located within the critical habitat of Central Valley spring-run chinook. Critical habitat within the action area ranges from riverine habitat to estuarine areas. The essential elements of critical habitat in these areas are the water, substrate, and adjacent riparian areas.

B. Factors Affecting Species Environment within the Action Area

The essential features of freshwater salmonid habitat include adequate (1) substrate; (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions. These features have been affected by human activities such as water management, flood control, agriculture, and urban development throughout the action area. Impacts to these features have led to salmonid population declines significant enough to warrant the listing of several salmonid species in the Central Valley of California.

High water quality and quantity are essential for survival, growth, reproduction, and migration of individuals dependent on riparian and aquatic habitats. Important water quality elements include flows adequate to support the migratory, rearing, and emergence needs of fish and other aquatic organisms. Desired flow conditions for salmonids include an annual abundance of cool, well-oxygenated water with low levels of suspended and deposited sediments or other pollutants that could limit primary production and/or invertebrate abundance and diversity.

Profound alterations to the riverine habitat of the American and Sacramento Rivers began with the discovery of gold in the middle of the nineteenth century. Dam construction, water diversion, and hydraulic mining soon followed, launching these Central Valley rivers into the era of water manipulation and coincident habitat degradation.

About 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation literally spreading four to five miles wide (Resources Agency 1989). By 1979, riparian habitat along the Sacramento River diminished to 11,000-12,000 acres or about 2 percent of historic levels (McGill 1979). More recently, about 16,000 acres of remaining riparian vegetation has been reported (McGill 1987). The degradation and fragmentation of riparian habitat has resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture (Jones and Stokes Associates 1993). In addition, alteration of the Sacramento River's natural flow regime following construction of Shasta Dam has impaired the regeneration of riparian vegetation. Historically, the seasonal flow patterns included high flood flows in the winter and spring with declining flows throughout the summer and early fall. As flows decline during the summer, the seeds from willows and cottonwood trees deposited on the recently created sand bars germinate, sprout, and grow to maturity. The roots of these plants would follow the slowly receding water table, allowing the plants to become firmly established before the next rainy season. Similar habitat impacts have occurred on the American River.

Hydropower and flood control dams of the CVP and private dams have permanently blocked or hindered salmonid access to historical spawning and rearing grounds in the American River basin. Downstream effects of these dams include significant alteration of flow regimes, riparian functions and quality, and primary productivity of the stream. Diversion and storage of natural flows have altered the natural cycles by which juvenile and adult salmonids base their migrations and have also depleted American river flows. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased gravel and large woody debris recruitment.

Increased sedimentation resulting from agricultural and urban practices within the action area is also a primary cause of salmonid habitat degradation. Sedimentation has adversely impacted salmonids during all freshwater life stages by clogging, or abrading gill surfaces; adhering to eggs; inducing behavioral modifications; burying eggs or alevins; scouring and filling pools and riffles; reducing primary productivity and photosynthetic activity; and affecting intergravel permeability and dissolved oxygen levels. Embedded substrates have reduced the production of juvenile salmonids and hindered the ability of some over-wintering juveniles to hide in the gravels during high flow events. Increased sedimentation has also been shown to increase water temperatures, thereby directly impacting incubating and rearing salmonids.

Land use activities associated with road construction, urban development, upstream logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through alteration of streambank and channel morphology; alteration of ambient stream water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of gravel and large woody debris; and removal of riparian vegetation resulting in increased streambank erosion. Agricultural practices and entrainment behind dams have eliminated large trees and logs and other woody debris that would have been otherwise recruited to the stream channel. Large woody debris influences stream morphology by affecting pool formation, channel pattern and position, and channel geometry. In addition, unscreened water diversions for agriculture and municipal use have adversely affected salmonids through direct entrainment of emigrating juveniles.

Preliminary, significant steps towards the largest ecological restoration project yet undertaken in the United States have occurred during the past four years and continue to proceed in California's Central Valley including the action area. The CALFED Program and the CVPIA's AFRP, in coordination with other Central Valley efforts, have implemented numerous habitat restoration actions that benefit Sacramento River winter-run chinook salmon, Central Valley steelhead, Central Valley spring-run chinook salmon, and their critical habitat. These restoration actions include the installation of fish screens, modification of barriers to improve fish passage, and habitat acquisition and restoration. The majority of these recent restoration actions address key factors for decline of these ESUs and emphasis has been placed in tributary drainages with high potential for winter-run chinook, steelhead and spring-run chinook production. Additional actions that are currently underway that benefit Sacramento River winter-run chinook, Central Valley steelhead and Central Valley spring-run chinook include new efforts to enhance fisheries monitoring and conservation actions to address artificial propagation.

V. ASSESSMENT OF IMPACTS

The fish screen replacement project is designed to protect certain life history stages of anadromous salmonids from entrainment and impingement. However, there may be some unavoidable, short term impacts related to construction of this project that may result in direct, indirect, and cumulative effects on steelhead and chinook salmon.

The action has the potential to adversely affect listed species or modify critical habitat through the following:

- Direct mortality;
- Temporary impacts to habitats such that listed species suffer increased mortality or lowered reproductive success;
- Permanent loss of habitat critical to listed fish species.

The project occurs within critical habitat for Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead. Project activities have the potential to adversely impact Central Valley winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead. A description of potential adverse impacts associated with the project are identified in the following analysis.

A. Physical Injury from Screen Contact

1. <u>FWTP Intake Structure</u>

Exposure time of juvenile fish to the screen will be approximately 60 seconds or less when the lower American River flow is 8,000 cfs or higher. At a flow of 8,000 cfs, sweeping velocity will be approximately 3.3 fps, and exposure time will be approximately 29 seconds across the first screened area, with a 10 second period without hydraulic pull (at the center divider), with an additional 20-second exposure across the remaining screened area. The probability of lower American River flows of 8,000 cfs or higher varies by month, as indicated below. At flows lower than 8,000 cfs, exposure time to the operational length of the intake screens will exceed 49 seconds. When the lower American River is at a minimum stage elevation of 12.0 ft mean sea level (msl), flow will be approximately 250 cfs. At a flow of 250 cfs, sweeping velocity will be approximately 1.2 fps, and exposure time will be approximately 80 seconds across the first screened area, with a 27-second period without hydraulic pull (at the center divider), with an additional 54-second exposure across the remaining screened area. The probability of lower American River flows equal to or greater than 250 cfs is shown below.

Table 2. Probability of Flow (cfs) in the Lower American River

Month	Percent Probability of Lower American River Flow ≥ 8,000 cfs	Percent Probability of Lower American River Flow ≤ 250 cfs
Oct	0	100
Nov	0	100
Dec	10	100
Jan	18	100
Feb	22	100
Mar	11	100
Apr	6	100
May	12	100
Jun	8	100
Jul	0	100
Aug	0	100
Sep	0	100

The months during which flows have the highest probability of exceeding 8,000 cfs include December through June which encompass the emigration period of juvenile anadromous salmonids in the lower American River. The longest possible exposure time of up to 134 seconds, which would occur only at a lower American River flow of 250 cfs, has the potential to occur only during extremely critical dry years. Specifically, based on modeling of the 70-year hydrologic period of record, flows lower than 250 cfs are not expected to occur. Thus, the range of exposure times that juvenile fish would experience at the fish screen will range from 49 seconds or less up to a theoretical maximum of 134 seconds. The benefits of a low approach velocity (≤0.33 fps) and screen mesh size (1.75 mm slotted openings) are expected to moderate any potential effects of a somewhat increased exposure time to the screen (i.e. impingement due to fatigue from high approach velocities and entrainment due to improper sizing of screen).

