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

In Reply Refer To:
151422SWR04SA9116:BFO

OCT 22 2004

Mr. Chester V. Bowling
Operations Manager
U.S. Bureau of Reclamation
Central Valley Operations Office
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Mr. Carl Torgersen
California Department of Water Resources
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Dear Messrs. Bowling and Torgersen:

This letter transmits the National Marine Fisheries Service's (NOAA Fisheries) biological opinion (Enclosure 1) on the effects of the proposed long-term operations, criteria and plan (OCAP) for the Central Valley Project (CVP) in coordination with operations of the State Water Project (SWP), hereinafter referred to as the Project, on Federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*O. kisutch*), and threatened Central California Coast (CCC) steelhead (*O. mykiss*) and their designated habitat in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*). Your letter dated March 15, 2004, initiated formal consultation. A draft biological assessment was provided to us by the Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) on March 23, 2004 with revised versions provided on May 24, 2004 and June 30, 2004.

Based upon the best available scientific and commercial information available, the current status of the species, the environmental baseline for the action area, and our analysis of the effects of the proposed action, including cumulative effects, NOAA Fisheries has determined that the Project, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, SONCC coho salmon, or CCC steelhead, or result in the destruction or adverse modification of designated critical habitat for Sacramento River winter-run Chinook salmon or SONCC coho salmon.

In addition, our preliminary conclusions based on early consultation regarding the effects of prospective actions to implement Project Integration and the South Delta Improvement Program (SDIP) are that including these prospective actions in the Project is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, SONCC coho salmon, or CCC steelhead, or result in the destruction or adverse modification of designated critical habitat for Sacramento River winter-run Chinook salmon or SONCC coho salmon. When Reclamation and DWR are prepared to implement these prospective actions, you must request in writing that NOAA Fisheries confirm our preliminary biological opinion as a final biological opinion. Because this is an early consultation, Reclamation and DWR are not exempt from the take prohibitions of section 9 of the ESA on prospective actions considered in the preliminary biological opinion. Instead, the preliminary biological opinion provides Reclamation and DWR with the foreknowledge of the likely effects of the prospective actions and terms and conditions that will be required if prospective actions are implemented.

Because incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring- run Chinook salmon, and Central Valley steelhead is expected, an incidental take statement is included with the biological opinion for the Project and a preliminary incidental take statement is included with the preliminary biological opinion on the prospective actions to implement project integration and the SDIP. These incidental take statements identify specific terms and conditions that Reclamation and DWR must comply with to minimize take of listed salmonids resulting from implementing the long-term CVP and SWP operations, criteria and plan, and the prospective actions to implement project integration and the SDIP.

The enclosed biological opinion supercedes all previous OCAP biological opinions for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead issued by NOAA Fisheries.

Also enclosed are Essential Fish Habitat (EFH) Conservation Recommendations (Enclosure 2) as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*). These recommendations are designed to conserve and enhance the EFH of starry flounder (*Platichthys stellatus*) managed under the Pacific Groundfish fishery management plan (FMP) and fall/late-fall run Chinook salmon (*O. tshawytscha*) managed under the Pacific Salmon FMP.

NOAA Fisheries finds that the Project will affect the EFH of starry flounder and Pacific Salmon within the action area and have included EFH Conservation Recommendations to avoid or minimize these effects. Section 305(b)(4)(B) of the MSA requires that Reclamation and DWR provide NOAA Fisheries with a detailed written response within 30 days to these EFH Conservation Recommendations, including a description of measures adopted for avoiding, minimizing, or mitigating the impact of the proposed action on EFH (50 CFR 600.920(j)). In the case of a response that is inconsistent with NOAA Fisheries' recommendations, Reclamation and DWR must explain the reason for not following the recommendations, including the scientific justification for any disagreements with NOAA Fisheries over the anticipated effects of the Project and the measures needed to avoid, minimize, or mitigate such effects.

If you have any questions concerning these consultations, please contact Mr. James H. Lecky in our Long Beach Office, 501 West Ocean Boulevard, Suite 4200, Long Beach, CA 90802. Mr. Lecky may be reached by telephone at (562) 980-4015 or by FAX at (562)-980-4027.

