# Biological Opinion for the Trinity River Mainstem Fishery Restoration EIS and Its Effects on Southern Oregon/Northern California Coast Coho Salmon, Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, and Central Valley Steelhead

**Consultation Conducted by:**
**National Marine Fisheries Service,**
**Southwest Region**

**October 12, 2000**

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
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OCT 12 2000

F/SWO:DRR

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Dear Messrs. Spear and Snow:

Enclosed is the National Marine Fisheries Services's (NMFS) biological opinion addressing the preferred alternative described in the October 1999 Trinity River Mainstem Fishery Restoration draft Environmental Impact Statement/Report (TRMFR DEIS), responding to your June 6, 2000, request for formal consultation (and enclosed June 5, 2000, biological assessment) regarding the effects of the proposed restoration program on listed salmon and steelhead, and reinitiation of the 1992-1993 consultation concerning Central Valley Project operations, in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). Based on a review of the TRMFR DEIS, the Trinity River Flow Evaluation (TRFE) Final Report, and other available information, NMFS has concluded that implementation of the TRMFR DEIS preferred alternative is not likely to jeopardize the continued existence of Southern Oregon/Northern California Coast coho salmon, Sacramento River Winter-run chinook salmon, Central Valley Spring-run chinook salmon, or Central Valley steelhead. Additionally, NMFS has determined that implementation of the proposed action is not likely to destroy or adversely modify designated critical habitat for these species.

The Incidental Take Statement provided in the enclosed biological opinion includes several Reasonable and Prudent Measures and Terms and Conditions for implementation that are expected to further reduce incidental take of listed salmon and steelhead populations in the Trinity and Sacramento river basins.

As you are aware, it is well documented that construction and operation of the Trinity River Division (TRD) has resulted in degraded fish habitat and declining anadromous fish populations. The first 10 years of TRD operations resulted in the export of about 88% of Trinity Lake inflow into the Sacramento River Basin. By 1973, the California Department of Fish and Game observed that Trinity River salmonid populations had noticeably decreased.

A 1980 U.S. Fish and Wildlife Service (USFWS) Environmental Impact Statement (EIS) addressing Trinity River fishery restoration activities determined that an 80% decline in chinook salmon and a 60% decline in steelhead populations had occurred since the beginning of TRD operation in 1964. In addition, the EIS estimated that the total salmonid habitat loss in the Trinity River Basin to be 80 to 90%. While acknowledging other factors that have contributed to the decline of these fish, the EIS concluded that insufficient streamflow was the most critical limiting factor. In the 1984 Trinity River Fish and Wildlife Management Act, Congress found that operation of the TRD resulted in degraded fish habitat and consequently a drastic reduction in anadromous fish populations. This Act also directed the Secretary of the Interior (Secretary) to develop a management program to restore fish populations to levels approximating those that existed immediately before TRD construction began.

The 1992 Central Valley Project Improvement Act (CVPIA) was enacted by Congress in part to address the fishery degradation in the Trinity River due to operation of the TRD. Pending the completion of the TRFE and associated recommendations, the Act also directed the Secretary to provide annual instream flow releases into the Trinity River of not less than 340 thousand acre feet for the purposes of fishery restoration and propagation, and in order to meet Federal trust responsibilities to protect the fisheries resources of the Hoopa Valley Tribe. Although the CVPIA clearly acknowledged that Trinity River flows had to be increased to protect fisheries resources, the TRFE later concluded that this flow allocation was equivalent to the third driest year on record and that this flow regime would not rehabilitate fish habitat.

In more recent years, the status of salmon and steelhead species (including Trinity River populations) have been evaluated in response to petitions to list these fish as threatened or endangered under the ESA. The outcome of these status reviews further documented declining trends in Trinity River salmon and steelhead populations and resulted in Trinity River coho salmon being among those populations listed as threatened and steelhead remaining as candidates for listing. This is the most compelling evidence that appropriate measures must be taken to reverse negative trends in Trinity River salmon and steelhead runs.

During the development and preparation of the TRFE final report (USFWS and HVT 1999), NMFS coordinated with the authors and others and provided document review. In addition, NMFS also served as a cooperating agency during the development of the TRMFR DEIS. As a result, NMFS is very familiar with the preferred alternative and agrees with the action agencies that the proposed restoration program is expected to provide necessary benefits to anadromous fish species in decline and their habitats. Now that the TRFE Final Report has been completed, and the recommendations from the Report have been incorporated as the preferred alternative in the TRMFR DEIS, the stage is set for the Secretary of the Interior to make the crucial decision to implement the proposed restoration program. Given the unequivocal record of precipitous declines in salmon and steelhead populations resulting from TRD operations, and the conclusion in the TRMFR DEIS that recent inriver escapement estimates represent only 14% of the restoration goal for naturally produced coho salmon, NMFS believes that implementation of the proposed restoration program is necessary to protect anadromous fish species and contribute to recovery efforts.

Even if the decision to implement the preferred alternative is made as soon as possible, NMFS is concerned that the funds needed to implement this crucial restoration program have not been completely identified. For example, the Technical Coordinating Committee (established by the Trinity River Task Force) has identified restoration program funding needs of between $10.1 and $15.2 million, annually, in their recent 2001 through 2003 budget. However, our current understanding is that Reclamation's budget request for the restoration program for 2001 is $7.5 million. Given this information, NMFS is gravely concerned that the preferred alternative in the TRMFR DEIS may not be fully implemented in a timely fashion. Consistent with the ESA section 7 implementing regulations (50 CFR § 402.16), failure to ensure the timely implementation of the preferred alternative, including the adaptive management program, will trigger reinitiation of consultation with the NMFS.

Finally, Department of the Interior staff and others should be commended for their fine work during development of both the TRFE and the TRMFR DEIS. Together with the adaptive management program that will serve to maintain the effectiveness of the restoration program, the preferred alternative represents the outcome of a thorough study of actions that are necessary to restore the mainstem Trinity River aquatic habitat and fish populations including coho salmon. Please do not hesitate to contact me or my staff if NMFS can further assist in facilitating the restoration program. Mr. Don Reck is the NMFS contact for this matter, and can be reached at (707) 825-5161.

Sincerely,

R. Lent

Rebecca Lent, Ph.D
Regional Administrator

Enclosure

# Endangered Species Act - Section 7 Consultation

# BIOLOGICAL OPINION

Trinity River Mainstem Fishery Restoration

Action Agencies:

U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service

Consultation Conducted by:

National Marine Fisheries Service,
Southwest Region

Date Issued: OCT 12 2000

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## INTRODUCTION

This document transmits the National Marine Fisheries Service (NMFS) biological opinion based on our review of the preferred alternative described in the draft Trinity River Mainstem Fishery Restoration Environmental Impact Statement (TRMFR DEIS), and its effects on Southern Oregon/Northern California Coast coho salmon, Sacramento River Winter-run chinook salmon, Central Valley Spring-run chinook salmon, and Central Valley steelhead, in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). The original request for formal consultation was received on December 14, 1999, and was followed by an updated consultation request on June 6, 2000.

This biological opinion is based on information provided and referenced in the October 9, 1999, TRMFR DEIS and appendixes, the Trinity River Flow Evaluation Final Report (TRFE, USFWS and HVT 1999), and the June 5, 2000, biological assessment (BA, USFWS and BOR 2000) and other supplemental information provided with the updated consultation request (June 6, 2000, letter and enclosures from M. Spear, U.S. Fish and Wildlife Service [USFWS], and L. Snow, U.S. Bureau of Reclamation [BOR], to R. McGinnis [sic], NMFS).

**Consultation History**

During the development and preparation of the TRFE final report (USFWS and HVT 1999), the NMFS coordinated with the authors and others and provided document review. In addition, the NMFS also served as a cooperating agency during the development of the TRMFR DEIS. As a result, the NMFS is very familiar with the preferred alternative and agrees with the action agencies that the proposed restoration program is expected to provide necessary benefits to anadromous fish species in decline and their habitats.

The NMFS received a request for formal consultation under section 7 of the ESA on the effects of the proposed action on listed Trinity River coho salmon, Central Valley spring-run chinook salmon, and Sacramento River winter-run chinook salmon (December 14, 1999, letter from M. Spear, USFWS, and L. Snow, BOR). Subsequently, the NMFS received a follow-up letter (June 6, 2000, letter and enclosures from M. Spear and L. Snow to R. McGinnis [sic]) and enclosed BA that provided supplemental information about the proposed action. In addition to the initial consultation request, the June 6, 2000, letter requested (and provided supplemental information for): (1) reinitiation of the 1992-1993 consultation concerning the impacts to winter-run chinook salmon, and its designated critical habitat resulting from the long term implementation of the Operating Criteria and Plan (OCAP) for the Central Valley Project, due to changed circumstances that would result from implementation of the proposed actions; and (2) consultation concerning the impacts of the proposed actions on listed Central Valley Spring-run chinook salmon, Central Valley steelhead, and their critical habitats.

## BIOLOGICAL OPINION

### I. Description of the Proposed Action

The proposed action is implementation of the "Flow Evaluation" alternative that is identified as the preferred alternative in the TRMFR DEIS (pages 2-16 through 2-22). Specifically, the proposed action consists of: (1) an alternative managed flow regime in the upper mainstem Trinity River; (2) mechanical habitat rehabilitation projects; and, (3) an adaptive management program. The TRMFR DEIS also includes an assumption common to all alternatives that various programs and ordinances addressing watershed protection would continue (e.g., TRMFR DEIS, pages 2-7 and 2-8). For example, watershed protection under the jurisdiction of the U.S. Forest Service and the Bureau of Land Management (BLM) is assumed to continue and feature implementation of existing land management plans as amended by the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (Northwest Forest Plan, USDA and USDOI 1994).

The proposed action would include changing the annual volumes and timing of releases from Lewiston Dam (approximately river mile [RM] 112) into the Trinity River. The volumes of water and release schedules for the Trinity River below Lewiston and diversion of water to the Sacramento River Basin vary depending on water year classifications described in USFWS and HVT (1999) and TRMFR DEIS. The following five water year classes and associated annual water volumes for delivery to the Trinity River are identified: Critically Dry (369,000 acre feet [AF]); Dry (453,000 AF); Normal (636,000 AF); Wet (701,000 AF); and Extremely Wet (815,000 AF) (TRMFR DEIS, page 2-17, Table 2-5). Release schedules between water year classes vary (Figure 1.; see also TRMFR DEIS, page 2-19, Figure 2-3) and were designed to address the environmental requirements of anadromous fish and fluvial geomorphic function. Summer base flows would be 450 cubic feet per second (CFS) (late June/late July through October 15), winter flows would be 300 CFS (October 16 through late April), and peak flows during the spring would vary by water year class (range of 1,500 to 11,000 CFS).

Several areas of specific concern would be addressed by these proposed flows. These include: 1) summer/fall water temperature requirements (TRMFR DEIS, page 3-125); 2) releases for salmonid spawning and rearing habitat mid-October through April with variation in April depending on water year designation; 3) peak flows to address fluvial geomorphic processes and temperature regulation for smolt outmigration from late April/mid May through June; and 4) ramping of water release rates between identified release levels to mimic the natural snow-melt runoff and assist in vegetation control during the spring and early summer (TRMFR DEIS, page 2-18).

Additional operational changes include a shift in timing of water diverted to the Sacramento River Basin to the summer/early fall to maintain cold water reserves for the Trinity River fishery while maintaining a minimum carryover storage of 600,000 AF between years in Trinity Reservoir (TRMFR DEIS, page 2-21).

Forty-seven mechanical habitat rehabilitation projects would be constructed between Lewiston Dam and the North Fork Trinity River confluence (RM 40), including removal of existing riparian berms that formed as a result of flow regulation for decades, and creation of new side channel habitat. The locations of these rehabilitation sites have been identified (TRMFR DEIS, Figure 2-4). Once portions of the berms are mechanically removed, high flows and gravel transport would naturally create and maintain dynamic alluvial features and floodplain riparian communities. Consequently, no mechanical maintenance would be planned for the proposed or existing channel rehabilitation projects.

Construction of these projects would be scheduled between July 15 and September 15 to minimize the impacts to anadromous salmonids (TRMFR DEIS), but construction during other seasons should not necessarily be precluded (USFWS and BOR 2000). A typical project is expected to take about 6 weeks for construction and require the use of font-end loaders, bulldozers, screens, and trucks. The proposed action in the BA (USFWS and BOR 2000) also includes provisions for additional coordination with NMFS and others as rehabilitation project designs are completed.

Mechanical habitat rehabilitation would also include annual placement of an average of 10,300 cubic yards ($y^3$) of spawning gravel, with an estimated range of 0 $y^3$ in critically dry water years to 49,100 $y^3$ in extremely wet water years. Supplementation of spawning gravel is intended to compensate for the loss of gravel recruitment from the area now blocked by Lewiston and Trinity Dams.

Finally, an Adaptive Environmental Assessment and Management (AEAM) Program would be implemented to ensure that overall program objectives are achieved. The AEAM Program would be a scientifically rigorous and structured process intended to refine management actions based on information acquired as a result of past management decision implementation. Because of the complex nature of the physical and biological systems such as the Trinity River, this program is believed to be an important component of the larger restoration program. The AEAM program would consist of a designated team of scientists recommending changes to fishery restoration plans and annual operating schedules (USFWS and BOR 2000). Annual recommendations would be approved by a Trinity Management Council (USFWS and BOR 2000), and may require additional environmental analyses (e.g., pursuant to NEPA, CEQA).

## II. Status of the Species

Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) are listed as threatened under the ESA (May 6, 1997, 62 FR 24588). This Evolutionarily Significant Unit[1] (ESU) consists of populations from Cape Blanco, Oregon, south to Punta Gorda,

[1]For purposes of conservation under the Endangered Species Act, an Evolutionarily Significant Unit (ESU) is a distinct population segment that is substantially reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy of the species (Waples 1991).