Due to the following reasons, NMFS has determined that there will be no adverse impacts to listed salmonids from screen contact at the FWTP intake structure and expects that the screens will have a beneficial effect on listed Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead survival by precluding juvenile impingement on or entrainment into the FWTP intake structure: (1) the screen face is designed to be parallel to the flow and adjacent bankline, and to minimize eddies in proximity of the screen; (2) the longest screen exposure time (at a minimum river stage elevation of 12.0 ft msl) would be anticipated to be about 134 seconds, separated into two discrete 80 and 54-second intervals, and that these conditions will only occur during extremely low flow years; (3) the screen is designed to provide a uniform approach velocity which will not exceed 0.33 fps, and oftentimes would be less than 0.33 fps; (4) the screen face is designed flush with adjacent screen bay walls, and sweeping velocity would be several times (5X or more) higher than the approach velocity; and (5) the screen design includes slotted openings of 1.75 mm to conform with the steelhead fry criterion.

2. SRWTP Intake Structure

Exposure time of juvenile fish to the screen (based on the length of the screen and estimated sweeping velocity) will be approximately 60 seconds or less when Sacramento River flow is 45,000 cfs or higher. At a flow of 45,000 cfs, sweeping velocity will be approximately 2.0 fps. Exposure time will be approximately 29-seconds across the first screened area, with a 15-second period without hydraulic pull (at the center divider), with an additional 29-second exposure across the remaining screened area. The probability of Sacramento River flows of 45,000 cfs or higher varies by month, as indicated below. At lower Sacramento River flows, exposure time to the operational length of the intake structure will exceed 60 seconds. When the Sacramento River is at a minimum stage elevation of 2.0 ft msl, river flow will be approximately 7,500 cfs, sweeping velocity will be approximately 1.3 fps, and exposure time will be approximately 45 seconds across the first screened area, with a 23-second period without hydraulic pull (at the center divider), with an additional 45-second exposure period across the remaining screened area. The probability of Sacramento River flows equal to or greater than 7,500 cfs is shown below.

The longest anticipated exposure time of up to 90 seconds, which will occur at a Sacramento River flow of approximately 7,500 cfs, will only occur during critically dry years. The data above shows that a 7,500 cfs flow rate will be met or exceeded nearly all of the time. Thus, the range of exposure times that juvenile fish will experience at the fish screen will range from 60 seconds or less up to 90 seconds, with the 90-second exposure time rarely occurring. The benefits of a low approach velocity (≤0.33 fps) and screen mesh size (1.75 mm slotted openings) are expected to moderate any potential effects of a somewhat increased exposure time to the screen (i.e. impingement due to fatigue from high approach velocities and entrainment due to improper sizing of screen).

Table 3. Probability of Flow (cfs) in the Sacramento River

Month	Percent Probability of Sacramento River Flow ≥ 45,000 cfs	Percent Probability of Sacramento River Flow ≤ 7,500 cfs
Oct	0	92
Nov	4	92
Dec	18	100
Jan	26	100
Feb	38	100
Mar	23	100
Apr	14	96
May	6	97
Jun	3	100
Jul	0	100
Aug	0	93
Sep	0	96

Due to the following reasons, NMFS has determined that there will be no adverse impact to listed salmonids from screen contact at the SRWTP intake structure and expects that the screens will have a beneficial effect on listed Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead survival by precluding juvenile impingement on or entrainment into the FWTP intake structure: (1) the screen face is designed to be parallel to the flow and adjacent bankline, and to minimize eddies in proximity of the screen; (2) the longest exposure time (at a minimum river stage elevation of 2.0 ft msl) would be anticipated to be about 90 seconds, separated into two discrete 45-second intervals, and that these conditions would only occur during only part of some years; (3) the screen is designed to provide a uniform approach velocity which would not exceed 0,2 fps, and oftentimes would be less than 0.2 fps; (4) the screen face is designed flush with adjacent screen bay walls, and sweeping velocity will be several times (6X or more) higher than the approach velocity; and (5) the screen design includes slotted openings of 1.75 mm to conform with the steelhead fry criterion,

B. Turbidity and Suspended Sediment

Construction activities adjacent to or in the flowing waters of the American and Sacramento Rivers will disturb soils and the riverbed and could lead to increased river turbidity and sedimentation. Increased water turbidity levels for prolonged periods of time could adversely affect the ability of young salmonids to feed effectively, resulting in reduced growth and survival. Turbidity may cause harm, injury, or mortality to juvenile chinook or steelhead in the vicinity and downstream of the project area. High turbidity concentration can cause fish mortality, reduce fish feeding efficiency and decrease food availability (Berg and Northcote 1985, McLeay et al. 1987, Gregory and Northcote 1993).

Project construction activities for installation of the FWTP and SRWTP screens are likely to result in an increase in turbidity and suspended sediments during the placement and removal of sheetpiles and during cofferdam dewatering operations. Turbidity and increased sediments are known to adversely affect juvenile steelhead by causing difficulty breathing, feeding, and migrating (Berg and Northcote 1985; Sykora et al. 1972). Due to the use of above ground desiltation basins located at the construction staging areas and the short term, localized and episodic increases in suspended sediments associated with cofferdam dewatering, turbidity is expected to be less than the levels associated with these adverse effects. Sheetpile placement and removal turbidity and suspended sediments impacts are also expected to be minimal due to the dilution rate associated with the large volume of water flowing in the American and Sacramento Rivers.

Because erosion control methods and best management practices will be employed, impacts to listed salmonids from erosion and sedimentation are expected to be minor and temporary and not result in the harm of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon. Further, predicted temporary and minor increases in erosion and sedimentation are not expected to appreciably diminish the value of critical habitat for both the survival and recovery of Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon or Central Valley steelhead.

C. Potential Impacts to Rearing Salmonids Associated With Cofferdam De-watering Operations

Instream habitat will be temporarily lost when the streamflow is diverted (e.g., coffer dams) and the workspace is de-watered as a result of project construction. Dewatering the workspace may cause harm, injury, and mortality to anadromous fishes by confining them to areas of increased water temperature, decreased dissolved oxygen concentration, and predation (Cushman 1985).

Winter-run chinook salmon fry and juveniles may be present in the project area from October to June and spring-run chinook salmon fry and juveniles may be present from November through June. Steelhead fry and juveniles may be present year-round.

Therefore, juvenile salmonids may be present at the FWTP and SRWTP intake structures during construction of the fish screens. Placement of sheetpile cofferdams in the American and Sacramento Rivers could trap rearing salmonids during construction. Juvenile salmonids that become trapped within isolated pockets of water behind coffer dams or sheet pile could be killed during dewatering and construction activities. NMFS does not anticipate that adult salmonids will be trapped during cofferdam construction.