Sincerely,

Rodney R McInnis

Rodney R. McInnis
Regional Administrator

Enclosures

cc:

Mr. Kirk C. Rogers, Regional Director, U.S. Bureau of Reclamation, 2800 Cottage Way Sacramento, CA 95825-1898
Mr. Frank Michny, Regional Environmental Officer, U.S. Bureau of Reclamation, 2800 Cottage Way, Sacramento, CA 95825-1898
Ms. Barbara McDonnell, California Department of Water Resources, Environmental Services Office, 3251 S Street, Room 111, Sacramento, CA 95816
Ms. Diana Jacobs, Deputy Director, California Department of Fish and Game, 1416 9th Street Sacramento, CA 95814
Mr. Wayne White, U.S. Fish and Wildlife Service, 2800 Cottage Way, Room W-2605, Sacramento, CA 95825

Enclosure 1

Endangered Species Act
Section 7 Consultation

BIOLOGICAL OPINION

on the

LONG-TERM CENTRAL VALLEY PROJECT AND STATE WATER PROJECT OPERATIONS CRITERIA AND PLAN

National Marine Fisheries Service
Southwest Region

October 2004

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(b)(1)	Section 3406, CVPIA pertaining to re-operation of the CVP
(b)(2)	Section 3406, CVPIA pertaining to use of 800 TAF of CVP water
(b)(3)	Section 3406, CVPIA authorizing environmental water acquisitions
8500 Banks	8500 cfs increased pumping at Banks Pumping Plant
95-1WR	SWRCB 1995 Water Quality Control Plan for the Delta
ACID	Anderson-Cottonwood Irrigation District
AFRP	Anadromous Fish Restoration Program
AFSP	Anadromous Fish Screen Program
AROG	American River Operations Group
Article 21 water	interruptible supplies to SWP contractors
ASIP	Action Specific Implementation Plan
BA	biological assessment
Banks	Harvey O. Banks Delta Pumping Plant
B2IT	CVPIA section (b)(2) Interagency Team
BO	biological opinion
BRT	Biological Review Team
CALFED	CALFED Bay-Delta Program
CALFED-OPS	CALFED Operations Group
CALSIM II	current CVP/SWP operations model
CCC steelhead	Central California Coast steelhead
CCDAM	Clear Creek Decision Analysis Model
CCF	Clifton Court Forebay
CCWD	Contra Costa Water District
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNFH	Coleman National Fish Hatchery
COA	Coordinated Operating Agreement
Corps	U.S. Army Corps of Engineers
CRR	Cohort Replacement Rate
CVI	Central Valley Index of salmon abundance
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
CWT	coded wire tag
D-1485	SWRCB 1978 Water Right Decision for the Delta
D-1641	SWRCB 1999 Water Right Decision for the Delta
DAT	Data Assessment Team
DBEEP	Delta-Bay Enhanced Enforcement Program
DCC	Delta Cross Channel
Delta	San Francisco Bay/Sacramento-San Joaquin Delta Estuary
DFG	California Department of Fish and Game
DMC	Delta Mendota Canal

DO	dissolved oxygen
DOI Final Decision	CVPIA Section 3406 (b)(2) Policy Decision
DWR	California Department of Water Resources
E/I	export-to-inflow ratio
EBMUD	East Bay Municipal Utility District
EC	electrical conductivity
EFH	Essential Fish Habitat
EOS	end-of-September
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
EPA	U.S. Environmental Protection Agency
EWA	Environmental Water Account
EWAT	Environmental Water Account Team
EWP	Environmental Water Program
FEIS/EIR	Final Environmental Impact Statement/Environmental Impact Report
FERC	Federal Energy Regulatory Commission
FPEIS	Final Programatic Environmental Impact Statement
FMP	Fishery Management Plan
Four-Pumps Agreement	Fish Protection Agreement 1986 between DWR and DFG
FRH	Feather River Hatchery
FRTT	Feather River Technical Team
FRWA	Freeport Regional Water Authority
FRWP	Freeport Regional Water Project
FWCA	Fish and Wildlife Coordination Act
FWS	U.S. Fish and Wildlife Service
GCID	Glen-Colusa Irrigation District
HCP	Habitat Conservation Plan
HFC	High Flow Channel
HSC	Habitat Suitability Curve
IEP	Interagency Ecological Program
IFIM	Instream Flow Incremental Methodology
IHNV	infectious hematopoietic necrosis virus
Interior	U.S. Department of the Interior
JPOD	Joint Point of Diversion
K	fish condition factor
LAR	Lower American River
LFC	low flow channel
LMMWC	Los Molinos Mutual Water Company
LOD	Level of Development
LSNFH	Livingston Stone National Fish Hatchery
LWD	large woody debris
M&I	Municipal and Industrial water supplies
MAF	million acre-feet
MGD	million gallons per day
MIDS	Morrow Island Distribution System

MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSA	Magnuson-Stevens Fisheries Conservation and Management Act
MSL	mean sea level
NCCPA	Natural Community Conservation Planning Act
NEPA	National Environmental Policy Act
NFH	Nimbus Fish Hatchery
NMIPO	New Melones Interim Plan of Operations
NOAA Fisheries	National Marine Fisheries Service
OCAP	Operations, Criteria and Plan
OCID	Orange Cove Irrigation District
OFF	Operations and Fish Forum
OID	Oakdale Irrigation District
PCWA Placer	County Water Agency
PDO	Pacific Decadal Oscillation
PFMC	Pacific Fisheries Management Council
PHABSIM	Physical Habitat Simulation Model
Project	CVP and SWP long-term operations
PTM	Particle Tracking Model
QWEST	San Joaquin River flow past Jersey Point
RBDD	Red Bluff Diversion Dam
RD	Reclamation District
Reclamation	U.S. Bureau of Reclamation
RM	river mile
ROD	Record of Decision
RSI	Relative Suitability Index
RST	rotary screw trap
RWQCB	Regional Water Quality Control Board
SAFCA	Sacramento Area Flood Control Agency
SCDD	Spring Creek Debris Dam
SCWA	Sacramento County Water Agency
SCE	Southern California Edison Company
SDIP	South Delta Improvement Program
SFPF	Skinner Fish Protection Facility
SJRA	San Joaquin River Agreement
SJTC	San Joaquin Technical Committee
SLR	San Luis Reservoir
SMSCG	Suisun Marsh Salinity Control Gates
SMUD	Sacramento Municipal Utilities District
SPCA	S.P. Cramer and Associates
SRTTG	Sacramento River Temperature Task Group
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
SWRCB	California State Water Resources Control Board
SWRI	Surface Water Resources, Incorporated
TAF	thousand acre-feet

TCCA	Tehama-Colusa Canal Authority
TCD	temperature control device
TDS	total dissolved solids
TPP	Tracy Pumping Plant
TFCF	Tracy Fish Collection Facility
TRH	Trinity River Hatchery
TRMFR Program	Trinity River Mainstem Fishery Restoration Program
USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Plan
VSP	Viable Salmonid Population guidelines
WAP	Water Acquisition Program
WAPA	Western Area Power Administration
WOMT	Water Operations Management Team
WQCP	Water Quality Control Plan
WRO	Sacramento River winter-run Chinook salmon biological opinion (NOAA Fisheries 1993, as amended)
WUA	weighted usable area
WY	water year
X2	the distance from the Golden Gate Bridge to the location where salinity in the Delta is 2 parts per thousand
YOY	young-of-the-year

BIOLOGICAL OPINION

AGENCY: U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, California

ACTIVITY: Long-term Central Valley Project and State Water Project Operations Criteria and Plan

CONSULTATION
CONDUCTED BY: National Marine Fisheries Service, Southwest Region

DATE ISSUED: October 22, 2004

I. INTRODUCTION

This document is the National Marine Fisheries Service's (NOAA Fisheries) biological opinion on Central Valley Project (CVP) and State Water Project (SWP) long-term operations as described in the Long-term CVP and SWP Operations, Criteria, and Plan (OCAP) Biological Assessment (BA), hereinafter referred to as the Project, on federally-listed endangered as Sacramento River winter-run Chinook salmon (winter-run Chinook salmon; *Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (CV spring-run Chinook salmon; *O. tshawytscha*), threatened Southern Oregon/Northern California Coast coho salmon (SONCC coho salmon; *O. kisutch*), threatened Central Valley steelhead (CV steelhead; *O. mykiss*), threatened Central California Coast steelhead (CCC steelhead, *O. mykiss*), and critical habitat for Sacramento River winter-run Chinook salmon and SONCC coho salmon in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.). The request for formal consultation was received on March 15, 2004. This biological opinion supercedes the 1993 Sacramento River winter-run Chinook salmon biological opinion (WRO) for the operation of the Federal CVP and California SWP (NOAA Fisheries 1993a), as amended on August 2, 1993, October 6, 1993, December 30, 1994, May 17, 1995, and August 18, 1995, and all previous interim and supplemental OCAP biological opinions for the effects of CVP and SWP operations on spring-run Chinook salmon and steelhead.