California, including coho salmon in the Trinity River. Designated critical habitat for SONCC coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Elk River in Oregon and the Mattole River in California, inclusive (May 5, 1999, 64 FR 24049). This critical habitat designation includes all waterways, substrate, and adjacent riparian zones, excluding: (1) areas above specific dams identified in the Federal Register notice (including Lewiston Dam); (2) areas above longstanding, natural impassable barriers (i.e., natural waterfalls in existence for at least several hundred years); and (3) Indian tribal lands.

Sacramento River Winter-run chinook salmon (*O. tshawytscha*) are listed as endangered under the ESA (January 4, 1994, 59 FR 440). This ESU consists of the Sacramento River population in California's Central Valley. Designated critical habitat for Sacramento River winter-run chinook salmon includes the waterways, bottom, and water of the waterways and adjacent riparian zones of the Sacramento River from Keswick Dan, Shasta County (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 (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge (June 16, 1993, 58 FR 33212). This critical habitat designation includes the river water, river bottom (including those areas and associated gravel used by winter-run chinook salmon as a spawning substrate), and the adjacent riparian zone used by fry and juveniles for rearing. In areas westward from Chipps Island, including San Francisco Bay to the Golden Gate Bridge, it includes the estuarine water column, essential foraging habitat, and food resources used by the winter-run chinook salmon as part of their juvenile out-migration or adult spawning migration.

Central Valley (CV) Spring-run chinook salmon (*O. tshawytscha*) are listed as threatened under the ESA (September 16, 1999, 64 FR 50394). This ESU consists of spring-run chinook salmon occurring in the Sacramento River Basin. Designated critical habitat for CV Spring-run chinook salmon includes all river reaches accessible to listed chinook salmon in the Sacramento River and its tributaries in California, except for reaches on Indian lands. 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 (February 16, 2000, 65 FR 7764). This above critical habitat designation includes all waterways, substrate, and adjacent riparian zones. Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding, natural impassable barriers (i.e., natural waterfalls in existence for at least several hundred years); and (3) Indian tribal lands.

Central Valley (CV) steelhead (*O. mykiss*) are listed as threatened under the ESA (March 19, 1998, 63 FR 13347). This ESU consists of steelhead populations in the Sacramento and San

Joaquin River basins in California's Central Valley. Designated critical habitat for CV steelhead includes all river reaches accessible to listed steelhead in the Sacramento and San Joaquin rivers and their tributaries in California, except for reaches on Indian lands. 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: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding, natural impassable barriers (i.e., natural waterfalls in existence for at least several hundred years); (3) Indian tribal lands; and (4) areas of the San Joaquin River upstream of the Merced River confluence (February 16, 2000, 65 FR 7764).

Following are descriptions of the general life histories and population trends of listed species that may be directly or indirectly affected by the proposed action.

A. Coho Salmon

1. General Life History

In contrast to the life history patterns of other Pacific salmonids, coho salmon generally exhibit a relatively simple three-year life cycle. Most coho salmon enter rivers between September and January and spawn from November to January (Weitkamp *et al.* 1995; Hassler 1987). Coho salmon river entry timing is influenced by many factors, one of which appears to be river flow. In addition, many small California stream systems have their mouths blocked by sandbars for most of the year except winter. In these systems, coho salmon and other Pacific salmonid species are unable to enter the rivers until sufficiently strong freshets open passages through the bars (Weitkamp *et al.* 1995). Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools with suitable water depth and velocity.

Coho salmon eggs incubate for approximately 35 to 50 days, and start emerging from the gravel two to three weeks after hatching (Hassler 1987). Following emergence, fry move into shallow areas near the stream banks. As coho salmon fry grow, they disperse upstream and downstream and establish and defend territories (Hassler 1987).

During the summer, coho salmon fry prefer pools and riffles featuring adequate cover such as large woody debris, undercut banks, and overhanging vegetation. Juvenile coho salmon prefer to over-winter in large mainstem pools, backwater areas and secondary pools with large woody debris, and undercut bank areas (Hassler 1987; Heifetz *et al.* 1986). Juveniles primarily eat aquatic and terrestrial insects (Sandercock 1991). Coho salmon rear in fresh water for up to 15 months, then migrate to the sea as smolts between March and June (Weitkamp *et al.* 1995).

While living in the ocean, coho salmon remain closer to their river of origin than do chinook salmon (Weitkamp *et al.* 1995). Nevertheless, coho salmon have been captured several hundred to several thousand kilometers away from their natal stream (Hassler 1987). Coho salmon typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three year-olds. Some precocious males, called "jacks," return to spawn after only six months at sea.

2. Population Trends - SONCC coho salmon

Available historical and recent published coho salmon abundance information for SONCC coho salmon are summarized in the NMFS coast-wide status review (Weitkamp *et al.* 1995). The following are some excerpts from this document.

> Gold Ray Dam adult coho passage counts provide a long-term view of coho salmon abundance in the upper Rogue River. During the 1940s, counts averaged ca. 2,000 adult coho salmon per year. Between the late 1960s and early 1970s, adult counts averaged fewer than 200. During the late 1970s, dam counts increased, corresponding with returning coho salmon produced at Cole Rivers Hatchery. Coho salmon run size estimates derived from seine surveys at Huntley Park near the mouth of the Rogue River have ranged from ca. 450 to 19,200 naturally-produced adults between 1979 and 1991. In Oregon south of Cape Blanco, Nehlsen *et al.* (1991) considered all but one coho salmon population to be at "high risk of extinction." South of Cape Blanco, Nickelson *et al.* (1992) rated all Oregon coho salmon populations as "depressed."
>
> Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon returning to California streams were less than one percent of their abundance at mid-century, and indigenous, wild coho salmon populations in California did not exceed 100 to 1,300 individuals. Further, they stated that 46 percent of California streams which historically supported coho salmon populations, and for which recent data were available, no longer supported runs.
>
> No regular spawning escapement estimates exist for natural coho salmon in California streams. California Department of Fish and Game (CDFG 1994) summarized most information for the northern California region of this ESU. They concluded that "coho salmon in California, including hatchery populations, could be less than six percent of their abundance during the 1940's, and have experienced at least a 70 percent decline in the 1960's." Further, they reported that coho salmon populations have been virtually eliminated in many streams, and that adults are observed only every third year in some streams, suggesting that two of three brood cycles may already have been eliminated.
>
> The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as "native" fish occurring in tributaries having little history of supplementation with non-native fish. Combining recent run-size estimates for the California portion of this ESU with Rogue River estimates provides a rough minimum run-size estimate for the

entire ESU of about 10,000 natural fish and 20,000 hatchery fish.

Additional information about Trinity River coho salmon is also available (e.g., TRMFR DEIS, USFWS and HVT 1999). Prior to the construction of Trinity and Lewiston Dams, Moffett and Smith (1950) observed that coho were observed in the Hoopa Valley by October but not common in the Trinity River above Lewiston. The USFWS and CDFG (1956) indicated that approximately 5,000 fish migrated past Lewiston prior to the TRD construction. Additional information includes reports of coho salmon being rescued from an irrigation ditch near Ramshorn Creek, 42 miles upstream of Lewiston in 1949, 1950, and 1951. Population estimates in 1969 and 1970 were 3,222 and 5,245, respectively, for in-river escapement above the North Fork Trinity River. Since 1978, escapement estimates above Willow Creek ranged from 558 to 32,373 with an average of 10,192 coho. From 1991 to 1995 the naturally produced in-river estimate ranged from 0 to 14 percent with an average of 3 percent and indicated an average of 202 naturally produced coho salmon returning annually (TRFE 1999, page 25). This average of 202 naturally produced coho represents 14 percent of the Trinity River Restoration Project (TRRP) goal (TRMFR DEIS, pages 3-128).

## B. Chinook Salmon

### 1. General Life History

Chinook salmon historically ranged from the Ventura River in southern California north to Point Hope, Alaska, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991).

Of the Pacific salmon, chinook salmon exhibit arguably the most diverse and complex life history strategies. Healey (1986) described 16 age categories for chinook salmon, 7 total ages with 3 possible freshwater ages. Two generalized freshwater life-history types were described by Healey (1991): "stream-type" chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" chinook salmon migrate to the ocean within their first year.

Chinook salmon mature between 2 and 6+ years of age (Myers *et al.* 1998). Freshwater entry and spawning timing are generally thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998). Spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Fall-run chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

Central Valley spring-run chinook salmon adults are estimated to leave the ocean and enter the Sacramento River from March to July (Myers *et al.* 1998). Spring-run chinook spawning typically occurs between late-August and early October with a peak in September. Spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995). Eggs are deposited within the gravel where incubation, hatching, and subsequent emergence takes place. The upper preferred water temperature for spawning adult chinook salmon is 55° F (Chambers 1956) to 57° F (Bjornn and Reiser 1979). Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable. In Butte and Big Chico creeks, emergence of spring-run chinook typically occurs from November through January. In Mill and Deer creeks, colder water temperature delay emergence to January through March (CDFG 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. In Deer and Mill creeks, juvenile spring-run chinook usually spend 9-10 months in their natal streams, although some may spend as long as 18 months in freshwater. Most "yearling" spring-run chinook move downstream in the first high flows of the winter from November through January (USFWS 1995; CDFG 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.

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 percent 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.

Adult Sacramento River winter-run chinook salmon leave the ocean and migrate through the Sacramento-San Joaquin Delta to the upper Sacramento River from December through June. Spawning generally occurs between mid-April and July, and occasionally into early August. The majority of winter-run chinook salmon spawning occurs upstream of Red Bluff Diversion Dam in the vicinity of Redding, California. The eggs are fertilized and buried in the river gravel where they incubate and hatch in approximately a two-month period.

Emergence of the fry from the gravel begins during early July and continues through September. Fall and winter emigration behavior by juveniles varies with streamflow and hydrologic conditions. Most juveniles redistribute themselves to rear in the Sacramento River through the fall and winter months. Some winter-run chinook salmon juveniles move downstream to rear in the lower Sacramento River and Delta during the late fall and winter. Smolting and ocean entry typically occurs between January and April.

2. Population Trends - Central Valley Spring-run Chinook Salmon

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; 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 (CDFG 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. Spring-run chinook salmon no longer exist in the American River due to the existence and operation of Folsom Dam.

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 (CDFG 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 (CDFG 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.

Additional historical and recent published chinook salmon abundance information are summarized in Myers *et al.* (1998).

3. Population Trends - Sacramento River Winter-run Chinook Salmon

Historically, the winter run chinook salmon was abundant in the McCloud, Pit, and Little Sacramento rivers. Construction of Shasta Dam in the 1940s eliminated access to all of the historic spawning habitat for winter-run chinook salmon in the Sacramento River Basin. Since then, the ESU has been reduced to a single spawning population confined to the mainstem Sacramento River below Keswick Dam; although some adult winter-run chinook have been observed in Battle Creek, tributary to the upper Sacramento River in recent years. The fact that this ESU is generally comprised of a single population with very limited spawning and rearing habitat increases its risk of extinction due to local catastrophe or poor environmental conditions. There are no other natural populations in the ESU to buffer it from natural fluctuations.

Quantitative estimates of run-size are not available for the period prior to the completion of Red Bluff Diversion Dam in 1966. CDFG estimated spawning escapement of Sacramento River winter-run chinook salmon at 61,300 (60,000 mainstem, 1,000 in Battle Creek, and 300 in Mill Creek) in the early 1960s, but this estimate was based on "comparisons with better-studied streams" rather than actual surveys. During the first 3 years of operation of the counting facility at Red Bluff Diversion Dam (1967-1969), the spawning run of winter-run chinook salmon averaged 86,500 fish. From 1967 through the mid-1990's, the population declined at an average rate of 18 percent per year, or roughly 50 percent per generation. The population reached critically low levels during the drought of 1987-1992; the 3-year average run size for period of 1989 to 1991 was 388 fish. However, the trend in the past 5 years indicates the population may be recovering. The most recent 3-year (1997-1999) average run-size was 2,220 fish.

Additional historical and recent published chinook salmon abundance information is summarized in Myers *et al.* (1998).

C. Steelhead

1. <u>General Life History</u>

Steelhead exhibit perhaps the most complex suite of life history traits of any species of Pacific salmonid. They can be anadromous or freshwater resident. Resident forms are usually called rainbow trout. Winter steelhead generally leave the ocean from August through April, and spawning occurs between December and May (Busby *et al.* 1996). The timing of upstream migration is generally correlated with higher flow events and associated lower water temperatures. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996; Nickelson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (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). The length of the incubation period for steelhead eggs is dependant on water temperature, dissolved oxygen concentration, and substrate composition. In late spring and following yolk sac absorption, alevins emerge from the gravel as fry and begin actively feeding in shallow water along perennial stream banks (Nickelson *et al.* 1992).

Summer rearing takes place primarily in higher velocity areas in pools, although young-of-the-year are also abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson *et al.* 1992). Juveniles feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn

1969), and emerging fry are sometimes preyed upon by older juveniles. Juveniles live in freshwater from one to four years (usually two years in the California) (Barnhart 1986), then smolt and migrate to the sea from February through April. Although some steelhead smolts may outmigrant during the fall and early winter months.

California steelhead typically reside in marine waters for one to two years prior to returning to their natal stream to spawn as three- or four-year olds (Busby *et al.* 1996).

2. Population Trends - Central Valley steelhead

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; 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 (CDFG 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).

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

Additional historical and recent published steelhead abundance are summarized in the NMFS west coast steelhead status review (Busby *et al.* 1996).

## III. 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. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area (50 CFR §402.02). Within the Trinity and Klamath river basins, the action area for this consultation includes the Trinity River downstream of Lewiston Dam (RM 112) to the mouth of the Klamath River near Klamath, California. Within California's Central Valley, the action area includes the following: the Sacramento River downstream of Keswick Dam to the Sacramento/San Joaquin Delta; Clear Creek downstream of Whiskeytown Dam to its confluence with the Sacramento River; the American River downstream of Nimbus Dam to its confluence with the Sacramento River; and the Sacramento-San Joaquin Delta.