Several measures will be implemented during project construction to remove fish that could be within the cofferdam prior to dewatering this structure. The cofferdam will be constructed via the sequential placement of sheetpiles from the upstream to the downstream end of the portion of the intake structure to be enclosed by the cofferdam. Prior to completion of the downstream end of the cofferdam, seining will be conducted within the cofferdam with a small mesh seine to remove as many fish as possible. This method will be used to primarily herd fish out of the cofferdam. Once seining is completed, exclusionary nets will be placed in the river to prevent fish from entering the cofferdam during the final stages of cofferdam placement prior to dewatering. Once the cofferdam has been completed, pumps will be used to dewater the cofferdam. When the cofferdam is partially dewatered, a final seining effort will be conducted within the cofferdam.

Because there is the possibility of listed fish being present in the project area year-round, additional requirements are required to reduce fish mortality. In addition to the above dewatering operations, only low flow pumps with screened intakes will be used during dewatering operations. If fish are still present after partial dewatering of the cofferdam and further seining cannot rescue all listed species, then electrofishing shall be used by a qualified fisheries biologist to capture any remaining fish. Electrofishing can result in acute and chronic impacts to salmonids including direct injury and other physiological responses, from spinal hemorrhage, fractured vertebra, spinal misalignment, separated spinal columns, handling stress and altered behavior. Recent investigations have documented substantial injuries to the spinal columns of fish that had been captured by electrofishing with a pulsed direct current. These injuries result from powerful convulsions of body musculature and include spinal compressions, breaks, misalignments, fractured vertebrae; and other associated hemorrhages; and damage to muscles, nerves, and other tissues. Generally, the injuries are not externally obvious or fatal; however, when external signs of injuries, such as brands or bent backs, are visible, the injuries may be severe. Unless the injury is severe, most fish experiencing electrofishing-related spinal injuries can eventually survive, and appear to behave normally (Fredenberg 1992, McMichael 1993).

All juvenile salmonids captured shall be released into the American or Sacramento rivers downstream of the construction area. Based on the poor quality of rearing habitat present within the immediate project areas, numbers of juvenile chinook salmon and steelhead that may be present during cofferdam installation is anticipated to be very low, probably less than 100 fish. There is potential for non-lethal capture, stranding, injury, and death to occur of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon as a result of relocating stranded fish, but overall, NMFS expects capture and relocation of these fish to provide beneficial effects over possible stranding and entrapment of all individuals within the cofferdam.

D. Percussion/Acoustic Impacts to Incubating Salmonid Embryos, Juvenile Salmonids andAdult Migrating Salmonids From Construction Activities

Underwater sound pressure levels of sufficient magnitude and frequency can affect all lifestages of salmonids. Response of underwater sound pressure levels is affected not only by intensity (re 1 μpa), but also by the frequency measured in cycles per second (Hz). The frequency range of Atlantic salmon (*Salmo salar*) salmonid hearing has been found to range from 5 to 300 Hz with the greatest sensitivity at 180 Hz. Atlantic salmon are functionally deaf above 380 Hz (Hawkins and Johnstone 1978). Effects of low-frequency sound pulses on fish have been reviewed by BBN Systems and Technologies (1993). The review concluded that sound pulses at received levels of 160 dB re 1 μpa (pressure) may cause subtle changes in behavior, and stronger pulses (180 dB re 1 μpa) could cause more noticeable changes.

The sound pressure levels of pile driving operations have not been well documented. One study has indicated that impact pile drivers can generate up to 20 dB re 1 μpa above ambient noise levels at 593 meters in water or greater depending on the size of the piling and pile driver (Feist 1991). Feist also found that within the range of salmonid hearing, the sound field generated by pile driving activities had a radius of at least 300m for large pile drivers (6,625 Kg hammer weight). This study indicated that the frequency range of impact pile drivers was found to range from 70 to 2000 Hz.

Construction impacts on juveniles are anticipated from pile driving operations associated with the construction of the sheetpile cofferdams and the pile supported access roadway. In addition, other noise/vibratory generating equipment will be used during construction of the FWTP and SRWTP intakes (jack hammer, air compressors, rock drill pump and pneumatic tools). The size and type of pile driver to be used in the construction of the FWTP and SRWTP intake structures is unknown at this time. Impacts associated from noise/vibratory equipment are expected to be temporary in nature, lasting no longer than 11 hours Monday through Saturday) and nine hours (Sunday) during daylight hours pursuant to the City of Sacramento Noise Ordinance.

NMFS anticipates that pile driving operations associated with construction of the intake structures can be expected to produce sound pressure levels of up to 95 to 120 dB, within the frequency range of salmonid hearing (Feist 1991). Feist has found that pile driving operations affected the general behavior and distributions of salmonid schools around the site. Fish were shown to exhibit avoidance behavior and have reduced growth rates in response to decibel levels in this range. Consequently, there is potential for harm or harassment of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon as a result of pile driving operations associated with intake structure construction.

Adult and juvenile salmonid fish passage through the Sacramento and American Rivers could potentially be affected by noise impacts that will occur as a result of in-channel construction activities. If pile driving or other noise/vibratory generating equipment is used during adult or juvenile salmonid migration periods, it may affect migration behavior. Underwater sound pressure levels of sufficient magnitude could result in delay of migratory fish movements. These migrational delays are expected to be temporary in nature, lasting no longer than 11 hours during daylight hours (nine hours on Sunday, as discussed above). However, there is potential for harassment or harm associated with migrational delays of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon to occur as a result of pile driving or other noise/vibratory generating equipment operations associated with intake structure construction.

E. Water Temperature Related Impacts

As previously stated, the City of Sacramento's diversions from the FWTP and SRWTP will not increase as a direct result of the fish screen replacement. Because of this fact, the fish screen project will not have any direct temperature related impacts in relation to the project baseline conditions.

There may, however be interrelated actions associated with screen installation that may have impacts on temperature conditions between the FWTP and the confluence of the American and Sacramento Rivers. A treatment plant expansion for the FWTP and SRWTP is anticipated in the near future and a Draft Environmental Impact Report for this treatment plant expansion is currently in preparation. This treatment plant expansion will enable the city to increase the diversion and treatment rate at the FWTP from the existing water treatment capacity of 90 mgd (139 cfs) to up to 200 mgd (310 cfs). As part of the City of Sacramento's Fish Screen Replacement Project, as analyzed in this biological opinion, the existing fish screen at the FWTP will be replaced to achieve current fish screen performance criteria for the original intake design capacity of 200 mgd.

There are several areas of concern regarding temperature effects associated with the increased diversion capacity of the FWTP. The first and most direct is the effect that increased diversions have upon water temperatures between the FWTP intake structure and the confluence of the American and Sacramento Rivers. The second concern is in regard to what effect increased releases from Reclamation's facilities to provide for increased diversions at the FWTP will have on the ability to control summer rearing temperatures for steelhead juveniles in the American River. Impacts to listed and candidate salmonids other than steelhead (winter-run, spring-run, and fall/late-fall run chinook salmon) are not expected to occur since they are not expected to be present in the American River when temperature problems may possibly occur due to indirect project effects.