This biological opinion is based on information provided by the U.S. Bureau of Reclamation (Reclamation) and the State of California Department of Water Resources (DWR) referenced in the following documents: 1) revised long-term OCAP Biological Assessments (BAs) dated June 2003, January 8, 2004, February 13, 2004, March 18, 2004, March 22, 2004, May 24, 2004, and June 30, 2004 (Reclamation 2003a, 2004a,) and letter dated September 14, 2004, to NOAA Fisheries clarifying language contained in the BAs; 2) a letter from DWR letter to Reclamation concerning project integration and early consultation dated March 12, 2004; 3) revised water temperature and salmon mortality model results based on CALSIM studies 4a and 5a dated April 8, 2004; and 4) other supplemental information provided during the consultation period (*e.g.,* the *2002/2003 Salmon Decision Process,* list of CVP contracts and unscreened diversions, cold water cumulative percent curves for May storage in Shasta Reservoir, revised Chinook salmon and steelhead loss estimates for Delta pumping plants, and Iron Mountain Mine remediation since 1993). Weekly meetings involving staff from Reclamation, DWR, NOAA Fisheries, U.S. Fish Wildlife Service (FWS), and the California Department of Fish and Game (DFG) were held to develop the long-term OCAP BA between March 2003 and June 2004. A complete administrative record of this consultation is on file at the NOAA Fisheries, Sacramento Area Office.

Reclamation's facilities and actions to be addressed in the long-term OCAP consultation include: on-going operations at all CVP divisions including the Tracy Pumping Plant and Fish Collection Facility (TFCF), the CVP/SWP Intertie, implementation of the Trinity River Record of Decision (ROD) flows, and operations of the proposed Freeport Regional Water Project. DWR's facilities to be addressed in this consultation include on-going operations of the following: the Oroville-Thermalito Complex, Harvey O. Banks Delta Pumping Plant (Banks), Clifton Court Forebay (CCF), Skinner Fish Protective Facility (SFPF), Northbay Aqueduct, and the Suisun Marsh Salinity Control Gates (SMSCG).

After much discussion between Reclamation and DWR regarding which facilities and actions to be included in the consultation, such as operation and schedule of the permanent barriers (which are a part of the South Delta Improvement Program [SDIP]), it was agreed upon by all agencies involved in the OCAP consultation to divide the project description into two components consisting of *formal consultation* on the effects of on-going operations and facilities mentioned above, combined with an *early consultation*[1] on the effects of future operations in the south Delta region. The following actions have been proposed as part of the *early consultation*: 1) operational components of the South Delta Improvement Program (SDIP) including increased pumping, and permanent barriers; 2) CVP/SWP integration; and 3) a CALFED Bay-Delta Program (CALFED) long-term Environmental Water Account (EWA).

Project operations alter the quantity, timing, and quality of water passing through the Central Valley into the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Delta), thereby affecting the conditions under which juvenile and adult salmonids migrate through the river reaches and spawn and rear downstream of project dams. This biological opinion evaluates the effects of the Project and determines whether those effects are likely to jeopardize the continued existence of the affected ESA-listed salmon and steelhead or result in the destruction or adverse modification of designated critical habitat.

A. Consultation History

Listed in Table 1 below is the consultation history for the Project beginning in 1991. NOAA Fisheries has continued to work with Reclamation, DWR, various CALFED groups, and the

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[1] The purpose of early consultation is to reduce the potential for conflicts between listed species or critical habitat and proposed actions which usually occurs before an applicant files an application for a Federal permit or license, in this case a permit to increase pumping at Banks.