The proposed actions will principally affect Trinity River fish and their habitats. There are also potential indirect affects to listed salmon and steelhead in the Central Valley, due to changes in the timing and quantity of water diversions from the Trinity River Basin to the Sacramento River Basin. First a discussion of the environmental baseline for SONCC coho salmon and the Trinity River is provided, followed by the environmental baseline for listed salmon and steelhead in the Central Valley.

A. SONCC Coho Salmon

The factors presenting risks to naturally-reproducing listed salmonid populations are numerous and varied. A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species listed under the ESA. For example, NMFS has prepared range-wide status reviews for west coast coho salmon (Weitkamp *et al.* 1995) and Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (July 25, 1995, 60 FR 38011 ; May 6 1997, 62 FR 24588; May 5, 1999, 64 FR 24049). For the purposes of this document, a general description of the environmental baseline for SONCC coho salmon listed under the ESA and occurring in the Klamath and Trinity basins is based on a summarization of these documents. Following this description, a more-detailed background of the Trinity River Division of the Central Valley Project construction, operation, and associated legislation is provided.

In general, the human activities that have affected these fish and their habitats consist of: (1) dam construction and culvert installation that can block previously available habitat; (2) water development activities that can affect water quantity, timing, and quality; (3) land use activities such as logging and mining that can degrade aquatic habitat; (4) hatchery operation and practices; and, (5) harvest activities.

1. Habitat Blockage

In California, dams have been constructed on many rivers and streams and have adversely impacted anadromous salmonid populations. Most hydroelectric development projects in California have not been required to provide fish bypass facilities; further, projects that have been required to provide fish passage have met with limited success. Impassable dams in northern California have blocked substantial portions of suitable spawning and rearing habitat for salmon and steelhead. These include Copco Dam (and Iron Gate Dam) on the Klamath River, and Lewiston Dam on the Trinity River. Numerous other minor blockages and fish passage impairments exist due to road culvert designs and water management activities. Blockage of previously available suitable habitat can reduce salmon production. In some cases, decreases in available habitat (and resulting fish production) can decrease population resiliency to fluctuations due to other causes, including stochastic events.

2. Water Development Activities

Depletion and storage of natural flows have drastically altered natural hydrologic cycles in many rivers in California. In some areas in the Klamath and Trinity basins, dewatering of stream reaches also occurs due to diversions for irrigation and municipal use uses.

Alteration of streamflows has resulted in juvenile salmonid mortality for a variety of reasons: migration delays from insufficient flows or habitat blockages; loss of sufficient habitat due to dewatering and blockage; stranding of fish from rapid flow fluctuations; entrainment of juveniles into poorly screened or unscreened diversions; and increased juvenile mortality resulting from increased water temperatures. In addition to these factors, reduced flows negatively impact fish habitats due to increased deposition of fine sediments into spawning gravels, decreased recruitment of new spawning gravels, and encroachment of riparian and non-endemic vegetation into spawning and rearing areas resulting in reduced available habitat.

3. Land Use Activities

Land use activities associated with logging, road construction, urban development, mining, and agriculture have significantly altered fish habitat quantity and quality, and have certainly contributed to salmon stock declines.

Timber harvesting and associated road building have occurred in many areas in the Klamath and Trinity basins. Activities associated with logging result in habitat simplification of stream channels through sedimentation, channelization, and loss of riparian vegetation, large woody debris, and habitat complexity. Further, historical practices, such as splash dams, and wide spread removal of beaver dams, log jams and snags from river channels, have adversely modified fish habitat. More recently, logging has reduced the amount of instream, large woody debris, resulting in significant impacts to salmonid habitat. Excessive sedimentation and unstable spawning gravels are cited as major habitat problems in this region. Since the listing of SONCC coho salmon in 1997, the NMFS has completed ESA section 7 consultations on a variety of land management activities occurring on U.S. Forest Service and Bureau of Land Management lands within the Klamath and Trinity River basins.

The discovery of gold in California in the 1860s resulted in intensive mining throughout the northern portion of this region. The Klamath and Trinity Basins were the sites of active mining, and suction dredging, placer mining, and gravel mining continues to the present day. Lode mining for gold, copper and chromite continued as recently as 1987. Hydraulic mining for gold washed hillslopes down into streams, causing siltation and sedimentation of waterways and degradation of riparian habitats. The specific effects of mining activities on aquatic ecosystems depend upon the extraction and processing techniques used and the degree of disturbance.

Gravel and sand removal from streams and adjacent floodplains is common in much of northern California. The greatest demand for these products is for industrial purposes. Removal of these materials from a stream channel may fundamentally alter the routing of water and sediment through the system, resulting in altered channel morphology, decreased stability, accelerated erosion, and changes in the composition and structure of the substrate. For example, complete channel degradation (to bedrock) can occur. This can adversely affect the amount of available salmon spawning habitat and juvenile rearing conditions. The extent to which this type of mining affects streams and rivers depends on many site-specific characteristics including the geomorphic setting, the quantity of material extracted relative to the sediment supply, and the hydrologic and hydraulic conditions within the stream reach.

4. Hatchery Operation and Practices

Hatchery production of coho salmon occurs in several areas in this region (e.g., Iron Gate and Trinity hatcheries). In the Trinity River, the vast majority of coho salmon runs consist of those with recent hatchery heritage. Competition may occur among hatchery and native adults for spawning sites, and may lead to decreased production. Hatchery fish may outnumber wild fish and monopolize available spawning habitat when wild stocks are small and hatchery supplementation occurs. The negative effect of such competition can be magnified by naturally spawning hatchery stocks have lower spawning success than do wild fish. Hatchery stocks may also produce fewer smolts and returning adults. Competition might be occurring in the mainstem of the Klamath and Trinity rivers among hatchery and wild salmonids, resulting in low survival of both.

When non-native hatchery strays spawn in the wild, young fish with some non-native genes may result. The impact of stock transfers may increase dramatically if non-native salmonids are planted on top of wild populations for several generations, and a loss of local adaptations may lead to extirpation of that local stock. Large differences in the genetic structure of wild and hatchery stocks may potentially lead to lower survival rates. Further, supplementation with hatchery stocks can have differing effects depending on the size of the wild population.

5. Harvest

Historically, salmon and steelhead were abundant in many western coastal and interior streams of the United States and have supported substantial tribal and sport fisheries, contributing millions of dollars to numerous local economies. Over-fishing in the early days of the European settlement led to the depletion of many stocks of salmon and steelhead even before extensive habitat degradation. Prior to the 1900s, canneries were established in the Klamath and Trinity Rivers. At the peak of harvest in 1912, an estimate of 141,000 salmon were harvested and canned. In 1915, only 72,400 chinook salmon were harvested and canned. By the early 1900s, over-harvest had reduced the dominant spring-run chinook salmon to low levels, making the fall-run chinook the dominant run in the basin.

More recently, overfishing in non-tribal fisheries is believed to have been a significant factor in the decline of coho salmon. This included significant overfishing that occurred from the time marine survival turned poor for many stocks (ca. 1976) until the mid-1990s when harvest was substantially curtailed. Since 1994, the retention of coho salmon has been prohibited in marine fisheries south of Cape Falcon, Oregon. Coho salmon are still impacted, however, as a result of hook-and-release mortality in chinook salmon-directed fisheries. Since 1970, the ocean exploitation rate index on Oregon Production Index (OPI) coho salmon stocks (including coho salmon ESUs listed under the ESA) has generally declined from a high of about 80 percent to less than 10 percent in recent years. This has resulted from implementing non-retention fisheries off the Oregon and California coasts. Sport and commercial fishing restrictions ranging from severe curtailment to complete closures in recent years may be providing an increase in adult coho salmon spawners in some streams, but trends cannot be established from the existing data.

Coho salmon in this region are contacted by ocean fisheries primarily off California. Coded-wire tagged coho salmon released from hatcheries south of Cape Blanco have a southerly recovery pattern, primarily in California (65-92 percent), with some recoveries in Oregon (7-34 percent), and almost none (1 percent) in Washington or British Columbia (percent data represent range of recoveries for five hatcheries by state or province). Ocean exploitation rates for SONCC coho salmon are based on the exploitation rate on Rogue/Klamath hatchery stocks and have only recently become available. The estimated ocean exploitation rates were 5 percent in 1996 and 1997, 12 percent in 1998, and were projected to be 5 percent in 1999 (PFMC 1997, 1998, 1999). The extent to which coded-wire tagged recovery patterns of these hatchery stocks coincide with the distribution patterns of wild coho salmon is not known.

In 1994, approximately 90 percent of the Klamath-Trinity basin coho salmon are of hatchery origin. The annual tribal harvest of coho salmon over the past 5 years has been reported as 670 fish, of which 70 may have been naturally spawning. If the minimum population of naturally spawning SONCC coho salmon is about 10,000 fish (Weitcamp *et al.* 1995), the tribal impact on listed coho salmon has been relatively small, on average less than 100 fish per year during the past 6 years and less than 1 percent of the SONCC coho salmon ESU. Estimated tribal harvest rates on Klamath Basin coho salmon averaged 5 percent from 1992-1997.

6. Trinity River Division Background

In 1938, The Rivers and Harbors Act, authorized the construction and operation of the Central Valley Project (CVP) and stipulated the use of dams and reservoirs for improvement of river navigation and flood control, irrigation and domestic water use, and power generation. The Act also provided for wildlife conservation to be given due regard in planning of federal water projects.

In 1955, Congress authorized the construction of the Trinity River Division (TRD) of the CVP (Public Law (P.L.) 84-386) to divert surplus water to the Sacramento River. This activity was not supposed to have detrimental affects to the fishery resources within the Trinity River. An average of 88 percent of the annual flow was diverted to the Sacramento River for the next ten years. Minimum flows released into the Trinity River ranged from 150 cubic feet per second (CFS) to 250 CFS with a total volume of 120.5 thousand acre feet (TAF). The minimum flow releases were focused primarily on chinook salmon spawning requirements and did not address fluvial geomorphic processes and the requirements of other fish species or life stages (USFWS and HVT 1999, Chapter 2).

Within a decade of completion of the TRD, salmonid populations had noticeably decreased (Hubble 1973). Declines in the fishery resources lead to the formation of the Trinity River Basin Fish and Wildlife Task Force (TRBFWTF). In an attempt to stop the degradation of fish and wildlife habitat and formulate a long term management plan, the Task Force developed the Trinity River Basin Comprehensive Action program. In 1973, the California Department of Fish and Game (CDFG) requested that additional water be released to the Trinity River to stop the decline of salmon and steelhead. A three year attempt to evaluate varied flows on salmon and steelhead populations was hampered by flood and drought with no formal evaluation completed.

A USFWS study in 1978 concluded that substantial gains could be made for all life stages of anadromous fish from higher flows. The study also concluded that a volume of 340,000 AF of water, after implementation of the stream restoration plan, would be necessary and result in tradeoffs between habitats available for various fish life history stages (USFWS 1980a). An EIS was prepared in 1980 to address the proposal to restore the salmon and steelhead populations by increasing the streamflow in the Trinity River (USFWS 1980b). The EIS determined declines of 80 percent to chinook salmon and 60 percent to steelhead and an overall decline of 80 percent of the habitat. Factors identified for the decline in the fishery resource included insufficient streamflow, streambed sedimentation, and inadequate regulation of harvest.

Congress passed P. L. 96-335 in 1980 to control the degraded watershed of Grass Valley Creek, a tributary to the Trinity River. Construction of Buckhorn Debris dam in the Grass Valley Creek watershed and dredging of the Trinity River in select locations from Lewiston to the North Fork Trinity River was authorized to control sedimentation within the Trinity River.

In 1981, the Secretary of Interior, Cecil Andrus, issued a directive to the USFWS to conduct the 12 year flow study to determine: (1) the effectiveness of flow restoration, and other measures including intensive stream and watershed management; (2) the adequacy of the 340,000 AF flow regime; (3) mitigation measures for impacts of the TRD; and (4) flow regimes and other measures appropriate to maintain instream habitat conditions. The Secretary's decision included increasing the flow releases in critically dry years to 140,000 AF, in dry years to 220,000 AF, and 340,000 AF in normal or wet years.

In 1984, the Trinity River Basin Fish and Wildlife Management Act was passed (P.L. 98-541). A complete description of associated actions can be found in the TRMFR DEIS, Appendix B, Table B-1. In 1986, Congress enacted the Klamath River Conservation Restoration Area Act (P.L. 99-552). Two groups were formed under P.L. 99-552, the Klamath Fishery Management Council and the Klamath River Basin Fisheries Task Force.

In 1990, the North Coast Regional Water Quality Control Board concluded that the operations of the TRD impacted spawning and egg incubation within the Trinity River. Subsequently in 1991, temperature control objectives were set from Lewiston to Douglas City (60 °F from July 1 to September 14, and 56°F from September 15 to October1) and from Lewiston to the confluence of the North Fork Trinity River (56°F from October 1 to December 31). Additionally in 1991, an administrative appeal by the Hoopa Valley Tribe resulted in a Secretarial decision (May 8, 1991) to increase Trinity River water releases during the 1992-1996 period to no less than 340,000 AF in all years and established low flows of not less than 300 CFS.

The enactment of the Central Valley Project Improvement Act in 1992 ( CVPIA, Title 34 of P.L. 102-575 - 3406(b)23) restated the flow releases included in the 1991 Secretarial Decision, established a completion date for the TRFE study and a date for permanent fishery flow allocation, and established that the Hoopa Valley Tribe and the Secretary must agree with any change in flow. The Environmental Protection Agency (EPA) approved the Trinity River Temperature Objectives as Clean Water Act 303 water quality standards and found that exports to the Sacramento River were "controllable factors" that could be modified to meet the water quality standards.