The preferred water temperature for various life stages of steelhead is well documented (Bovee 1978, Reiser and Bjornn 1979, Bell 1986). Optimum temperature requirements of steelhead may vary depending on season, life stage, and stock characteristics.

Rearing steelhead juveniles prefer water temperatures of 45°F to 60°F (Reiser and Bjornn 1979, Bovee 1978, Bell 1986). Temperatures above 60°F have been determined to induce varying degrees of chronic stress and associated physiological responses in juvenile steelhead (Leidy and Li 1987). Steelhead have difficulty extracting oxygen from water at temperatures greater than 70°F and the upper lethal temperature limit has been identified as 75°F (Bell 1973). Because over 82% of their historical spawning and rearing habitat is now inaccessible due to impassable dams (Yoshiyama et al. 1996), juvenile steelhead rearing is mostly confined to lower elevation reaches where high water temperatures during late-summer and fall are a major stressor (IEPPWT 1999).

As previously described, the expanded FWTP will be operated in response to the water demands of the City, and will work in conjunction with other City facilities (e.g., the SRWTP) to provide up to 130,600 annual acre feet (AFA) of water within the City limits, by the year 2030. The proposed FWTP Expansion Project will involve diversion of up to 96,300 AFA from the expanded FWTP. As part of this project, it is currently proposed that diversion of American River water at the FWTP will be restricted in accordance with the Water Forum Proposal to minimize environmental concerns regarding fish and aquatic habitat in the Lower American River. The restrictions are as follows:

1. Diversions of up to 310 cfs (200mgd) will be allowed as long as the flow bypassing the diversion at the FWTP exceeds the Hodge flow criteria[5]

2. Whenever flow bypassing the diversion at the FWTP is less than the Hodge flow criteria, diversions no greater than the following will be allowed:

January through May	120 cfs (78mgd)
June through August	155 cfs (100mgd)
September	120 cfs (78mgd)
October through December	100 cfs (65mgd)

In extremely dry years, the City will limit its diversions of City water at the FWTP to not greater than 155 cfs (100 mgd) and not greater than 50,000 AFA.

The City of Sacramento provided NMFS with a temperature assessment that addressed the proposed FWTP expansion dated November 3, 1999. The results of

[5] The "Hodge" flow criteria are flow levels established by Judge Richard Hodge in his 1990 decision rendered in *Environmental Defense Fund et al. v. East Bay Municipal District*. These minimum flow levels in the Lower American River defined the flow threshold below which parties to the litigation would not be allowed to divert water. Specifically, parties to the litigation could not divert water from the American River unless instream flows measured at least 2,000 cfs from October 15 through February, 3,000 cfs from March through June, and 1,750 cfs from July through October 14. The City of Sacramento was not a party to the litigation.

these modeling efforts indicate that, overall, no adverse impacts to salmonid resources of the lower American River were anticipated to occur from operation of the proposed expansion of the FWTP when compared to the No Project Alternative under the State Water Board Decisions D893/D1400M hydrology ("worst case") or the anticipated Reclamation operations/releases to the lower American River for either dry year or average/normal year conditions. With the exception of early lifestage salmon mortality, modeling output provided mean monthly values for each of the parameters for each year of the 70-year hydrologic period of record modeled for river flows and reservoir storage and elevation, and the 69-year period of record modeled for river water temperatures. Output from the salmon mortality models provided estimates of annual (rather than mean monthly) losses of emergent fry from egg potential which was presented in terms of survival. Because no steelhead mortality model has been developed for the lower American River, no steelhead mortality modeling could be performed as a part of the assessment for this process.

Because the modeling provides estimates of temperature impacts on a monthly basis and not on a daily basis, we are uncertain as to the impacts associated with increased FWTP diversions on juvenile steelhead downstream of the FWTP intake structure on a real time basis when low flow conditions may exist (1750 cfs and below) and temperatures may be elevated due to low flow conditions and high ambient air temperatures. Because of the lack of information available to determine daily temperature impacts associated with increased water withdrawals, it is unknown whether adverse modification to constituent elements of critical habitat or adverse impacts to listed salmonids from temperature increases associated with increased diversion rates will occur. Because insufficient commercial or scientific information exists to determine the impacts on this listed species, NMFS is making the conservative determination that increased FWTP diversions may adversely affect Central Valley steelhead juveniles in the American River below the FWTP intake structure due to potential temperature increases associated with City of Sacramento actions during late summer and early fall months and may result in harm or mortality of listed steelhead. The extent and severity of these adverse impacts are unknown at this time.

In order to obviate the risk of such impacts, and to provide actual benefits to the fishery habitat throughout the length of the lower American River, NMFS and the City of Sacramento have agreed that, in cooperation with Reclamation[6], the City of Sacramento will contribute funds to assist in water temperature management for the Lower American River. Specifically, the temperature shutters on the Folsom penstocks can be made more efficient. Leakage along the guidance structure

[6]Reclamation has agreed to manage and expend these funds in furtherance of temperature improvements in the Lower American River, and anticipates doing so in a time frame preceding the City's utilization of the full treatment capacity to be provided by the water treatment expansion project. NMFS, Reclamation, and the City recognize that Reclamation is not hereby agreeing to or being required to augment the funding being provided by the City.

associated with the shutters does not currently permit the most effective management of the coldwater pool at Folsom Reservoir. The leakage, in effect, may produce a "flow net" drawing water throughout the vertical profile in Folsom Reservoir, rather than at specified vertical locations which provides the most effective tool for coldwater pool management. However, an evaluation of the amount of leakage and how it relates to the magnitude and management of the cold water pool would be needed to address this more sufficiently. The leakage should be reduced or eliminated by repair or replacement of the structure. The funding to be provided by the City will be used to assist in modifying or replacing the shutters, and will confer benefits to the fishery throughout the lower American River. The benefits to lower American River fisheries from the improved temperature conditions associated with this effort will fully offset and may well exceed possible impacts of the water treatment plant expansion project, if any, to listed species in the river downstream of the FWTP intake structure.

Because of the improvements to the Folsom penstock shutters and the concomitant improvement to American River water temperature conditions for fisheries benefits as a result of funds committed by the City of Sacramento, elevated water temperatures are not expected to occur as a result of increased water withdrawals in the American River at the FWTP. Hence, increased water withdrawals at the FWTP are not expected to appreciably reduce the likelihood of both the survival and recovery of steelhead in the wild by reducing its reproduction, numbers, or distribution.

Increased FWTP diversions will not adversely affect Sacramento River winter-run chinook salmon or Central Valley spring-run chinook salmon in the American River below the FWTP intake structure. This is because any increased temperatures that may be experienced downstream of the FWTP will be fully mitigated by the improvements to the Folsom temperature shutters associated with City of Sacramento funding actions.