FWS through the CVPIA to minimize impacts associated with project operations and ensure incidental take does not exceed the levels identified in the biological opinions (BOs). However, changes to Project operations occur on a regular basis and have been dealt with by amending existing biological opinions (*e.g.*, 1993, 1994, 1995, and 2002), or through an adaptive process using CALFED groups that allow a degree of flexibility in meeting standards. Starting with the 1993 WRO, the SWP has been included with CVP operations for ESA purposes because the CVP and SWP use a common water supply and common water conveyance system (NOAA Fisheries 1993a). Under the Coordinated Operating Agreement (COA), the CVP and SWP must jointly share in providing water for Sacramento in-basin uses (which includes, Delta standards and other legal uses of water). For the long-term consultation of this Project, Reclamation for the CVP and DWR for the SWP, are considered co-lead agencies.

Table 1. NOAA Fisheries, ESA section 7 Consultation History (1991-2004) for the Project

Date	Species	Consultation Description
2/26/91	WR	NOAA Fisheries requests consultation on Reclamation's CVP operations and plans
2/14/92	WR	Initial biological opinion addressing effects of CVP operations (J)
2/12/93	WR	Long-term OCAP biological opinion addressing effects of both CVP and SWP operations (J)
8/02/93	WR	1st amendment on Red Bluff Diversion Dam (RBDD) Pilot Pumping Program
10/06/93	WR	2nd amendment changed date of RBDD screening requirement
12/30/94	WR	3rd amendment incorporated new Bay-Delta Standards
5/17/95	WR	4th amendment changed Delta flow criteria and increased take limit
8/18/95	WR	5th amendment temporarily changed temperature compliance point
3/27/00	SR, Sthd	1999-2000 Interim OCAP BO (*i.e.*, new species listed)
8/28/00	all	CALFED Bay-Delta Program, Record of Decision (ROD)
10/12/00	all*	Trinity River Mainstem Fishery Restoration biological opinion
11/14/00	all	Central Valley Project Improvement Act (CVPIA) programmatic BO
5/08/01	SR, Sthd	2001-2002 Interim OCAP BO
9/20/02	SR, Sthd	2002-2004 Interim OCAP BO, amends and extends
6/03	all	Preliminary working draft, Long-term OCAP BA
2/27/04	SR, Sthd	2004-2006 Supplemental interim OCAP BO

3/15/04	all	Reclamation initiates consultation with NOAA Fisheries and FWS on a Long-term OCAP and provides a preliminary BA
6/30/04	all	Reclamation issues latest revision Long-term OCAP BA

J = Jeopardy Finding, WR = Sacramento River winter-run Chinook salmon, SR = CV spring-run Chinook salmon, Sthd = CV steelhead, all = all three of the previous species, * = SONCC coho salmon also was included in this consultation

On August 28, 2000, CALFED issued a ROD describing a 30-year program for increasing water supply reliability, restoring the Central Valley ecosystem, improving water quality, and providing for levee system integrity. Recognizing that implementation of the CALFED Restoration Program will result in changes to project operations over the 30-year life of the program, NOAA Fisheries, Reclamation and DWR agreed that a long-term OCAP consultation should be conducted after the CALFED ROD was released. However, considerable modeling and other analysis relative to project operations had to be completed on the yet to be described future programs, especially the EWA and SDIP, before initiating consultation on long-term operations. Therefore, NOAA Fisheries, Reclamation, and DWR agreed to conduct interim consultations for project operations based on current water supply and annual operations forecasts until a long-term modeling methodology and project description could be developed.

From March 2000 to February 2004 (see Table 1), NOAA Fisheries issued interim OCAP biological opinions to Reclamation and DWR that assessed the effects of the CVP/SWP coordinated operations on spring-run and steelhead. Based on the best information available, these short-term biological opinions concluded that project operations were not likely to jeopardize the continued existence of these species, or result in the destruction or adverse modification of designated habitat of these species, however, some incidental take of spring-run and steelhead was anticipated; therefore, take levels for each species were specified in incidental take statements (NOAA Fisheries 2000a, 2001a, 2002a, 2004).

Scoping meetings for the long-term CVP-OCAP consultation began in April 2002. Through interagency discussions, Reclamation, NOAA Fisheries, DWR, FWS, and DFG developed a framework for future long-term operations and project integration using newly-completed CALSIM II modeling studies and other tools.