The USFWS halted efforts in 1993 on a Environmental Assessment/Environmental Impact Report for a Trinity River Anadromous Fish Habitat Improvement Plan, recognizing the need for a document with a more comprehensive scope. Recognizing that Buckhorn Debris Dam and sand dredging in the Trinity River were not adequate to permanently protect the Trinity River from massive discharges of decomposing granite, P.L 98-541 and the Fiscal Year 1993 Energy and Water Appropriation Act (P.L. 102-377) authorized the purchase of 17,000 acres of the Grass Valley Creek Watershed by Congress. This land is now managed by the Bureau of Land Management, with a primary focus on watershed rehabilitation.

B. Central Valley Listed Species

Profound alterations to the riverine habitat of the Central Valley began with the discovery of gold in the middle of the last century. Dam construction, water diversion, and hydraulic mining soon followed, launching the Central Valley into the era of water manipulation and coincident habitat degradation. A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley. For example, NMFS has prepared range-wide status reviews for west coast chinook (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996). Information is also available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (June 16, 1993, 58 FR 33212; January 4, 1994, 59 FR 440; March 19, 1998, 63 FR 13347; September 16, 1999, 64 FR 50394; February 16, 2000, 65 FR 7764). The draft Programmatic Environmental Impact Statement/Report for the CALFED Bay-Delta Program (June 1999) (CALFED 1999) and the final Programmatic Environmental Impact Statement for the Central Valley Project Improvement Act (October 1999) (U.S. DOI 1999) provide an excellent summary of historical and recent environmental conditions for salmon and steelhead in the Central Valley. For the purposes of this document, a general description of the environmental baseline for Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon, and Central Valley steelhead is based on a summarization of these documents. Following this description, a more detailed background of the CVP is provided.

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

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the CVP, SWP, and other municipal and private entities have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent 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 (CDFG 1998). On the Sacramento River Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud and Pit rivers. On Clear Creek Whiskeytown Dam blocks access to the upper portions of the Clear Creek watershed. Oroville Dam and associated facilities block passage to the upper Feather River watershed and Nimbus Dam blocks access to most the American River Basin.

2. Water Development Activities

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted streamflows and altered the natural cycles by which juvenile and adult salmonids base their migrations. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased recruitment of gravel and large woody debris. In addition, the altered flow regime below several Central Valley dams has impaired the regeneration of riparian vegetation. Historical seasonal flow patterns included high flood flows in the winter and spring with declining flows throughout the summer and early fall. As flows declined during the summer, the seeds from willows and cottonwood trees, deposited on the recently created sand bars, would 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. With the completion of upstream reservoir storage projects throughout the Central Valley, the seasonal distribution of flows differs substantially from historical patterns. The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round that diminish natural channel forming, riparian vegetation, and foodweb functions.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds of small and medium size water diversions exist along the Sacramento River, San Joaquin River and their tributaries. Depending on the size, location, and season of operation, these unscreened intakes entrain many life stages of aquatic species, including juvenile salmonids. More than 2,000 unscreened diversions in the Delta entrain resident and anadromous fishes.

3. Land Use Activities

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 (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).

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation. Sedimentation can adversely effect 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 can reduce the production of juvenile salmonids and hinder the ability of some over-wintering juveniles to hide in the gravels during high flow events.

Land use activities associated with road construction, urban development, 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 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.

Historically in the Sacramento/San Joaquin Delta, tidal marshes provided a highly productive estuarine environment for juvenile anadromous salmonids. During the course of their downstream migration, juvenile winter-run chinook, spring-run chinook, and steelhead utilize the Delta's estuarine habitat for seasonal rearing, and as a migration corridor to the sea. Since the 1850s, reclamation of Delta islands for agricultural purposes caused the cumulative loss of 94 percent of the Delta's tidal marshes (Monroe *et al.* 1992).

In addition to the degradation and loss of estuarine habitat, downstream migrant juvenile salmon in the Delta have been subject to adverse conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmon have been adversely affected by: (1) water diversion from the mainstem Sacramento River into the Central Delta via the manmade Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; and (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay. Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges.

4. Hatchery Operation and Practices

Five hatcheries currently produce chinook salmon in the Central Valley and four of these also produce steelhead. Releasing large numbers of hatchery fish can pose a threat to wild chinook and steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley are primarily caused by the straying of hatchery fish and the subsequent hybridization of hatchery and wild fish. In the Central Valley, practices such as trucking smolts to distant sites for release and the transferring of eggs between hatcheries contribute to elevated straying levels (U.S. DOI 1999).

5. Harvest

Extensive ocean recreational and commercial troll fisheries for chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for chinook salmon and steelhead. Ocean harvest of Central Valley chinook is estimated using an abundance index, called the Central Valley Index (CVI). The CVI harvest rate is the ratio of salmon harvested south of Point Arena (where 85 percent of Central Valley chinook are caught) to the CVI escapement.

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

There are limited data on spring-run chinook ocean harvest rates. An analysis using CWT spring-run from the Feather River Hatchery estimate harvest rates were 18 percent to 22 percent for age-3 fish, 57 percent to 85 percent for age-4 fish, and 97 percent to 100 percent for age-5 fish (CDFG 1998).

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

To address potential incidental take of chinook salmon that occurs in the recreational trout fishery, the California Fish and Game Commission adopted in 1992 gear restrictions (all hooks must be barbless and a maximum 2.25 inches in length) to minimize hooking injury and mortality caused by trout anglers incidentally catching winter-run chinook. That same year, the Commission also adopted regulations which prohibited any salmon from being removed from the water to further reduce the potential for injury and mortality to winter-run chinook from the trout and steelhead fishery.

Specific regulations for the protection of spring-run chinook salmon in Mill, Deer, Big Chico, and Butte creeks were added to the existing CDFG regulations in 1994. Existing regulations, including those developed for winter-run chinook provide some level of protection for Central Valley spring-run chinook (CDFG 1998).

There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-54 through 1958-59 seasons ranges from 25.1 percent to 45.6 percent assuming a 20 percent non return rate of tags. Staley (1976) estimated the harvest rate in the American River during the 1971-72 and 1973-74 seasons to be 27 percent. The average annual harvest rate on adult steelhead above Red Bluff Diversion Dam for the three year period 1991-92 through 1993-94 is 16 percent (McEwan and Jackson 1996).

6. Ecosystem Restoration

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. The CALFED Program and the CVPIA's Anadromous Fish Restoration Program (AFRP), in coordination with other Central Valley efforts, have implemented numerous habitat restoration actions that benefit Central Valley steelhead, Central Valley spring-run chinook salmon, and their proposed 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 steelhead and spring-run chinook production. Additional actions that are currently underway that benefit Central Valley steelhead and Central Valley spring-run chinook include new efforts to enhance fisheries monitoring and conservation actions to address artificial propagation. In the Delta, approximately 1,500 acres of land have been purchased for restoration activities since 1996. Restoration of these Delta areas primarily involves flooding lands previously used for agriculture, thereby creating additional wetland areas and rearing habitat for juvenile salmonids.

A beneficial action unrelated to the CALFED Program or AFRP includes the Environmental Protection Agency's remedial actions at Iron Mountain Mine. The completion of a state-of-the-art lime neutralization plant is successfully removing significant concentrations of toxic metals in acidic mine drainage from the Spring Creek Watershed. Containment loading into the upper Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990's.

7. Central Valley Project Background

The CVP is one of the nation's largest water development projects which extends from the Cascade Mountain Range in Northern California to the Kern River in the south. The CVP includes a series of storage facilities, conveyance systems, and powerplants operated by the Reclamation to make multipurpose use of the water supplies that can be controlled by the facilities. Reservoirs of the CVP are coordinated in their operation to obtain maximum yields and deliver water into the main river channels and canals of the project in an efficient manner. Water is delivered for irrigation, municipal and industrial, and environmental purposes in accordance with long-term contracts negotiated with irrigation districts and other organizations.

Facilities of the CVP are categorized by divisions and units. Most of the distribution and drainage systems constructed by Reclamation have been transferred to the irrigation and water districts for operation and maintenance, including some small reservoirs and pumping plants. Of the nine divisions of the CVP, four are described below by division and a fifth, the Trinity River Division, has been previously described.

a. Sacramento River Division

The Sacramento River Division of the CVP includes facilities for the diversion and conveyance of water to CVP contractors on the west side of the Sacramento River. At Red Bluff, the Sacramento Canals Unit of the Sacramento River Division includes the Red Bluff Diversion Dam, the Corning Pumping Plant, and the Corning and Tehama-Colusa canals. These facilities provide for diversion and conveyance of irrigation water to over 200,000 acres of land in the Sacramento Valley, principally in Tehama, Glenn, Colusa, and Yolo counties. The Sacramento River Division also includes Black Butte Dam and Lake. Black Butte Dam and Lake were integrated into the CVP in 1970. The facilities are operated jointly by the Army Corps of Engineers and Reclamation to provide for flood control and for irrigation water supplies, respectively. Black Butte Reservoir provides supplemental water to the Tehama-Colusa Canal as it crosses Stony Creek.

b. Shasta Division

The Shasta Division of the CVP includes facilities that conserve water on the Sacramento River for flood control, navigation maintenance, conservation of fish in the Sacramento River, protection of the Sacramento-San Joaquin Delta from intrusion of saline ocean water, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. The Shasta Division includes Shasta Dam, Lake, and Powerplant; Keswick Dam, Reservoir, and Powerplant; and the Toyon Pipeline. Shasta Dam and Lake (4,552,000 AF capacity) is the largest storage reservoir on the Sacramento River. Completed in 1945, Shasta Dam controls floodwater and stores winter runoff for various uses in the Sacramento and San Joaquin valleys. Keswick Dam, located approximately 9 miles downstream from Shasta Dam creates an afterbay (23,000 AF capacity) for Shasta Lake and Trinity River diversions. Keswick Dam and Reservoir stabilizes the peak hydroelectric operation water releases from Spring Creek and Shasta Powerplants. Anadromous fish trapping facilities at Keswick Dam are operated in conjunction with the FWS. Some of the salmon trapped at the Keswick fish trap are taken for use as broodstock at the Coleman National Fish Hatchery approximately 25 miles downstream of Keswick Dam on Battle Creek, tributary to the Sacramento River.

Construction of a temperature control device (TCD) at Shasta Dam was completed in 1997. This device is designed to selectively withdraw water from elevations with Shasta Lake while enabling hydroelectric power generation. The TCD allows greater flexibility in the management of cold water reserves in Shasta Lake for maintenance of adequate water temperatures in the Sacramento River downstream of Keswick Dam.

Approximately 5 miles downstream of Keswick Dam, the Anderson-Cottonwood Irrigation District (ACID) has been diverting water for irrigation from the Sacramento River since 1916. The ACID diversion dam and canal operate seasonally from the spring through fall of each year to deliver irrigation water supplies along the westside of the Sacramento River between Redding and Cottonwood. A contractual agreement between the Federal Government and ACID provides for diversion of water and requires Reclamation to reduce Keswick Dam releases to accommodate the installation, removal, or adjustment of boards associated with the ACID diversion dam.

c. American River Division

The American River Division includes the Folsom Unit, Sly Park Unit, and Auburn-Folsom South Unit of the CVP. These facilities conserve water on the American River for flood control, fish and wildlife protection, recreation, protection of the Sacramento-San Joaquin Delta from intrusion of saline ocean water, agricultural water supplies, municipal and industrial (M&I) water supplies, and hydroelectric generation. The Folsom Unit consists of Folsom Dam and Lake (977,000 AF capacity), Folsom Powerhouse, Nimbus Dam, Lake Natoma, and Nimbus Powerplant on the American River. The Sly Park Unit which provides water from the Consumnes River to El Dorado Irrigation District (EID) includes Jenkinson Lake formed by Sly Park Dam on Sly Park Creek, a low concrete diversion dam on Camp Creek, and Sly Park Conduit. The Folsom and Sly Park Units were added to the CVP in 1949. In 1965, the Auburn-Folsom South Unit was authorized and includes County Line Dam, Pumping Plant, and Reservoir; Sugar Pine Dam and Reservoir; Linden and Morman Island Pumping Plants; Folsom South Canal; and other necessary diversion works, conduits, and appurtenant works for delivery of water supplies to Placer, El Dorado, Sacramento, and San Joaquin counties.

Although Folsom Lake is the main storage and flood control reservoir on the American River, numerous other small reservoirs in the upper basin provide generation and water supply. None of the upstream reservoirs have specific flood control responsibilities. The total upstream storage above Folsom lake is approximately 820,000 AF. Ninety percent of this upstream storage is contained by five reservoirs: French Meadows; Hell Hole (208,000 AF); Loon Lake (76,000 AF); Union Valley (271,000 AF) and Ice House (46,000 AF). French Meadows and Hell Hole reservoirs, located on the Middle Fork of the American River are owned and operated by Placer County Water Agency (PCWA). The PCWA provides wholesale water to agricultural and urban areas within Placer County. Loon Lake on the Middle Fork, and Union Valley and Ice House reservoirs on the South Fork of the American River are operated by Sacramento Municipal Utilities District (SMUD).

d. Delta Division

The CVP uses the Sacramento and San Joaquin Rivers and channels in the Delta to transport natural river flows and reservoir storage to a large water export facility in the south Delta. The CVP's Tracy Pumping Plant is operated to meet the water supply needs in the San Joaquin

Valley, Central Coastal area, and south San Francisco Bay area.

The Tracy Pumping Plant, about five miles north of Tracy, California, consists of six pumps including one rated at 800 CFS, two at 850 CFS, and three at 950 CFS. Although the total plant capacity is about 5,300 CFS, the maximum permitted pumping capacity by the State Water Resources Control Board (SWRCB) is 4,600 CFS. The Tracy pumping plant is located at the end of an earth-lined intake channel about 2.5 miles long and pumps water from Old River into the Delta-Mendota Canal. A portion of the water conveyed through the Delta-Mendota Canal flows into the O'Neill Forebay and is lifted to the joint CVP/SWP San Luis Reservoir for storage.