F. Effects to Designated Critical Habitat

Riparian vegetation greatly influences the biological and physical processes that provide freshwater habitat for salmonids. These processes include shade and cover, water quality and flow routing, the aquatic food web, sediment routing and composition, stream channel bedform and stability, and linkages to the floodplain (Beschta 1991: Gregory et al. 1991; Schlosser 1991; Sullivan et al 1987). Nearshore areas provide valuable attributes for rearing and migrating juvenile salmonids including (1) banks composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water, (2) water containing variable amounts of woody debris, such as leaves, logs, branches and roots, often substantial natural detritus, and (3) variable water velocities, depths and flows. In-water cover, from downed branches or trees or overhanging vegetation and irregular banks, enhances the diversity of the stream habitat and provides juvenile salmonids many opportunities for feeding and protection from predators.

The gradual and continuous loss of mature riparian habitat through levee and bank protection activities leads to lower stream productivity and increased homogeneity of the nearshore areas. Additionally, continued maintenance of denuded levees and riprapped banks eliminates the potential for revegetation and recovery of quality nearshore habitat for juvenile salmonids. Large areas lacking riparian vegetation limit the viability of the stream to support anadromous fish. Studies have shown high preference of juvenile salmon for natural shoreline areas indicating that continued loss of riparian habitat could hinder the successful rearing of juvenile salmonids (U.S. Fish and Wildlife Service 1993).

1. FWTP Intake Structure

Due to the lack of substantial riparian vegetation along the affected bank of the American River in the FWTP intake structure project area, and avoidance measures that will be implemented to preserve the existing riparian vegetation, no adverse impacts to anadromous fish species due to loss of critical habitat associated with the elimination of shoreline vegetation from construction activities of the FWTP intake structure is expected.

A minimal amount of riverbed in the immediate area of the cofferdam and the existing FWTP intake structure will be permanently displaced by the project. This amount of riverbed within the project area represents an insignificant amount (<0.001 percent) of the critical habitat for Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon. This unavoidable loss of critical habitat associated with project construction is not expected to appreciably diminish the value of critical habitat of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon because it is not expected to reduce the capability of the habitat to satisfy the requirements essential to both the survival and recovery of these species.

Adverse habitat conditions, such as decreased water quality and quantity from construction and operations of the FWTP, have been previously discussed.

2. SRWTP Intake Structure

Construction of the replacement intake structure of the Sacramento River will include construction of two new raw water pipelines and an access bridge to the structure. These activities will involve disruption of vegetation along the Sacramento River shoreline at the replacement intake structure location. This reach of shoreline is currently maintained as a leveed, non-erodible shoreline and represents an established hard point in the river. Therefore, any disruption or alteration of the bank as part of construction will not result in loss of erodible shoreline. An estimated total of 450 cubic yards of rock riprap will be placed at the intake structures.

One-hundred and fifty linear feet of riparian habitat will also be removed along the bank of the Sacramento River in association with construction of the new SRWTP intake structure. A revegetation plan will be developed and implemented to mitigate for any loss of shoreline vegetation that will occur. The revegetation plan will take into account new rip-rap placed or replaced along the shoreline as part of construction of the access bridge. Habitat values will be replaced to compensate for any disruption of vegetation. Therefore, degradation of critical habitat associated with removal of riparian habitat will be temporary in nature. However, the temporary loss of riparian habitat may adversely affect listed Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon by temporarily diminishing the amount and value of critical habitat. This may result in displacement of listed species resulting in reduced growth or increased predation and result in harm or mortality of listed species. This unavoidable loss of critical habitat associated with project construction, because of its temporary nature, is not expected to appreciably diminish the value of critical habitat of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon because it is not expected to reduce the capability of the habitat to satisfy the requirements essential to both the survival and recovery of these species.

A minimal amount of riverbed in the immediate area of the cofferdam and the existing intake structure will be permanently displaced by the project. This amount of riverbed area represents an insignificant amount (<0.001 percent) of the critical habitat for Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon. This unavoidable loss of critical habitat associated with project construction is not expected to appreciably diminish the value of critical habitat of Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon because it is not expected to reduce the capability of the habitat to satisfy the requirements essential to both the survival and recovery of these species.

G. Overall Impacts

Installation and operation of the proposed City of Sacramento Water Treatment Plant Fish Screen Replacement Project is expected to have an overall beneficial effect on the survival and recovery of Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead populations due to decreased impingement and entrainment associated with operation of the FWTP and SRWTP.

Although the exact number of individual Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead within the action area that will experience adverse effects due to the implementation of these projects is unknown, NMFS anticipates that the number of Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead adversely affected will be small relative to Central Valley populations of these fish as a whole. This determination has been made because the project has a small footprint and limited associated habitat disturbance associated with project construction. Additionally, any potential indirect temperature effects that may be associated with increased water withdrawals in the American River due to the treatment plant expansion project are confined to a relatively small area and would be temporary in nature.

Therefore, the level of harm, harassment, and mortality resulting from the construction of the proposed City of Sacramento Fish Screen Replacement Project and the increased water withdrawals associated with the Water Treatment Plant Expansion Project is not expected to appreciably reduce the likelihood of survival and recovery of the Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead populations.

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 Act. For the purposes of this consultation, the action area includes the reach of the American River between RM 22.9 and RM 0, and river reaches downstream of this area that may be affected by the FWTP and SRWTP Fish Screen Replacement Project activities.

New, non-federal actions which are reasonably certain to occur within the action area during the term of this Opinion and that are not subject to section 7 consultation include riparian habitat restoration projects such as the planned Lower American River Fisheries and Aquatic Habitat Management and Restoration Plan. These actions are not expected to result in measurable adverse effects to listed Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead trout, and over time will provide benefits to steelhead critical habitat through increased aquatic cover and shading.

Future federal actions in the American River basin including, but not limited to, the ongoing operation of federal reservoirs and hydropower projects, as well as new bank stabilization/erosion control projects and spawning gravel replacement program activities will be reviewed through separate section 7 consultations.

VII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of the endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon, the environmental baseline for the action area, the effects of the proposed City of Sacramento Water Treatment Plant Fish Screen Replacement Project and Treatment Plant Expansion Project (including the increased diversion and temperature management actions associated therewith), and the cumulative effects, it is NMFS' biological opinion that these actions, as proposed, are not likely to jeopardize the continued existence of the endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon. A temporary and minor loss of designated critical habitat for Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon may occur as a result of the proposed project but this loss is not likely to destroy or adversely modify their designated critical habitat.

Notwithstanding NMFS' conclusion that the proposed City of Sacramento Water Treatment Plant Fish Screen Replacement Project is not expected to jeopardize the continued existence of endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon or destroy or adversely modify their critical habitat, NMFS anticipates that some actions associated with the City of Sacramento Water Treatment Plant Fish Screen Replacement Project may result in incidental take of the species. Therefore, an incidental take statement is provided with this Opinion for these actions.

VIII. INCIDENTAL TAKE STATEMENT

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. NMFS further defines harm to include any act which actually kills, or injures fish or wildlife and emphasizes that such acts may include significant habitat modification or degradation that significantly impairs essential behavioral patterns, including breeding, spawning, rearing, migration, feeding or sheltering. Incidental take is defined as take of a listed animal species that results from, but is 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 intended as part of, the proposed 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.