By letter dated April 2, 2002, NOAA Fisheries extended the 2002-2004 interim OCAP consultation to accommodate review and add clarifying language to the steelhead incidental take statement. In order to provide guidance for the long-term OCAP consultation, NOAA Fisheries provided Reclamation by letter (dated December 19, 2002) with a list of 20 key points or questions that it would like to see addressed in the long-term BA. Reclamation responded with several draft documents which were included in the OCAP preliminary BA and as supplemental information.

In June 2003, Reclamation issued a preliminary working draft of the long-term OCAP BA with the intention of initiating formal ESA consultation in August 2003. However, due to disagreements with DWR concerning the description and implementation of the SDIP, consultation was delayed pending discussions of several proposals concerning water quality and project integration. By letter dated July 15, 2003 (from R. McInnis to C. Bowling) NOAA Fisheries provided Reclamation comments on the June 2003, draft long-term OCAP BA.

In September 2003, DWR in coordination with Reclamation proposed to implement the SDIP consistent with the objectives set forth in the CALFED ROD (CALFED 2000). A Draft action specific implementation plan (ASIP) for the SDIP was completed by DWR in October concurrently with an Administrative Draft Environmental Impact Statement (ADEIS). NOAA Fisheries provided Reclamation with comments (by letter dated November 7, 2003, from R. McInnis to D. Meier) on both the ASIP and ADEIS documents. However, after discussion about the operation of the permanent barriers, it was agreed upon by all agencies involved in the OCAP consultation to divide the project description into two components; 1) *formal consultation* to include the effects of the Trinity River ROD, Freeport Regional Water Project, CVP/SWP Intertie, and 2020 level of development (LOD); and 2) *early consultation* on the additional effects of the SDIP, permanent barriers, project integration, and a long-term EWA.

On February 15, 2004, Reclamation provided NOAA Fisheries a revised working draft of the long-term OCAP BA. By letter dated March 15, 2004, Reclamation initiated formal consultation with NOAA Fisheries for long-term operations of the Project and provided another revised BA with associated water temperature and mortality modeling results. Reclamation requested that the consultation be completed by June 30, 2004, in order to facilitate the renewal of subsequent long-term water service contracts. The fourth revised BA was issued on March 22, 2004, and additional revised water temperature and mortality modeling results were provided to NOAA Fisheries on April 8, 2004.

On March 30, 2004, NOAA Fisheries sent a letter to Reclamation indicating that the latest revision of the long-term OCAP BA was insufficient to allow consultation to be completed without the following information: 1) updated CALSIM II studies describing the effects of *early consultation* actions versus *formal consultation* actions; 2) the number of ESA-listed salmonids lost to unscreened diversions that are a part of CVP long-term water service contracts; 3) the predicted amount of cold water storage available in Shasta Reservoir each May; 4) Delta fish salvage expanded for loss under the new model studies; 5) an Essential Fish Habitat (EFH) assessment; and 6) a final version of the BA. Through April and May 2004, Reclamation worked with the interagency OCAP team to provide this information. On May 25, 2004, Reclamation provided NOAA Fisheries with a revision of the long-term OCAP BA.

For purposes of this opinion all analyses are based on the project description and CALSIM modeling as contained in the OCAP BA dated May 24, 2004, with associated appendices. Reclamation issued a later version of the OCAP BA with appendices on June 30, 2004, and a letter (dated September 15, 2004) with *clarifying language* which containing slight changes to the project description but all modeling results remained unchanged. The differences between the May and June versions of the OCAP BA include the following 1) Trinity River forecasting changed to use of the 50 percent probability of exceedence; 2) additional language on CVP allocations in water needs assessment; 3) additional information on Article 21 water (*i.e.*, interruptible supplies) for SWP contractors; 4) revision of South Delta permanent barrier operations, and 5) revision of Water Forum description under American River operations.

II. DESCRIPTION OF PROPOSED ACTION

The purpose of the proposed action is to continue to operate the CVP and SWP in a coordinated manner to divert, store, and convey Project water consistent with applicable law. In addition to current day operations, several future facilities and actions are to be included in this consultation. These actions are: (1) increased flows in the Trinity River, (2) an intertie between the California Aqueduct (CA) and the Delta-Mendota Canal (DMC), (3) the Freeport Regional Water Project (FRWP), (4) water transfers, and (5) renewal of long term CVP water service contracts. *Early consultation* will address: (1) increased pumping at the SWP Banks Pumping Plant (referred to as 8500 Banks), (2) permanent barriers operated in the South Delta (*i.e.*, proposed as part of the SDIP) and water transfers, (3) a long-term EWA, and (4) various operational changes identified as CVP/SWP project integration. The purpose of the SDIP is to increase water supply south of the Delta, ensure water quality and quantity to agricultural diverters within the south Delta, and to reduce straying of Central Valley fall-run Chinook salmon (*O. tshawytscha*) in the south Delta (SDIP 2003). These proposed actions will come online at various times in the future. Thus, the proposed action is a) continued operation of the CVP/SWP without these actions, and b) operations as they come online.