At the head of the intake channel, the Tracy Fish Collection Facility is designed to intercept fish before they pass through the canal to the Tracy Pumping Plant. Fish are collected and transported by tanker truck to release sites away from the pumps. This facility uses behavioral barriers consisting of primary and secondary louvers to guide targeted fish into holding tanks. When compatible with export operations, the louvers are operated with the objective of achieving water approach velocities for striped bass of approximately one foot per second from May 15 through October 31 and for salmon of approximately three feet per second from November 1 through May 14. Channel velocity criteria are a function of bypass ratios through the facility. Hauling trucks are used to transport salvaged fish to release sites in the western Delta. The CVP maintains two permanent release sites: one on the Sacramento River near Horseshoe bend and the other on the San Joaquin River immediately upstream of Antioch Bridge.

## IV. Effects of the Action

As mentioned in the Consultation History section of this document, the NMFS coordinated with the authors during development and preparation of the TRFE final report (USFWS and HVT 1999) and provided document review. In addition, the NMFS also served as a cooperating agency during the development of the TRMFR DEIS. Consequently, the NMFS is familiar with the preferred alternative and has had many opportunities to contemplate the expected efficacy of the proposed restoration program and the expected effects of implementation on listed species. Further, the NMFS finds that these two documents (TRMFR DEIS and USFWS and HVT 1999) provide excellent analyses regarding the expected effects of implementation of the proposed action, i.e., that the proposed restoration program is likely to provide necessary benefits to anadromous fish species in decline and their habitats.

### A. Analysis Approach - SONCC coho salmon

Operation of the TRD affects flows and water quality in the Trinity River during all portions of the year. Changes in flow affect the river channel and the amount of suitable habitat available to coho salmon in the Trinity River. In addition, changes in the volume and timing of exports of Trinity River water to the Sacramento River Basin may result in indirect effects to listed anadromous fish species in the Central Valley. The relationship between changes in habitat quality and quantity, and the status and trends of fish and wildlife populations has been the subject of extensive scientific research and publication. The assumptions underlying our assessment are consistent with this extensive scientific base of knowledge. For further detailed discussions of the relationship between habitat variables and the status of salmon populations, readers should refer to the work of FEMAT (USDA Forest Service *et al.* 1993), Gregory and Bisson (1997), Hicks *et al.* (1991), Murphy (1995), NRC (1996), Nehlsen *et al.* (1991), Spence *et al.* (1996), Thomas *et al.* (1993), and others.

The relationship between habitat and populations is embodied in the concept of carrying capacity. The concept of carrying capacity recognizes that specific areas of land or water can support a finite population of a particular species because food and other resources in that area are finite (Odum 1971). By extension, increasing the carrying capacity of an area (increasing the quality or quantity of resources available to the population within that area) increases the number of individuals the area can sustain over time. By the same reasoning, decreasing the carrying capacity of an area (decreasing the quality or quantity of resources available to a population) decreases the number of individuals that the area can support over time. In either case, there is a corresponding but non-linear relationship between changes in the quality and quantity of resources available to the species in the area and the number of individuals that the area can support.

The approach used in this assessment is intended to determine if the proposed action is likely to degrade the quality and quantity of natural resources necessary to support populations of coho salmon in the action area. The assessment approach is intended to determine if any changes are likely to decrease the size, number, reproduction, dynamics, or distribution of the listed coho salmon population in the action area in ways that would be expected to appreciably reduce the likelihood of both the survival and recovery of SONCC coho salmon in the wild.

In addition to the direct and indirect effects that the proposed action is expected to have on SONCC coho salmon, indirect effects may occur to listed Central Valley salmon and steelhead. The discussion of effects to Trinity River fish is followed by consideration of the potential indirect effects to Sacramento River Winter-run chinook salmon, CV Spring-run chinook salmon, and CV steelhead.

B. Effects Analysis - SONCC coho salmon

The proposed action may affect Trinity River coho salmon in a variety of ways. For the purposes of this analysis, consideration of these affects by activity type is appropriate. Following these discussions, a summary will synthesize the net effects of the proposed action on these fish.

1. Alternative Managed Flow Regime

The recommended flow regimes and release schedules were developed on the basis of water year classifications and the hydrograph components necessary to meet objectives for each water-year class. In order to meet targeted microhabitat, fluvial processes, and desired temperature conditions, a variety of flows were necessary. It was determined that no single annual flow regime could be expected to perform all the functions needed to maintain an alluvial river system and restore fishery resources, including coho salmon (TRMFR DEIS). Under the proposed action, unregulated runoff into Trinity Lake would be used to designate the water year class during each year, in order that the various targeted fluvial processes will be met with appropriate frequencies.

During the winter (mid-October through late April/mid-May), a base flow of 300 CFS from Lewiston Dam is expected to provide suitable microhabitat for spawning and rearing anadromous salmonids including coho salmon in all water years. This flow level was determined with consideration of the current channel condition, and is also expected to protect early life stages throughout incubation and emergence periods for all salmonid species (USFWS and HVT 1999). However, the flood control and "safety of dam" releases that are assumed to occur under all alternatives considered in the TRMFR DEIS may adversely affect early life stages of fish. Specifically, if coho salmon spawn prior to these releases, some redds may be scoured by high flows and lost. If coho salmon spawn during these releases, some redds may be subject to dessication or resulting fry may be stranded during flow decreases. The extent to which these flood control releases adversely affect coho salmon is dependant on release timing, duration, and meteorological conditions. Pusuant to 50 CFR §402.05, Reclamation is expected to consult with the NMFS under emergency consultation procedures should any of these releases be necessary.

During the late-April/mid-May through June 30 period, the proposed flow regime was designed to mimic the natural snowmelt peak and snowmelt recession hydrograph (similar to pre-dam conditions). These hydrograph components historically varied and therefore the proposed action includes variation between water year classes. The specific purpose of the snowmelt peak component of the hydrograph is to achieve a frequently mobilized channelbed surface and to periodically scour and fill the channelbed. This is expected to mobilize spawning gravels and reduce levels of fine sediment, scour small woody plant seedlings on alternate point bars, deposit fine sediment onto upper alternate bar and floodplain surfaces, develop additional point bar sequences, and result in increased pool depths (USFWS and HVT 1999). In turn, higher survival of coho salmon eggs and emerging alevins is expected due to reduced fine sediment in the channel substrate, an increased food base for these fish due to increased macroinvertibrate production, and improved spawning and rearing habitat. The snowmelt recession component of the hydrograph is primarily intended to promote the transport of fine bed material once peak flows have mobilized the surface layer of the channelbed and alternate bars (USFWS and HVT 1999). This is expected to help prevent the filling of pools, and improve spawning and rearing habitat for coho salmon.

In addition to the fluvial geomorphic purposes for the proposed spring/summer hydrograph, the releases during this time of year are also expected to achieve optimum salmonid smolt water temperatures during normal and wetter water year classes. Optimum smolt temperatures would not be met during Dry and Critically Dry water years, although at least marginal temperatures are expected throughout much of the outmigration period. Allowing mainstem water temperatures to warm earlier in the outmigration period would cue salmonids to outmigrate before water temperatures in the lower watershed are likely to become too warm to ensure smolt survival (USFWS and HVT 1999).

During outmigration, coho salmon smolts pass from the Trinity River into the lower Klamath River and into the Pacific Ocean. At the confluence of the Trinity and Klamath rivers, the respective discharges are combined in a mixing zone and generally result in an equilibrium temperature downstream of the confluence. Depending on specific conditions, Trinity River water may be several °F warmer or cooler than the Klamath River upstream of the confluence. As outmigrating smolts pass from the Trinity to the Klamath River, they may be subject to a change in water temperature. Water temperatures affect the smoltification process and under some conditions may interrupt this transition which prepares these fish for life in the marine environment (USFWS and HVT 1999).

The effect of spring and early summer Lewiston Dam releases into the Trinity River on water temperatures at the Trinity/Klamath River confluence was examined and several generalities were found. Water temperature modeling predicted that high level releases in the Trinity can result in Trinity River water temperatures being colder than and the Klamath River, and conversely, low magnitude releases may result in warmer temperatures in the Trinity River relative to the Klamath River (TRMFR DEIS). Factors affecting the potential temperature differential include tributary accretions to both rivers. When either the Lewiston Dam release is relatively large under drought condition (low tributary accretion) or small during wet conditions, the temperature differentials are the greatest. Under the proposed action, release magnitudes were selected in part to emulate pre-TRD hydrologic conditions and generally match tributary accretions. As a result, the temperature differential at the Trinity/Klamath confluence is expected to be lessened (TRMFR DEIS).

Using available water temperature data from 1992 ('dry' water year classification), 1993 ('wet' classification), and 1994 ('critically dry' classification), each year (1992 to 1994) was modeled using flow schedules for all water year types to estimate potential temperature differences between the Trinity and Klamath rivers at the confluence (see USFWS and HVT 1999, Appendix L). Under the proposed Trinity River "critically dry" flows for the April 29 through July 1 period, and using 1994 Klamath River measured temperatures, the range of differences in the weekly average temperatures was estimated to be +2.8 to -2.2 °F (negative value indicates that the estimated Trinity River temperature is colder than measured temperatures in the Klamath River). Assuming the proposed "dry" year Trinity River releases and using1992 Klamath conditions for comparison, the range was found to be -0.7 to -6.0 °F. Comparing modeled Trinity River temperatures during a "wet" year and 1993 Klamath River data showed a differential range of +1.9 to -3.3 °F. Complete data were not available for the Klamath River during a "normal" water year, but estimated temperatures under "normal" Trinity River releases were compared with 1992 ('dry') and 1993 ('wet') Klamath River data. The 1992 data comparison found an estimated differential range of -9.8 to -3.0 °F, and the 1993 comparison resulted in a -3.3 to +2.6 °F range. Based on available information, these ranges are likely to represent extreme bounds beyond the expected differences during "normal" water years.

Although water temperature differentials imposed upon salmon may be detrimental, differences of less than 10 °F are considered to be safe to stock chinook salmon juveniles (K. Rushton, California Department of Fish and Game, pers. comm., as cited in USFWS and HVT 1999). As stocking salmon from one location to another often consists of an abrupt immersion into a completely different environment, this probably represents a worse case scenario. Other information suggests that fish transfers should occur when water temperature differences are less than 10 °F (USFWS and HVT 1999). As outlined above, the expected water temperature differences under the proposed action are well below 10 °F. Also, fish are generally expected to be able to move in and out of any temperature gradients at will during acclimation to the new thermal regime. Therefore, the proposed action is not likely to result in substantial adverse affects to coho salmon traveling from the Trinity River, through the mixing zone at the confluence, and downstream into the lower Klamath River. Finally, Trinity River water entering the Klamath River during the late spring and summer period may modestly improve water quality in the lower river, depending on specific conditions (TRMFR DEIS).

From July through mid-October, the 450 CFS release in all water year classes would provide suitable microhabitat for rearing coho salmon as well as appropriate water temperatures needed to increase their expected survival, and in turn, production of coho salmon and steelhead (USFWS and HVT 1999).

2. Mechanical Habitat Rehabilitation Projects

Mainstem Channel Reconstruction/Rehabilitation activities will occur along the mainstem Trinity River from Lewiston Dam to the North Fork Trinity River confluence (TRMFR DEIS; USFWS and BOR 2000), but the implementation schedule proposed is not specific (due in part to a lack of identified funding for the preferred alternative). Channel rehabilitation projects are expected to provide stable amounts of habitat for salmonid fry and juveniles over a wide range of flows relative to the existing channel, increase shallow low velocity areas for fry rearing, and promote river dynamics necessary to maintain an alluvial system. The intent is to selectively remove the hardened riparian berm and recreate alternate bars similar in form to those that existed prior to the construction of the TRD. Channel rehabilitation is not intended to completely remove all riparian vegetation, but to remove vegetation at strategic locations to promote alluvial processes necessary for the restoration and maintenance of salmonid populations. The tightly bound berm material is hard to mobilize even at high flows, and mechanical berm removal is necessary. After selected berm removal, subsequent high-flow releases and coarse sediment supplementation would maintain these alternate point bars and create a new dynamic channel. Additionally, channel-rehabilitation efforts also would remove large quantities (potentially up to 1 million $y^3$) of fine sediment stored in the riparian berms between Lewiston and the North Fork Trinity River confluence. Specific channel rehabilitation recommendations vary by river segment between Lewiston Dam and the North Fork Trinity confluence because the need for channel rehabilitation changes with tributary inputs of flow and sediment.

A total of 44 potential channel-rehabilitation sites, 3 potential side channel-rehabilitation sites, and 2 tributary delta maintenance sites have been identified in the TRFE (USFWS and HVT 1999). These sites are located where channel morphology, sediment supply, and high-flow hydraulics would encourage a dynamic, alluvial channel. A short implementation period for a significant number of these projects is recommended in the TRFE (USFWS and HVT 1999) to evaluate whether they achieve their intended benefits: increased quality and quantity of salmonid habitat. The remaining projects could proceed following a positive evaluation of the completed projects through the adaptive management process.

The construction period for past pilot projects has been limited to the summer months (July through September). The proposed projects would again be constructed during the summer, however, consideration of construction during other seasons (e.g., winter) is not precluded in the biological assessment (USFWS and BOR 2000) addressing the TRMFR DEIS preferred alternative. Removal of riparian vegetation would occur outside of the wetted channel. For projects constructed during the summer, fine sediments remaining on a point bar will be moved into the channel by the first high flows (October or November) following construction. Tributary accretion contributing to high flows may result in additional turbidity from sand and fine sediment, but this would occur regardless of the time of year a project is constructed.