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA, and the proposed action may incidentally take individuals of a listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. It also states that reasonable and prudent measures, and terms and conditions to implement the measures, be provided that are necessary to minimize such impacts. Under the terms and conditions of section 7(o)(2) and 7(b)(4), taking that is incidental to and not intended as part 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 the Incidental Take Statement.

The measures described below are non-discretionary. They must be implemented by Reclamation so that they become binding conditions of any grant or permit issued to the City of Sacramento, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity covered in this Incidental Take Statement. If Reclamation (1) fails to assume and implement the terms and conditions of the Incidental Take Statement, and/or (2) fails to require the City of Sacramento 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, Reclamation and the City of Sacramento must report the progress of the action and its impact on the species to NMFS as specified in this Incidental Take Statement (50 CFR §402.14(i)(3)).

A. Amount or Extent of Take

The NMFS anticipates that endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon, will be taken as a result of this proposed action. The incidental take is expected to be in the form of death, injury, harassment, harm, capture, and collection. This Incidental Take Statement addresses the elements of the City of Sacramento Water Treatment Plant Fish Screen Replacement Project that may adversely effect Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon as determined in the accompanying biological opinion including: 1) cofferdam construction and dewatering operations, 2) acoustic impacts from pile driving and other sound/vibratory related equipment during construction and (3) loss of riparian habitat within the Sacramento River riparian zone associated with construction of the SRWTP intake structure.

As a result of the fish monitoring plan, NMFS anticipates that a small number of endangered Sacramento River winter-run chinook salmon, threatened Central Valley steelhead, and threatened Central Valley spring-run chinook salmon may be taken by trapping, electrofishing and collection. It is anticipated that no more that 10 Sacramento River winter-run chinook salmon, 10 threatened Central Valley steelhead, and 10 threatened Central Valley spring-run chinook salmon will be incidentally taken during fish monitoring activities.

As a result of cofferdam construction and dewatering, NMFS anticipates that a small number of juvenile salmonids, no more than 100 fish, will be captured and relocated to areas downstream of the construction site. NMFS further anticipates that juvenile salmonids will suffer no more than 5% mortality from electrofishing activities if electrofishing is utilized for cofferdam rescue activities. This should result in no more than 5 juvenile salmonid mortalities.

The NMFS anticipates that other incidental take of Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon associated with construction and increased diversions at the FWTP and SRWTP fish screen replacement structures will be difficult to detect because of the difficulty in detecting juvenile salmonids and the low probability of detecting dead or impaired specimens. Due to the difficulty in quantifying the number of Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon that will be taken as a result of the direct impacts of the project, the NMFS is quantifying take incidental to the project in terms of the 150 linear feet of riparian habitat that will be removed, the 615 cubic yards of rock riprap that will be placed, and the 6,120 square feet of lost bottom habitat from construction of the intake structures that will become unuseable for the species as a result of the action. Loss of riparian habitat may result in displacement of listed juvenile salmonid species resulting in reduced growth or increased predation and result in harm or mortality of listed species.

A sixteen month construction schedule is anticipated for the FWTP intake structure, including 3 months to conduct the initial in-river work, 11 months to conduct the work inside the cofferdams, and 2 months of final in-river work to remove the cofferdams and construction equipment. A 30-month construction schedule is anticipated for the SRWTP intake structure, including three months to conduct the initial in-river work, 20 months to conduct the work inside the cofferdams and seven months of final in-river work to remove the cofferdams and construction equipment. Construction at both WTPs is anticipated to begin in April of 2001. All juvenile salmonids rearing and emigrating in the construction area during the five months of in-river (non-cofferdammed work) will be subject to harassment from construction activities. Migrational delays of adult salmonids may result from pile driving activities or the use of other noise/vibratory generating equipment. Migrational delays of up to eleven hours during daylight hours may occur and affect Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon adults.

Measurable temperature increases in the lower American River between RM 7.3 and RM 1.0 that result in reduced growth, physiological stress and lethality to steelhead as a result of increased diversions at the FWTP and SRWTP are not anticipated. No take of adult or juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon is anticipated as a result of increased water temperatures associated with increased FWTP or SRWTP diversions.

No adverse impacts to listed salmonids from screen contact at the FWTP and SRWTP fish screens are expected and take of listed salmonids is not anticipated. No take of adult Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon is anticipated as a result of impacts from physical contact with the FWTP and SRWTP fish screens.

B. Effect of the Take

The effect of this action will consist of fish behavior modification, temporary and permanent loss of habitat value as a result of streamflow reductions, habitat loss and disturbance, and potential death or injury of juvenile steelhead as a result of construction or collection.

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the listed species or destruction or adverse modification of proposed critical habitat.

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento River winter-run chinook salmon, Central Valley steelhead, or Central Valley spring-run chinook salmon and impacts to their designated critical habitat:

1. Reclamation, through the City of Sacramento and their contractors shall reduce harm, harassment, and mortality from cofferdam construction and dewatering operations and intake construction on juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon.

2. Reclamation, through the City of Sacramento and their contractors shall minimize the adverse effects of acoustic impacts from pile driving and other sound/vibratory related equipment during construction on adult and juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon.

3. Reclamation, through the City of Sacramento and their contractors shall minimize the adverse effects associated with the loss of riparian vegetation within the Sacramento River riparian zone associated with construction of the SRWTP intake structure on adult and juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon to ensure no net loss of habitat value, and to compensate for temporal loss of habitat.

4. Reclamation will assist the City of Sacramento and their contractors in minimizing and avoiding the potential for adverse effects of any increased diversion and associated operation and maintenance activities at the FWTP and SRWTP on adult and juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon.

5. Reclamation, through the City of Sacramento and their contractors, shall evaluate the performance of the newly-constructed fish screen and ensure the fish screen and pumping plant are operated and maintained properly for acceptable fish screen performance. If any adverse operational adverse effects of physical contact between listed fish and the fish screens are found, Reclamation, through the City of Sacramento and their contractors, shall eliminate these adverse effects.

D. Terms and Conditions

Reclamation must comply or ensure compliance by the City of Sacramento or their contractors with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

The following terms and conditions implement the following reasonable and prudent measures:

1. Reclamation, through the City of Sacramento and their contractors shall reduce harm, harassment, and mortality from cofferdam construction and dewatering operations and intake construction on juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon.

    a. To minimize take of juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon during cofferdam dewatering, a qualified biologist shall be on-site to examine the cofferdams prior to dewatering and a fish rescue/salvage program shall be conducted prior to complete dewatering. This plan shall be reviewed by NMFS before it is implemented. Only low flow pumps with screened intakes will be used during dewatering operations. If fish are still present after partial dewatering of the cofferdam and further seining cannot rescue all listed species, then electrofishing shall be used to capture any remaining fish. In order to minimize impacts, the electrofishing personnel should follow NMFS electrofishing guidelines (Attachment 1). Rescued fish shall be immediately transferred to an oxygenated holding tank and transported to an appropriate downstream release site. The water inside the holding tank shall be the same temperature as the river, to reduce shock as the fish are released. The fish shall be released in a manner that will not injure the fish.