The future actions listed in the preceding paragraph are not being implemented at present (except for increased flows in the Trinity River); however, they are part of the future proposed action on which Reclamation requested *early consultation*. Only the water operations associated with the proposed activities are addressed in this consultation (*i.e.*, Project activities do not include construction of any facilities to implement the actions). All site-specific/localized activities of the actions such as construction/screening and any other site-specific effects will be addressed in separate action-specific section 7 consultations.

A. Project Action Area

The CVP, administered by Reclamation, is one of the nation's largest water development projects with 20 reservoirs, 500 miles of major canals and aqueducts, and 12 MAF of storage capacity. The SWP, administered by DWR, consists of facilities that store 3.5 MAF of water on the Feather River. Included in this Project is the Trinity River portion of the CVP. The Central Valley Basin of California includes two major watersheds, the Sacramento River to the north, and the San Joaquin River to the south. The combined watersheds encompass an area approximately 500 miles wide in a northwest to southwest direction. The two major river

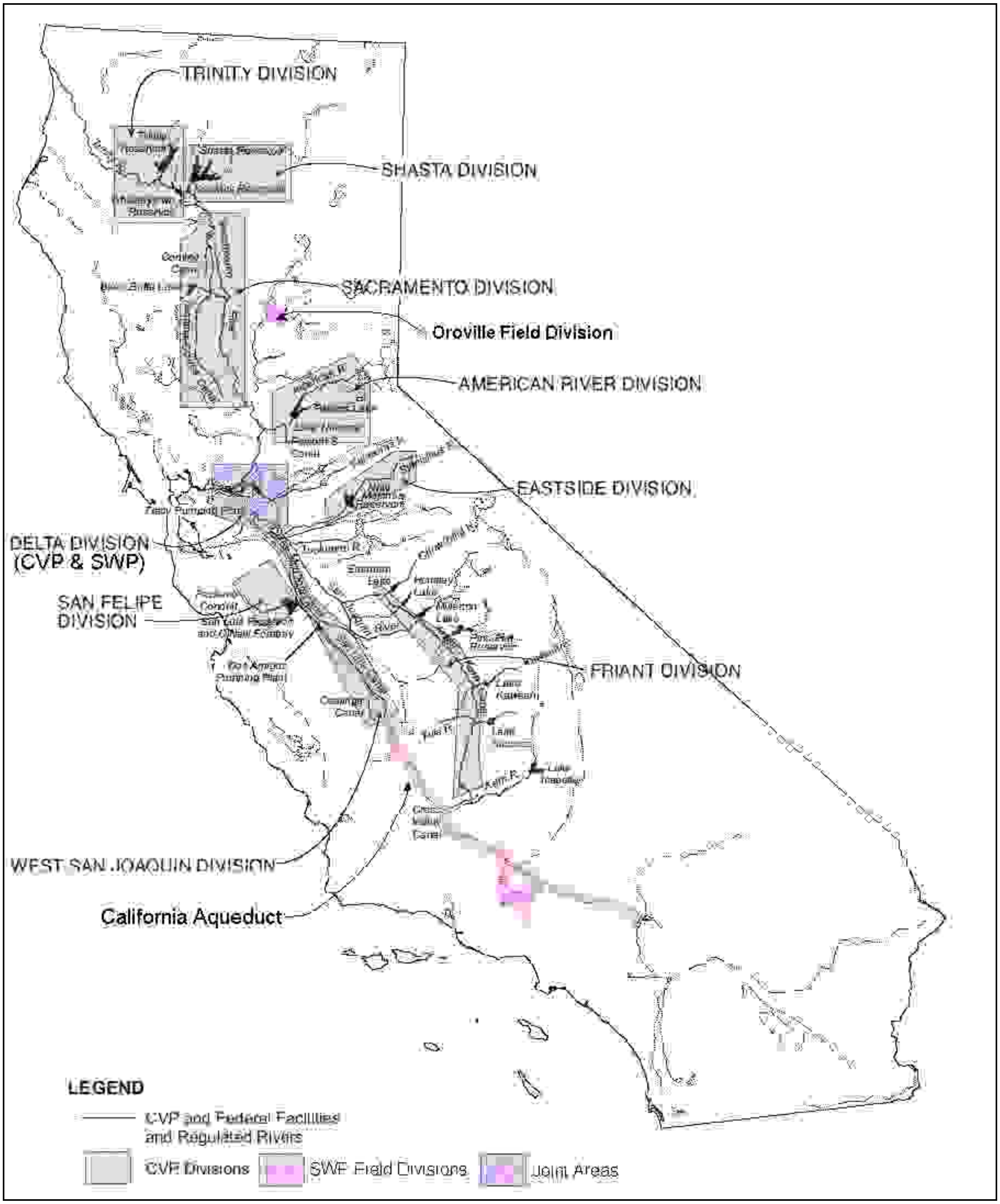

Figure 1: CVP and SWP Service Areas

systems join at the Sacramento-San Joaquin Delta (hereinafter referred to as the Delta), which flows through Suisun Bay and Carquinez Straits into the San Francisco Bay, and past the Golden

Gate to the Pacific Ocean. The action area includes the following: the Trinity River from Lewiston Dam to downstream to the confluence with the Klamath River, Clear Creek from Whiskeytown Dam to the Sacramento River, Spring Creek from the Debris Dam to Keswick Reservoir, Sacramento River from Shasta Dam to the Delta, Feather River from Oroville Dam to the confluence with the Sacramento River, American River from Folsom Dam to the confluence with the Sacramento River, Stanislaus River from New Melones Dam to the confluence with the San Joaquin River, the San Joaquin River from Friant Dam to the Delta, and the Delta to the Pacific Ocean. In addition, the action area includes service areas for long-term CVP water contracts which are interrelated to the Project (Figure 1).

B. Operating Agreements and Constraints