Construction will not occur within the wetter channel, however, juvenile coho salmon rearing in the vicinity of construction activities may be displaced from the local area. Any displacement would likely be due to increased turbidity and noise disturbance from heavy machinery. If construction activities continue into the winter months, these activities and the associated noise levels may or may not have a negative affect on adult spawning coho salmon spawning behavior in the vicinity of a project site. Reduced egg to fry survival may occur as a result of fine sediment deposition downstream of a project site (USFWS and BOR 2000). Any negative effects to coho salmon as a result of increased turbidity levels are expected to depend on the magnitude and duration of these conditions and would be expected to be minimal and short lived.

Over the long-term, habitat rehabilitation projects are expected to be overwhelmingly beneficial to coho salmon due to the reduced potential for stranding juveniles, increased low velocity habitats for fry, increased habitat diversity, removal of excess fine sediments, and improved streambank condition and floodplain connectivity (USFWS and BOR 2000).

Annual gravel supplementation activities would occur prior to adult coho salmon entering the project area to spawn (October through Novbember), so no adverse affects to this life stage are anticipated. Smolt outmigration from the project area is expected to be largely completed prior to gravel supplementation activities. Coho salmon fry and possibly late outmigrating smolts may be displaced from the gravel deposition site due to the placement of gravel into the river and/or the noise from heavy machinery. Displaced juveniles are expected to seek alternative downstream or upstream habitats for rearing (USFWS and BOR 2000). Alternative rearing habitats may not be as productive in terms of food or cover availability, and increased competition may occur for these resources resulting in decreased coho salmon fitness and survival rates. Although there may be minor, short lived adverse effects to juvenile coho salmon as a result of the gravel supplementation projects, long-term results such as improved spawning habitat, improved salmonid over-wintering habitat, and a net increase in aquatic insect production in the immediate and downstream areas are expected to provide survival benefits to Trinity River coho salmon populations.

3. Adaptive Management Program

By definition, the specific affects of the AEAM program cannot be determined at this time. However, it is anticipated that the program will function as designed, i.e., that the assumptions and expectations underlying the TRFE (USFWS and HVT 1999) and the resulting restoration program (TRMFR DEIS, preferred alternative) will be tested through time and that this additional knowledge and analyses will result in recommendations that support a continuing, more effective restoration program. Any modifications resulting from the AEAM program may be subject to additional NEPA and CEQA analyses as required by law (TRMFR DEIS), as well as additional ESA section 7 consultation.

C. Summary of Effects - SONCC coho salmon

To evaluate the effects of alternative approaches to mainstem Trinity River fish habitat restoration, the Trinity River System Attribute Analysis Method (TRSAAM) was developed (TRMFR DEIS, Appendix B). This approach was based on the fundamentals and relationships of key river system characteristics and functions, and allowed comparison of the expected effects of the proposed action on anadromous salmonid fish resources relative to current operations. Detailed assumptions, methodologies, and results are described in the TRMFR DEIS and by the USFWS and HVT (1999).

The results of the TRSAAM analyses indicated that, compared to previous project operation (e.g., 340,000 AF annual releases into the Trinity River), the proposed action would result in greatly improved fishery habitat in the mainstem Trinity River by the year 2020. Further, the proposed action would result in highly beneficial improvements in river system and habitat conditions allowing naturally produced anadromous salmonid populations, including coho salmon, to greatly increase. Specifically, river system health and habitat conditions would be expected to improve nearly 733 percent, using the TRSAAM scores as a measure of comparison (TRMFR DEIS, Appendix B).

As a result of improved habitat conditions, Trinity River coho salmon are expected to benefit from increases in suitable habitat due to increased survival of associated freshwater life history stages and resulting production of smolts. These benefits are expected to substantially contribute toward the achievement of management goals for these fish.

In summary, the proposed action represents the outcome of thorough study of actions that are necessary to restore the mainstem Trinity River, aquatic habitat, and the fish inhabitants including coho salmon. Although some individual components of the proposed action have the potential to result in low magnitude, short lived adverse affects to coho salmon, these same components (and the entire program) are expected to result in overwhelming benefits to all salmon and steelhead species through time. Because implementation of the proposed action is expected to result in substantial increases in coho salmon populations, implementation of the preferred alternative in the TRMFR DEIS is not expected to appreciably reduce the likelihood of both survival and recovery of SONCC coho salmon in the wild. Similarly, because the expected outcome of implementation of the proposed action is greatly improved fish habitat conditions (including necessary coho salmon habitat), the value of critical habitat for both the survival and recovery of SONCC coho salmon will not be appreciably diminished.

D. Analysis Approach - Central Valley listed species

Adequate flows, temperatures, water depths and velocities, appropriate spawning and rearing substrates, instream cover, and food are critical for the production of all anadromous salmonids. In the Central Valley the potential effects of the proposed action are limited to indirect effects related to Reclamation's ability to manage water temperatures in the upper Sacramento River and reduced summer flows in the lower American River.

The effects of the proposed action on temperature conditions in the upper Sacramento River were evaluated by three different measures in the TRMFR DEIS: (1) estimated carryover storage conditions in Shasta Reservoir; (2) estimated temperature conditions in the upper Sacramento River; and (3) estimated mortality levels of the early life stages of chinook salmon and steelhead. Estimated Shasta carryover storage and water temperature conditions in the proposed action were compared to existing conditions and the no action alternative. Carryover storage levels and temperatures were also evaluated by estimating consistency with the reasonable and prudent alternative (RPA) in the February 12, 1993, biological opinion issued by the NMFS to Reclamation regarding the effects of CVP and State Water Project operations on the endangered winter-run chinook salmon (Winter-run CVP-OCAP BO) (NMFS 1993).

The RPA in the Winter-run CVP-OCAP BO established two sets of criteria for protecting spawning and incubating winter-run chinook salmon in all years except critically dry conditions: (1) minimum end-of-September carryover requirement of 1.9 MAF in Shasta Reservoir and (2) temperature criteria in the upper Sacramento River by location and season. Under critical dry conditions (defined as the driest 10 percent of water year types), the RPA recognized that it may not be possible to maintain a minimum carryover storage of 1.9 million acre feet (MAF) in Shasta Reservoir and/or comply with the 56°F temperature criteria. Therefore, the RPA requires Reclamation to reinitiate section 7 consultation with NMFS prior to the first water allocation of the year under critical dry water year conditions or if the 90 percent exceedance forecast estimates Shasta carryover storage levels will drop below 1.9 MAF at the end of September. Upon reinitiation of consultation, Reclamation and NMFS will develop a year-specific temperature control plan based upon the observed winter-run chinook spawning distribution in the upper Sacramento River and designed to maximize use of the limited cold water reserves in Shasta Reservoir. Modeled estimates of the percentage of years that carryover storage at Shasta Reservoir drops below 1.9 MAF and temperature compliance at various locations in the upper Sacramento River are presented in the TRMFR DEIS and its appendices.

Estimates of temperature-related losses of the early life stages of chinook salmon and steelhead for the proposed action were evaluated using Reclamation's Sacramento River Salmon Mortality Model, (LSALMON2) (Reclamation 1991). The estimated monthly water temperature data for the Sacramento River from Reclamation's Sacramento River Basin Temperature Model (LSACTEM3) were input into Reclamation's salmon mortality model. Spatial and temporal spawning distributions of winter-run chinook, spring-run chinook, fall-run chinook, and late-fall run chinook salmon in the upper Sacramento River were also input into the salmon mortality model. From the salmon mortality model, losses of chinook eggs and fry were estimated for the chinook salmon run in the Keswick Dam to Woodson Bridge reach. For the purposes of the temperature analysis, it was assumed that the Shasta TCD would operate as designed (TRMFR DEIS, Appendix B). For steelhead in the Sacramento River, there is no similar temperature model available. However, the temporal spawning of steelhead is similar to late-fall run chinook. Thus, it was assumed that the estimated losses of steelhead eggs and fry would be similar to those estimated for late-fall run chinook salmon using Reclamation's salmon mortality model.

The analyses of potential temperature impacts to Central Valley listed anadromous salmonids in this biological opinion are based upon information contained in the TRMFR DEIS and its appendices; Programmatic Environmental Impact Statement (PEIS) for the Central Valley Project Improvement Act (CVPIA); and the Explanation of Tables and Figures Generated from the Original Data Sets in PROSIM Modeling for the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (June 6, 2000, letter and enclosures from M. Spear and L. Snow to R. McGinnis [sic]).

The analyses of potential changes in flow and temperature conditions in the American River in this biological opinion are based PROSIM modeling results provided in the Final PEIS for the CVPIA.

E. Effects Analysis - Central Valley Listed Species

1. Sacramento River Winter-run Chinook Salmon

The endangered winter-run chinook salmon spawn in a 60-mile reach of the Sacramento River between Keswick Dam and Red Bluff during the late spring and summer (mid-April through July). Eggs are deposited in river gravels (redds) approximately 20 to 60 cm below the streambed surface (Allen and Hassler 1986). Eggs hatch after a variable incubation period dependant on water temperature, but is generally about 40 to 60 days in the Sacramento River.

After hatching, the alevins (yolk-sac larvae) remain in the gravel interstices for an additional 2 to 4 weeks (Vogel and Marine 1991).

During this period of spawning and incubation, winter-run chinook eggs and alevins are susceptible to stress and mortality at water temperatures exceeding 57°F, although the later stages of embryonic development have a greater temperature tolerance than the earliest life stages (Allen and Hassler 1986). To provide suitable conditions for winter-run chinook spawning and incubation, a water temperature criteria of 56°F has been established in the Winter-run CVP-OCAP BO from mid-April through September and 60°F during October. In addition, the Central Valley Water Quality Control Plan has established a temperature objective of 56°F or less to protect all salmon runs in the upper Sacramento River (Central Valley Region Water Quality Control Board 1994), and the CALFED Ecosystem Restoration Plan has established a general temperature target of 56°F or less in salmon and steelhead spawning areas during the spawning and incubation seasons below major dams on rivers (CALFED 1999). Additional information regarding the effects of water temperature on the survival of incubating winter-run chinook eggs and alevins is summarized in the Winter-run CVP-OCAP BO (NMFS 1993).

a. Shasta minimum end-of-September carryover storage

The Winter-run CVP-OCAP BO establishes a minimum end-of-September carryover storage criteria for Shasta Reservoir of 1.9 MAF to maintain the cold water pool in Shasta Reservoir. Modeling and operational experience has shown that reservoir carryover storage levels of 1.9 MAF and greater generally provide Reclamation sufficient operational flexibility to manage water temperature conditions in the upper Sacramento River. When Shasta Reservoir levels drop below 1.9 MAF, the cold water pool is rapidly depleted and suitably low water temperatures during critical periods of winter-run chinook spawning and incubation can not be ensured.

Under existing conditions, PROSIM analysis of historical hydrology for the water years 1922 through 1990 indicates Reclamation would reinitiate section 7 consultation pursuant to the Winter-run CVP-OCAP BO in 8.7 percent of the water years (i.e. 1924, 1931, 1932, 1933, 1934, 1977) due to critically dry hydrological conditions and/or Shasta carryover storage levels below the 1.9 MAF. The PROSIM analysis of this same time period adjusted to a future 2020 level of water development indicates that under both existing operations the proposed action, Reclamation would be required to reinitiate section 7 consultation in 14.5 percent of the water years (i.e. years 1924, 1929, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1977). This increase of 5.8 percent in the frequency of reinitiated consultations does not differ between the proposed action and current operations, because reduced Shasta Reservoir carryover storage levels are also a result of Reclamation's 2020 water delivery projections. Both the proposed action analysis based on current operations assume Reclamation's deliveries increase in the year 2020 by 320,000 AF annually to M&I water service contracts and water rights allocations north of the Delta and 40,000 AF annually to agricultural service contracts north of the Delta. Thus, the proposed action is not expected to increased the frequency of carryover storage levels in Shasta dropping below the 1.9 MAF (relative to the no action alternative).

b. Temperature criteria

The second measure for assessing potential impacts to winter-run chinook presented in the TRMFR DEIS is evaluation of violations of the temperature criteria established in the Winter-run CVP-OCAP BO. Based on the results of Reclamation's monthly temperature model with the years with reinitiation of consultation removed, the percentage of months with violations increases from 9.3 percent under the no action alternative to 14.3 percent in the proposed action. Under existing conditions, the model estimates 9.3 percent of the months would have temperature criteria violations. The 5.0 percent increase in violations of the temperature criteria appears to be related to the revised timing of exports from the Trinity River to the Sacramento River. All Trinity Basin exports pass through the Clear Creek Tunnel and Whiskeytown Reservoir prior to release into the Sacramento River. The proposed action includes a timing shift in the export schedule from spring/summer to the summer/autumn for the purpose of maintaining cold water reserves in Trinity Reservoir.

The spring/summer pattern for exporting water from the Trinity Basin to the Sacramento Basin in existing conditions and the no action alternative benefits winter-run chinook temperature management in two primary ways. First, by exporting Trinity Basin water early in the irrigation season, Shasta Reservoir storage levels are maintained at higher levels and the resulting larger coldwater reserves in Shasta Lake are available for use in the Sacramento River during the late summer and autumn. Second, exporting Trinity Basin water during the spring/summer results in water moving quickly through Whiskeytown Reservoir and minimizes the warming of Whiskeytown Lake. Under the existing conditions and no action alternative schedules, the majority of the annual diversion volume from the Trinity Basin is moved across to the Sacramento River early, Whiskeytown Reservoir remains relatively cool during this period, and thus, Trinity Basin exports do not adversely affect temperature conditions in the upper Sacramento River.

In the proposed action, the timing of Trinity Basin exports to the Sacramento River is shifted to later in the season. Lower volumes of Trinity Basin water will move through Whiskeytown Reservoir during the spring/summer resulting in an increase in retention time and allow for greater warming of the waters in Whiskeytown. Once Whiskeytown Reservoir has warmed up, summer/autumn Trinity Basin exports to the Sacramento River will also warm as they pass through Whiskeytown. The modified schedule in the proposed action delays the majority of exports to the summer/autumn period when Whiskeytown Reservoir will have warmed considerably. Reclamation's temperature model predicts the modified export schedule in the proposed action will increase the number of violations of the temperature criteria established in the Winter-run CVP-OCAP BO.