b. All pumped water shall be routed to either: (1) a sedimentation pond located on a flat stable area above the ordinary high water level (OHW) that prevents silt-laden runoff to enter the river, or (2) a sedimentation tank/holding facility that allows only clear water to return to the river and includes disposal of settled solids at an appropriate off-site location.

c. Stockpiling of construction materials, including portable equipment, vehicles and supplies, including chemicals and chemical containers, shall be restricted to designated construction staging areas and exclusive of the riparian areas.

d. Erosion control measures that prevent soil or sediment from entering the river shall be placed, monitored for effectiveness, and maintained throughout construction operations.

e. Refueling of construction equipment and vehicles within the floodplain shall occur only within a designated, paved, bermed area where possible spills shall be readily contained and properly disposed of.

f. Litter and construction debris shall be removed from below the OHW line daily, and disposed of at an appropriate site. All litter, debris and unused materials, equipment and supplies shall be removed from the construction staging areas above the OHW at the end of each construction season.

g. Any spills of hazardous materials shall be cleaned up immediately. Such spills shall be reported in post construction compliance reports.

h. A representative shall be appointed by Reclamation or the City of Sacramento who will be the contact source for any employee or contractor who might incidentally take a listed salmon or steelhead species or who finds a dead, injured, or entrapped salmon or steelhead. This representative shall be identified to all employees during an employee education orientation session on impacts of construction activities that may impact listed salmon or steelhead. This orientation session should be conducted by a qualified fisheries biologist and cover specific information on measures to prevent injury to listed fish and the actions to take if listed fish are found injured.

i. NMFS (contact: Michael Aceituno, 916-498-6498) shall be notified immediately if one or more salmon or steelhead are found dead or injured and will review the activities resulting in take to determine if additional protective measures are required. Follow-up written notification shall include the date, time, and location of the carcass or injured specimen, a color photograph, cause of injury or death, and name and affiliation of the person who found the specimen. Any dead specimen should be placed in a cooler with ice and held for pickup by NMFS.

j. Reclamation shall provide a written report regarding water quality, fisheries, and other habitat impacts associated with the instream construction activities of the City of Sacramento Water Treatment Plant Fish Screen Replacement Project to NMFS within 60 days of completion of the instream construction activities. The report shall include at a minimum a description of any problem encountered during the project or when implementing terms and conditions and any effect associated with the instream construction activities on salmon or steelhead that was not previously considered.

2. Reclamation, through the City of Sacramento and their contractors shall minimize the adverse effects of acoustic impacts from pile driving and other sound/vibratory related equipment during construction on adult and juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon.

   a. Reclamation shall limit pile driving operations or other noise/vibratory operations on the Sacramento River and American Rivers in association with construction of the FWTP and SRWTP intake structures to a maximum of eleven hours (Monday through Saturday) and nine hours (Sunday) per day during daylight hours only.

3. Reclamation, through the City of Sacramento and their contractors shall minimize the adverse effects associated with the loss of riparian habitat within the Sacramento River riparian zone associated with construction of the SRWTP intake structure on adult and juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon to ensure no net loss of habitat value, and to compensate for temporal loss of habitat.

   a. If requested, during or upon completion of construction activities, the contractor and City of Sacramento personnel shall accompany NMFS personnel on an on-site inspection of the construction sites to review project impacts to salmon and steelhead and their habitat.

   b. Riparian vegetation restoration shall be based on a three to one replacement value, calculated on an acreage basis, with no net loss of quantity or quality. Reclamation shall ensure the NMFS has the opportunity to review and approve the tree/vegetation removal plan and the revegetation plan thirty days in advance of removal operations. Replacement vegetation should consist of native plant species appropriate for riparian ecotomes. Irrigation should be provided for a period of up to five years to ensure plant viability and remediation undertaken if reestablishment of riparian vegetation is unsuccessful.

c. Reclamation through the City of Sacramento and their contractors shall minimize the effects for 450 cubic yards of rock riprap that will be placed around the intake structure at the SRWTP and the 165 cubic yards at the FWTP. All rock riprap placement shall incorporate high quality riparian habitat into its design. No other rock riprap shall be placed at either site.

d. Provide written report detailing riparian vegetation reestablishment to NMFS five, ten and fifteen years after completion of the instream construction activities. These reports shall include at a minimum a description of any problem encountered during the reestablishment of riparian vegetation and a comparison of pre-project vegetation with the current vegetation growth. If vegetation is not re-established on a 1:1 basis at the end of the fifteen year time frame, Reclamation, through the City of Sacramento and their contractors, shall continue planting and monitoring efforts until such time that it can be demonstrated that a 1:1 replacement value has been accomplished.

4. Reclamation, through the City of Sacramento and their contractors, shall minimize the potential for adverse effects of the fish screen project. Reclamation will assist the City of Sacramento and their contractors in minimizing and avoiding the potential for adverse effects of any increased diversion and associated operation and maintenance activities at the FWTP and SRWTP on adult and juvenile Sacramento River winter-run chinook salmon, Central Valley steelhead, and Central Valley spring-run chinook salmon, specifically as follows:

a. Prior to initiation of construction of the water treatment expansion project, the City of Sacramento shall advance one-half million dollars ($500,000.00) to Reclamation pursuant to the Contributed Funds Acts for the purpose of funding activities leading to the improvement of water temperatures in the lower American River. These funds shall comprise a portion of the local cost share for the work described in term and condition 4.b. The terms and conditions of the deposit of funds into an appropriate account will be addressed in a subsequent agreement between the City and Reclamation.

b. Funds in the account shall be applied by Reclamation to effect the repairs and/or replacement of the Folsom penstock shutters that will improve their efficiency for conserving and releasing cold water for the benefit of anadromous fisheries in the lower American River as deemed appropriate by Reclamation and NMFS. Appropriate expenditures include an evaluation of shutter efficiency, design of shutter modifications or replacement, construction and associated administration. reduce or eliminate leakage through the facility or other temperature related actions deemed appropriate by Reclamation and NMFS. Mutual agreement of Reclamation and the NMFS for expenditure of these funds is required.