The revised Trinity Basin diversion schedule to the Sacramento River was designed to provide temperature-related benefits for Trinity River salmonids and ensure compliance with the Trinity River temperature objectives at Douglas City Bridge and the confluence with the North Fork of the Trinity River. Although not part of the proposed action, use of Trinity Dam auxiliary outlets to improve temperature conditions in the Trinity River was also evaluated in the TRMFR DEIS (Water Resources/Quality, Appendix A). Based on the results of this analysis, it appears that temperature benefits in the Trinity River can also be achieved under all alternatives if the auxiliary bypass outlets on Trinity Dam are used from July through October. Modeling predicts the direct temperature benefit to the Sacramento River is minimal under this operational scenario. However, if the auxiliary outlets on Trinity Dam can be used to meet Trinity River temperature objectives, Reclamation would have additional flexibility in the timing of the diversion schedule to the Sacramento River. In fact, the results of temperature model runs that incorporated the use of auxiliary bypasses under existing conditions and the no action alternative indicated that Trinity River temperature criteria can be achieved in 96 percent and 95 percent of the time, respectively, without altering the timing of Trinity exports to the Sacramento River (Kamman 2000). This analysis suggests a combination of using the auxiliary outlet to pass cold water to the Trinity River for Trinity temperature objectives and an intermediate version of the Trinity Basin diversion schedule for Sacramento River temperature control would provide for temperature compliance in both basins in most years. A drawback to the auxiliary outlet releases is a loss in power generation at Trinity Dam.

c. Temperature-related salmon mortality

The third measure of potential effects is Reclamation's salmon mortality model. This model estimates the proposed action will increase temperature-related losses of the early life stages of winter-run chinook salmon by an average of approximately 2 percent when compared to current operations. Review of the annual mortality values for the period of 1922 to 1990 indicates that the estimated mortality of winter-run chinook salmon under the proposed action increases from current operations by less than 1 percent in 63 of 69 years modeled (≈ 91 percent) (June 13, 2000, facsimile transmittal from T. Hamaker, CH2M HILL, to G. Stern, NMFS). The remaining 6 years (≈ 9 percent) are dry and critically dry years with annual estimated mortality increases of 4, 5, 17, 52, and 64 percent. All 6 of these water years with an estimated mortality increase of greater than 1 percent meet the Winter-Run CVP-OCAP BO's criteria for reinitiation of consultation due to critically dry water year conditions or Shasta Reservoir carryover storage levels below 1.9 MAF. The Winter-run CVP-OCAP BO does not establish temperature criteria for critically dry water years, but does required Reclamation to reinitiate section 7 consultation to develop a year-specific temperature management plan. Upon reinitiation of consultation, Reclamation and NMFS would develop a year-specific temperature control plan based upon the observed winter-run chinook spawning distribution in the upper Sacramento River and designed to maximize use of the limited cold water reserves in Shasta Reservoir. Experience with temperature management in the upper Sacramento River and aerial spawning surveys for winter-run chinook redds will allow for development of a temperature control plan that is likely to keep temperature-related losses to levels significantly less than the highest estimates projected by Reclamation's model.

d. Trinity minimum carryover storage

During critically dry water years, the proposed action may significantly reduce the volume of Trinity Basin exports to the Sacramento River through the establishment of a new minimum carryover storage objective for Trinity Reservoir. The proposed action assumes that the Trinity Reservoir would be operated to maintain a minimum carryover storage of 600 TAF between water years whereas the no action alternative assumes 400 TAF. In critically dry years, this loss of up to 200 TAF of exports from the Trinity Basin may lower Shasta Reservoir below an important threshold level for Sacramento River temperature control (i.e. depletion of the Shasta coldwater pool) and result in significant increases in mortality of the early life stages of winter-run chinook salmon. Again, in these years Reclamation would be required to reinitiate consultation and year-specific temperature control plans would be developed prior to the first water allocation announcement of the year. However, PROSIM modeling does indicate the loss of up to 200 TAF of exports from the Trinity Basin in critically dry water years reduces Reclamation's ability to provide suitable temperature conditions for winter-run chinook throughout the upper Sacramento River spawning grounds.

e. American River

Flow changes in the lower American River are projected to occur during the summer months under the proposed action. Juvenile winter-run chinook are known to rear during the winter and early spring months in the lowermost reaches of the American River prior to emigration as smolts to the ocean. Since juvenile winter-run chinook salmon are not expected to be present during the summer months, flow changes in the lower American River below Nimbus Dam are not expected to adversely affect conditions for juvenile winter-run chinook salmon in the lower reaches of the American River.

f. Sacramento-San Joaquin Delta

In the Delta changes in X2 locations during February and June are projected by Reclamation's PROSIM model. Juvenile winter-run chinook may be present in the Delta in February, but are not expected to be present during the month of June. A relationship between juvenile salmon survival and X2 has been evaluated, but not established. It is unlikely that the location of X2 within the Sacramento-San Joaquin Delta directly influences the survival of juvenile winter-run chinook smolts. Changes to X2 location under the proposed action are not likely to adversely affect winter-run chinook salmon.

2. Central Valley Spring-run Chinook Salmon

a. Temperature-related salmon mortality

Reclamation's salmon mortality model estimates that the annual temperature-related losses of the early life stages of spring-run chinook salmon in the upper Sacramento River will remain unchanged between the proposed action and the no action alternative (Table 3-15, TRMFR DEIS). Based on this information, the proposed action is not likely to adversely affect threatened Central Valley spring-run chinook salmon in the upper Sacramento River.

b. American River

Flow changes in the lower American River are projected to occur under the proposed action during the summer months. Juvenile spring-run chinook may rear during the winter and spring months in the lowermost reaches of the American River prior to emigration as smolts to the ocean. Since juvenile spring-run chinook salmon are not expected to be present during the summer months, reduced summer flows in the lower American River below Nimbus Dam are not expected to adversely affect conditions for juvenile spring-run chinook salmon in the lower reaches of the American River.

c. Sacramento-San Joaquin Delta

In the Delta changes in X2 locations during February and June are projected by Reclamation's PROSIM model. A relationship between juvenile salmon survival and X2 has been evaluated, but not established. It is unlikely that the location of X2 within the Sacramento-San Joaquin Delta directly influences the survival of juvenile spring-run chinook smolts. Changes to X2 location under the proposed action are not likely to adversely affect Central Valley spring-run chinook salmon in the Sacramento-San Joaquin Delta.

3. Central Valley Steelhead

a. Temperature-related salmon mortality

Reclamation's salmon mortality model estimates the average annual temperature-related losses of the early life stages of steelhead in the upper Sacramento River will remain unchanged between the proposed action and the no action alternative (Table 3-15, TRMFR DEIS). Based on this information, the proposed action is not likely to adversely affect threatened Central Valley steelhead in the upper Sacramento River.

b. American River

Under both existing conditions and the no action alternative, streamflow and temperature conditions can vary widely in the lower American River below Nimbus Dam depending on water year type. The proposed action and associated changes in CVP operations may result in changes in Folsom Reservoir storage. Reduced storage levels in Folsom Reservoir may adversely affect juvenile Central Valley steelhead rearing within the lower American River as a result of reduced summer flow conditions and increased water temperatures.

Some information regarding potential temperature-related impacts from the proposed action to steelhead in the American River is available in the PEIS for the CVPIA (DOI 1999). Among several assumptions in the PROSIM modeling for the PEIS, the CVPIA alternatives assume increased flows to the Trinity River that closely resemble the proposed action (flows ranging from 390,000 AF/year to 750,000 AF/year). In addition, the CVPIA alternatives assume implementation of re-operation and preliminary (b)(2) Water Management actions.

On the American River, simulated water temperatures under the CVPIA alternatives increased between June and September due to reduced flows and other CVP operational changes (see DOI 1999). These elevated water temperature conditions were identified as an adverse impact to steelhead in the PEIS. The source of these reduced summer flows and elevated temperatures appears to be related to implementation of reoperation and (b)(2) Water Management. One of the primary goals of reoperation and (b)(2) Water Management in the CVPIA alternatives are to increase Folsom Lake September end-of-water year storage, and provide higher, more stable fall and winter flows in the American River. Under the CVPIA alternatives, average end-of-water year storage in Folsom Reservoir increases by about 80,000 AF per year in an attempt to meet these fall and winter fishery flow targets (CVPIA PEIS, Technical Appendix Volume Two). Thus, it appears reduced summer flows and elevated temperature conditions on the American River described in the CVPIA alternatives are primarily related to reoperation and (b)(2) Water Management, not the proposed action on the Trinity River.

Management of water temperature and streamflow conditions for steelhead and chinook salmon in the Lower American River by Reclamation is currently performed in coordination with the state and federal fishery agencies through the American River Operations Group. The American River Operations Group is comprised of representatives of Reclamation, USFWS, NMFS, the California Department of Fish and Game, and the California Department of Water Resources. This group assists Reclamation with operational decisions related to reservoir releases and management of the temperature shutters on the penstocks at Folsom Dam. Manipulation of releases and the temperature shutters allows for optimization of the cold water pool in Folsom Reservoir during temperature sensitive periods including the summer steelhead rearing season and the fall-run chinook spawning period. In addition to the American River Operations Group, the Anadromous Fish Restoration Program (b)(2) Interagency Team works with Reclamation to manage the use of CVPIA (b)(2) water in the American River for the benefit of anadromous fish. The American River Operations Group and the (b)(2) Interagency Team work in close coordination on a real-time basis. Through the efforts of these two groups, potential adverse effects to Central Valley steelhead associated with the proposed action are likely to be insignificant.

c. <u>Sacramento-San Joaquin Delta</u>

In the Delta changes in X2 locations during February and June are projected by Reclamation's PROSIM model. Juvenile steelhead may be present in the Delta in February, but are not expected to be present during the month of June. A relationship between juvenile steelhead survival and X2 has not been established. It is unlikely that the location of X2 within the

Sacramento-San Joaquin Delta directly influences the survival of juvenile steelhead smolts in the Delta. Changes to X2 location under the proposed action not likely to adversely affect Central Valley steelhead in the Sacramento-San Joaquin Delta.

F. Summary of Effects - Central Valley Listed Species

To evaluate the effects of the proposed action on Central Valley listed species, operational changes at CVP facilities and associated streamflow and water temperature conditions were examined. Potential indirect adverse effects to Central Valley listed species in the upper Sacramento River due to implementation of the proposed action are temperature-related stress and mortality below Keswick Dam during the winter-run chinook salmon spawning and incubation season (April through September). Temperature conditions in the upper Sacramento River were evaluated by three different measures: (1) estimated carryover storage conditions in Shasta Reservoir; (2) estimated temperature conditions in the upper Sacramento River; and (3) estimated mortality levels of the early life stages of chinook salmon and steelhead.

In summary, the indirect adverse effects of the proposed action to winter-run chinook are related to reducing Reclamation's ability to comply with the temperature criteria in the RPA of the Winter-run CVP-OCAP BO. With the exception of critically dry water years, the modified schedule for Trinity Basin exports to the Sacramento River results in a 5.0 percent increase in number of months that violations of the winter-run temperature criteria occur. Most of these violations are slight exceedances (less than 1.0°F) from the 56°F (mid-April through September) or 60°F (October) temperature criteria. Based on the salmon mortality model, these violations increase losses of the early life stages of winter-run chinook by less than 1 percent in 91 percent of the water years. These increases in losses are small compared to current operations and may be within the limits of precision of Reclamation's model used for estimation (TRMFR DEIS, Appendix B). In critically dry years (defined as the driest 10 percent of water years), and absent any additional measures to reduce impacts, Reclamation's model estimated that increases in losses of winter-run chinook salmon eggs and alevins ranged from 4 to 64 percent. Pursuant to the RPA in the Winter-run CVP-OCAP BO, Reclamation would be required to reinitiate consultation in these critically dry water years and year-specific temperature control plans would be developed to optimize use of Shasta coldwater reserves. Through the development of a year-specific plan based upon the observed winter-run spawning distribution, temperature-related losses in critically dry years are likely to be considerably lower than that estimated by Reclamation's model. The diminished CVP operational flexibility to address temperature criteria in the Sacramento River resulting from implementation of the proposed action is not expected to appreciably reduce the likelihood of both survival and recovery of Sacramento River winter-run chinook salmon in the wild. Similarly, the value of critical habitat for both the survival and recovery of Sacramento winter-run chinook salmon will not be appreciably diminished.

Reclamation's salmon mortality model estimates the annual temperature-related mortality of the early life stages of spring-run chinook salmon and steelhead will remain unchanged between the proposed action and the no action alternative. In addition, changes in American River summer flow and temperatures conditions resulting from the proposed action are likely to be minor and changes in the location of X2 in the Delta will not directly influence smolt survival. Based on the best available information, the proposed action is not likely to adversely affect threatened Central Valley spring-run chinook salmon or steelhead, or appreciably diminish the value of critical habitat for both the survival and recovery of these fish.

## V. Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." For the purposes of this analysis, the action area in the Trinity Basin encompasses the Project and downstream aquatic habitat below Lewiston Dam in the Trinity and Klamath rivers. In the Central Valley, the action area includes the following: the Sacramento River downstream of Keswick Dam to the Sacramento/San Joaquin Delta; Clear Creek downstream of Whiskeytown Dam to its confluence with the Sacramento River; the American River downstream of Nimbus Dam to its confluence with the Sacramento River; and the Sacramento-San Joaquin Delta.