5. Reclamation, through the City of Sacramento and their contractors shall evaluate the performance of the newly-constructed fish screen and ensure the fish screen and pumping plant are operated and maintained properly for acceptable fish screen performance.

   a. Fish surveys shall be implemented to assess what species are using the area in the vicinity of the existing intake structure and the new intake structure, both before the new intake structure is built, and within one year after the new intake structure is built. Two electrofishing surveys or an alternative survey methodology acceptable to NMFS, shall suffice. The monitoring plan shall be received by NMFS within four months from the time the permit for construction is awarded for review and approval.

   b. A draft hydraulic evaluation plan shall be submitted to NMFS and the Anadromous Fish Screen Program's Project Manager prior to completing construction of the project. The plan shall outline in detail a proposed methodology for measuring near-screen velocities under conditions least favorable to migrating juvenile salmonids, as outlined in the document, *Guidelines for Developing Post-Construction Evaluation & Assessment Plans, and Operations & Maintenance Plans* (Guidelines) available though the Anadromous Fish Screen Program. Entrainment studies may be waived if NMFS engineering staff (1) is involved in the design review process, (2) inspected the completed fish screen project in the dry, and (3) found materials and workmanship to be within specifications for the protection of juvenile salmon and steelhead.

   c. A draft operations and maintenance plan shall be developed and submitted to NMFS prior to initiating operations of the pumping plant. The plan shall act as a owner's manual for operating and maintaining the pumping plant and fish screens. The plan shall be developed in accordance with the Guidelines document.

   d. An operations and maintenance log book shall be maintained by Reclamation on a daily basis. The log book shall be made available for inspection to NMFS personnel with 24 hours notice to Reclamation.

   e. NMFS staff, including diving personnel, shall be granted access to the site for inspection and measurement of fish screen performance. NMFS will provide a minimum of 48 hours advance notice to Reclamation and the City of Sacramento.

f. In the event the screen is damaged such that protection of juvenile fish is compromised, the City of Sacramento shall cease pumping through damaged or missing screen panels to the greatest extent possible and notify NMFS within 48 hours.

All requested reports shall be submitted to:

Regional Administrator
National Marine Fisheries Service
Southwest Regional Headquarters
501 West Ocean Blvd., Suite 4200
Long Beach, CA 90802-4213

and

National Marine Fisheries Service
Protected Resources Division
Sacramento Area Office
File # 12203 (F-SA-00-04)
650 Capitol Mall, Suite 6070
Sacramento, California 95814-4706

IX. CONSERVATION RECOMMENDATIONS

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

NMFS believes the following conservation recommendations are consistent with these obligations, and therefore should be implemented by Reclamation.

1. Reclamation should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed councils to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the lower American River.

2. To maintain current knowledge of important fish production areas and the overall success of habitat protection and restoration efforts, Reclamation should conduct stream surveys and monitor fish populations on the lower American River.

3. To optimize temperatures for Central Valley steelhead downstream of Nimbus Dam, Reclamation should develop a basin-wide cumulative impacts model and take a lead role in developing an temperature optimization plan with the other federal, state, local government and private entities in the American River basin.

In order for NMFS to be kept informed of actions for minimizing or avoiding adverse effects, or that benefit listed or proposed Pacific salmonids or their habitat, NMFS requests notification of the implementation of these conservation recommendations.

X. REINITIATION NOTICE

This concludes formal consultation on the effects of the proposed City of Sacramento Water Treatment Plant Fish Screen Replacement Project on Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon and Central Valley steelhead and their designated critical habitat. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or authorized by law) and if: (1) the amount or incidental take specified in the Incidental Take Statement is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species not considered in this 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 consultation shall be reinitiated immediately.

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Attachment 1.

NMFS BACKPACK ELECTROFISHING GUIDELINES
December 1998

Suggested protocol for the use of backpack electrofishing equipment in waters containing fish listed under the Endangered Species Act (ESA).

These recommendations are guidelines for developing consistent and safe electrofishing technique. It is hoped that these guidelines will ultimately help improve electrofishing technique in ways which will reduce fish injury and increase electrofishing efficiency.

Purpose and Scope

The purpose of this document is to recommend guidelines for using backpack electrofishing equipment to sample or rescue ESA-listed fish. Because electrofishing can kill or severely injure fish, every effort should be made to avoid electrofishing and use snorkeling or other fishery information collection techniques. Where electrofishing is the only suitable sampling or rescue method, these guidelines are suggested to help reduce the number of fish killed or severely injured.

These guidelines are concerned only with studies that involve electrofishing juvenile or adult salmonids that are *not* in spawning condition. Electrofishing in the vicinity of adults in spawning condition or operating equipment in the vicinity of redds containing developing eggs is not discussed as there is no justifiable basis for permitting these activities near listed species.

Also, these guidelines do not deal with factors such as temperature or fish handling technique both of which can significantly affect fish health during an electrofishing session. None the less, all ESA-listed fish must be sampled or rescued with extreme care. The field crew must carefully design the sampling sessions or rescue efforts to minimize fish stress by working within favorable temperature regimes, using anesthetics when necessary, and minimizing the time the fish are held before release. As with all fieldwork involving live ESA-listed fish, the best science should be used along with an experienced crew and good equipment in order to minimize handling stress.

Equipment

Equipment should be in good working condition. Operators should go through the manufacturer's preseason checks, adhere to all provisions, and record major maintenance work in a log.

Training

A crew leader having at least 100 hours of electrofishing experience in the field using similar equipment should train the crew. The crew leader's experience must be documented and available for confirmation; such documentation may be in the form of a logbook. The training should occur before an inexperienced crew begins any electrofishing; it should also be conducted in waters that do not contain ESA-listed fish.

The training program must include the following elements:

1. Definitions of basic terminology: e.g. galvanotaxis, narcosis, and tetany.
2. An explanation of how electrofishing attracts fish.
3. An explanation of how gear can injure fish and how to recognize signs of injury.
4. A review of these guidelines and the manufacturer's recommendations.
5. A demonstration of the proper use of electrofishing equipment, the role each crew member performs, and basic gear maintenance.
6. A field session where new individuals actually perform each role on the electrofishing crew.

Specific Electrofishing Guidelines

The following guidelines are recommended for all electrofishing sessions.

1. Coordinate research activities with fishery personnel from other agencies to avoid duplication of effort and unnecessary stress on fish. In order to avoid contact with spawning adults or active redds, carefully survey the area to be sampled before beginning electrofishing.

2. Measure conductivity and set voltage as follows:

Conductivity (μmhos/cm)	Voltage
Less than 100	900 to 1100
100 to 300	500 to 800
Greater than 300	150 to 400

3. Only direct current (DC) should be used.

4. Each session should begin with pulse width and rate set to the minimum needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured. Start with pulse width of 500 μs and do

not exceed 5 milliseconds. Pulse rate should start at 30Hz and work carefully upwards. *In general*, exceeding 40 Hz will injure more fish.

5. The zone of potential fish injury is 0.5m from the anode. Care should be taken in shallow waters, undercut banks, or where fish can be concentrated because in such areas the fish are more likely to come into close contact with the anode.

6. The stream segment should be worked systematically, moving the anode continuously in a herringbone pattern through the water. Do not electrofish one area for an extended period.

7. Crew should carefully observe the condition of the sampled or rescued fish. Dark bands on the body and longer recovery times are signs of injury or handling stress. When such signs are noted, the settings for the electrofishing unit may need adjusting. Sampling should be terminated if injuries occur or abnormally long recovery times persist.

8. When the sampling or rescue design involves taking scales and measurements, a healthy environment for the stressed fish must be provided and the holding time must be minimized. Water to water transfers, the use of shaded, dark containers and supplemental oxygen should all be considered in designing fish handling operations. For these operations, additional crewmembers who are experienced in holding and processing stressed fish may be necessary.

9. Whenever possible, a block net should be placed below the area being sampled to capture stunned fish that may drift downstream.

10. The electrofishing settings should be recorded in a logbook along with conductivity, temperature, and other variables affecting efficiency. These notes, together with observations on fish condition, will improve technique and form the basis for training new operators.