### A. Trinity Basin

Non-Federal actions that may affect the Trinity Basin action area include State angling regulation changes, voluntary State or privately sponsored habitat restoration activities, agricultural practices, timber harvest and related activities, water withdrawals/diversions, potential population growth, and mining. The dominant land-use activities on non-federal lands adjacent to the action area are forestry and other types of resource development activities. Significant improvements in SONCC coho salmon production within non-Federal lands are unlikely without changes in forestry and other practices that occur in riparian areas.

Now that SONCC coho salmon are listed as threatened, the NMFS is hopeful that non-Federal land owners will recognize the need to take steps to curtail or avoid land management practices that may result in potential unauthorized take of listed coho salmon. For actions on non-Federal lands which the land owner or administering non-Federal agency believes are likely to result in adverse effects to SONCC coho salmon or their habitat, the land owner or agency should contact NMFS regarding the appropriate section 10 incidental take permits, which require submission of Habitat Conservation Plans. If an incidental take permit is requested, NMFS would seek appropriate measures to avoid or minimize adverse affects and taking of listed and proposed anadromous fish.

Until improvements in non-Federal land management practices and other activities are actually implemented, the NMFS assumes that future private and State actions will continue at similar intensities as in recent years. Given the degraded environmental baseline for listed and proposed Pacific salmonids, actions that do not lead to improvement in habitat conditions over time could contribute to species extinctions.

Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or have been) reviewed through separate section 7 consultation processes. In addition, non-Federal actions that require authorization under section 10 of the ESA will be considered in the environmental baseline for future section 7 consultations.

B. Central Valley

Non-Federal actions that may affect the Central Valley action area include State angling regulation changes, voluntary State or private sponsored habitat restoration activities, State hatchery practices, agricultural practices, water withdrawals/diversions, increased population growth, mining activities, and urbanization. State angling regulations are generally moving towards greater restrictions on sport fishing to protect listed fish species. Habitat restoration projects may have short-term negative effects associated with in-water construction work, but these effects are temporary, localized, and the outcome is a benefit to these listed species. State hatchery practices may have negative effects on naturally produced salmonids through genetic introgression, competition, and disease transmission resulting from hatchery introductions. Farming activities within or adjacent to the action area may have negative effects on Sacramento River water quality due to runoff laden with agricultural chemicals. Water withdrawals/diversions may result in entrainment of individuals into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, gravel recruitment and transport of large woody debris. Future urban development and mining operations in the action area may adversely affect water quality, riparian function, and stream productivity. Future land conservation and habitat restoration activities expected in the action area, such as those planned by the ongoing CALFED process, are anticipated to offset many of the adverse effects associated with these non-Federal actions.

## VI. Conclusion

A. Trinity Basin

After reviewing the current status of SONCC coho salmon, the environmental baseline for the action area, the effects of the proposed action (i.e., the TMFR DEIS Preferred Alternative), and cumulative effects, it is NMFS' biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of SONCC coho salmon. The NMFS has also determined that the action, as proposed, is not likely to destroy or adversely modify critical habitat for the SONCC coho salmon.

B. Central Valley

After reviewing the current status of Central Valley listed species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run chinook salmon, Central Valley spring-run chinook salmon, or Central Valley steelhead. The NMFS has also determined that the action, as proposed, is not likely to destroy or adversely modify critical habitat for these species.

## VII. 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. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not 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 this incidental take statement.

A. SONCC coho salmon

1. Amount or Extent of Take Anticipated

The NMFS does not anticipate that implementation of the proposed flow schedules will incidentally take any SONCC coho salmon. The NMFS does anticipate that SONCC coho salmon habitat adjacent to and downstream of the 47 channel rehabilitation projects may be temporarily degraded due to localized turbidity and potential fine sedimentation of channel substrate during construction activities. However, the amount of habitat temporarily degraded due to these localized effects is negligible compared to the long-term creation of additional suitable habitat along approximately 40 miles of the Trinity River. Although placement of spawning gravel in the Trinity River may temporarily displace (harass) an unknown number of juvenile coho salmon to alternative habitats, this is not expected to result in lethal take of these fish.

2. Effect of the Take

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

B. Central Valley Listed Anadromous Salmonids

1. Amount or Extent of Take

The NMFS does not anticipate that the implementation of the proposed action will incidentally take Central Valley spring-run chinook salmon or Central Valley steelhead. Reclamation's salmon mortality model estimates the annual temperature-related mortality of the early life stages of spring-run chinook salmon and steelhead will remain unchanged between the proposed action and the no action alternative.

The NMFS anticipates that implementation of the proposed action will result in a minute increase in the level of Sacramento River winter-run chinook salmon incidentally taken through temperature-related losses in the upper Sacramento River in all years except critically dry water years (defined as the driest 10 percent of water years). Reclamation's salmon mortality model estimates temperature-related losses of the early life stages of winter-run chinook will increase by less than 1 percent in 91 percent of water years. In the critically dry years, and absent any additional measures to reduce impacts, increases in losses of winter-run chinook eggs and alevins were estimated by Reclamation's model to range from 4 to 64 percent. Pursuant to the RPA in the Winter-run CVP-OCAP BO, Reclamation would be required to reinitiate consultation in these critically dry water years and year-specific temperature control plans would be developed to optimize use of Shasta coldwater reserves. Through the development of a year-specific plan based upon the observed winter-run spawning distribution, temperature-related losses in critically dry years are likely to be considerably lower than that estimated by Reclamation's model.

2. Effect of the Take

In the accompanying biological opinion, the NMFS determined that this level of anticipated take is not likely to result in jeopardy to Sacramento River winter-run chinook salmon.

C. Reasonable and Prudent Measures

The NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of SONCC coho salmon and Sacramento River winter-run chinook salmon.

The USFWS and Reclamation shall:

1. Implement the flow regimes included in the proposed action (as described in TRMFR DEIS, page 2-19, Table 2-5) as soon as possible;

2. Ensure that the NMFS is provided the opportunity to be represented during implementation of the Adaptive Environmental Assessment and Management Program;

3. Ensure that the replacement bridges and other infrastructure modifications, needed to fully implement the proposed flow schedule, are designed and completed as soon as possible;

4. Periodically coordinate with the NMFS during the advanced development and scheduling of the habitat rehabilitation projects described in the TRMFR DEIS;

5. Complete "the first phase of the channel rehabilitation projects" (USFWS and BOR 2000) in a timely fashion;

6. Implement emergency consultation procedures during implementation of flood control or "safety of dams" releases from Lewiston Dam to the Trinity River;

7. In dry and critically dry water year types, Reclamation and USFWS shall work cooperatively with the upper Sacramento River Temperature Task Group to develop temperature control plans that provide for compliance with temperature objectives in both the Trinity and Sacramento rivers.

D. Terms and Conditions

The USFWS and Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1.a. Following completion of the Record of Decision addressing the proposed action, Reclamation shall immediately implement the components of the proposed flow schedule (as described in the TRMFR DEIS, page 2-19, Table 2-5) equal to or less than 6,000 CFS, and implement the entire flow schedule as soon as possible (i.e., after infrastructure modifications are completed);

1.b. As necessary infrastructure modifications are made, Reclamation shall incrementally implement higher Trinity River flows (consistent with the proposed flow regime), e.g., potentially releasing up to 8,500 CFS after some bridge modifications, but prior to completion of the "Bucktail" and "Poker Bar" bridge replacements (see USFWS and BOR [2000]);

1.c. Reclamation shall provide two reports per year detailing flows released into the Trinity River below Lewiston Dam; reports will be provided to the NMFS (1655 Heindon Road, Arcata, CA 95521) by August 31, and March 31, annually;

2.a. The USFWS and Reclamation shall provide the opportunity for full NMFS participation on the technical team ('designated team of scientists' [USFWS and BOR 2000], 'technical modeling and analysis team' [TRMFR DEIS]) offering restoration program recommendations, and on the Trinity Management Council policy group (described in the TRMFR DEIS and USFWS and BOR [2000]);

3.a. The replacement bridges and other infrastructure modifications needed to fully implement the proposed flow schedules shall be completed by the end of calendar year 2002 (consistent with the schedule outlined in USFWS and BOR [2000]);

4.a. The USFWS and/or Reclamation shall meet with the NMFS annually in March to coordinate during the advanced development and scheduling of habitat rehabilitation projects, including mainstem channel rehabilitation projects, sediment augmentation program, and dredging of sediment collection pools;

4.b. The USFWS and/or Reclamation shall provide for review of individual mainstem channel rehabilitation projects via the technical team ('designated team of scientists' [USFWS and BOR 2000], 'technical modeling and analysis team' [TRMFR DEIS]) or equivalent group, and provide a written recommendation to the NMFS whether the projects are similar to those described in the TRMFR DEIS and should be covered by this incidental take statement; if the technical team determines that these projects and their impacts to aquatic habitat are substantially different than described in the TRMFR DEIS and USFWS and BOR (2000), the technical team will recommend to the NMFS that additional ESA section 7 consultation is appropriate;

5.a. The USFWS and Reclamation shall complete the "first phase of the channel rehabilitation projects" (USFWS and BOR 2000) (i.e., '24 channel projects' [TRMFR DEIS]) within 3 years of issuance of the Record of Decision;

6.a. Reclamation shall initiate emergency consultation procedures during implementation of any flood control or "safety of dam" releases, pursuant to 50 CFR §402.05;

7.a. Be prepared to make use of the auxiliary bypass outlets on Trinity Dam as needed, and pursuant to reinitiation of ESA section 7 consultation regarding Sacramento River Winter-run chinook salmon, to protect water quality standards; associated actions may include modification of the export schedule of Trinity Basin diversions to the Sacramento River.

7.b. In years that Reclamation has reinitiated consultation pursuant to criteria established in the Winter-run chinook salmon CVP-OCAP BO, evaluate drawdowns of Trinity Reservoir below the 600 TAF minimum end-of-water year carryover level to the extent needed to avoid significant temperature-related loss of the early life stages of winter-run chinook salmon (> 10% as predicted by Reclamation's Salmon Mortality Model). Implementation of drawdowns below the 600 TAF minimum end-of-year carryover level in Trinity Reservoir shall be determined by Reclamation, USFWS, and NMFS on a case-by-case basis in dry and critically dry water years.

## VIII. Conservation Recommendations

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

1. The USFWS and Reclamation should make every effort to ensure that the entire Mainstem Trinity River Restoration Program is funded and implemented.

## IX. Reinitiation Notice

This concludes formal consultation and reinitiation of consultation on the actions outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the actions has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of agency actions that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

The analyses in the TRMFR DEIS, and consequently this opinion, are based on several key assumptions. These include the expectations that: (1) the flow schedules will be fully implemented in a timely fashion; (2) the habitat rehabilitation projects will be completed; and (3) the adaptive management program will be implemented as described in the TRMFR DEIS. This list is not exhaustive. If these assumptions are violated for whatever reason (e.g., lack of funding), the USFWS, Reclamation, or the NMFS may determine that reinitiation of ESA section 7 consultation is appropriate.

## X. Literature Cited


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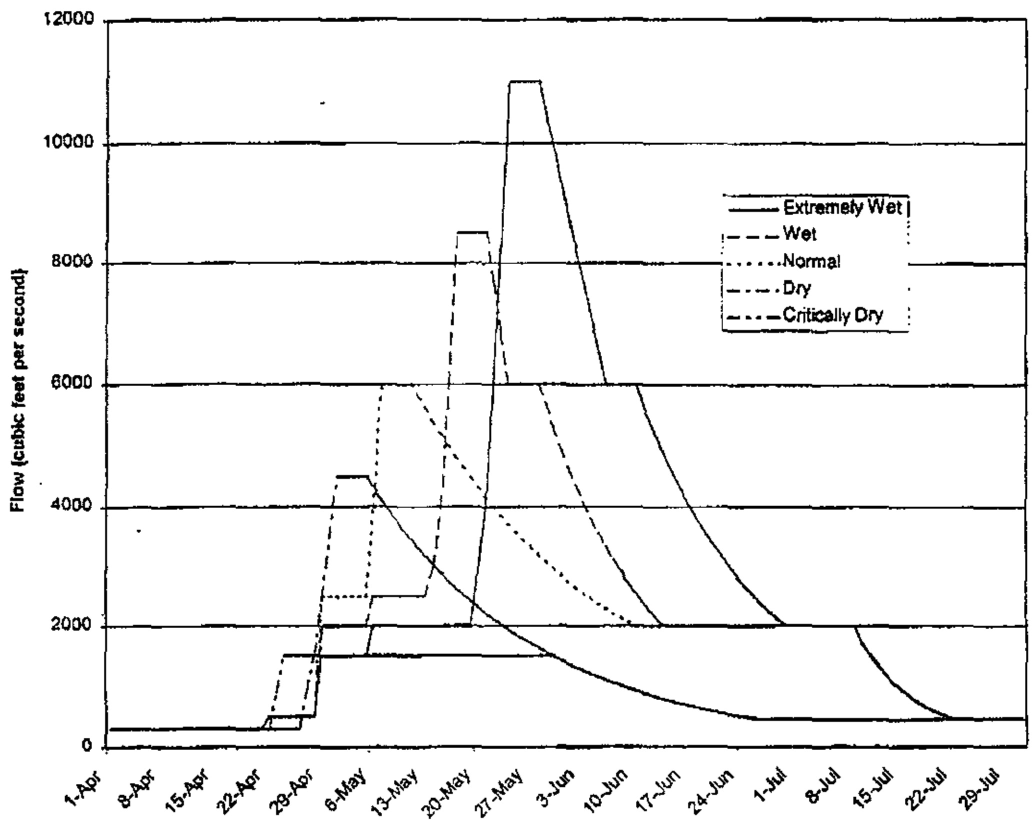


Figure 1. Proposed annual Trinity River hydrographs for each water year class: Extremely Wet, Wet, Normal, Dry, and Critically Dry. For all hydrographs, the proposed release from Lewiston Dam is 300 CFS from October 16 to April 8 and 450 CFS from August 1 to October 15. Data are from USFWS and HVT (1999).