Reclamation and DWR begin their water year planning well before the conclusion of the rainy season. DWR makes its initial allocation to SWP contractors in early December with updates being made on a regular basis through the winter and spring. Usually, the final allocation is made in the early summer but has been known to be changed later in the calender year. Reclamation announces proposed water allocations to CVP contractors in mid-February and makes adjustments as needed on a regular basis until as late as September. Because this water allocation planning must occur before the available volume of water in CVP and SWP reservoirs is known, operators must predict rainfall, snowmelt, and runoff for the remainder of the year. To do this CVP and SWP water operators rely upon water supply forecasts at various exceedence probabilities. They also utilize various techniques to understand the potential long-term effects of operational strategies such as probability distributions, historical hydrology and long-term planning models (*e.g.*, CALSIM) to make such predictions.

Reclamation and DWR use similar approaches to determine water allocations; that is, they both tend to use conservative estimates of the available water supply for the Project. That is, they look at the probability that runoff through the remainder of the wet season will be greater than or equal to a certain value (*i.e*., the “probability of exceedence” of the value). For example, a 90 percent probability of exceedence means that based on historical occurrences, the actual runoff would be less than the value in question in only 10 percent of the years.

1. <u>Coordinated Operations Agreement</u>

Since both the CVP and the SWP utilize the Sacramento River and the Delta as common conveyance facilities, reservoir releases and Delta export operations must be coordinated to ensure that the CVP and SWP each retains its share of the commingled water and each bears its share of the joint obligations to protect beneficial uses. The 1986 Agreement between the United States of America and the State of California on Coordinated Operations defines the rights and responsibilities of the CVP and SWP with respect to in-basin water needs and provides a mechanism to measure and account for those responsibilities. In-basin uses are defined in the COA as legal uses of water required under the State Water Resources Control Board (SWRCB) Decision 1485 (D-1485) Delta standards.

Balanced water conditions are defined in the COA as periods when it is agreed that releases from the upstream reservoirs plus unregulated flows approximately equals the water supply needed to meet Sacramento Valley in-basin demands plus exports. Excess water conditions are periods when sufficient water is available to meet all beneficial needs, and the CVP/SWP are not required to make releases from reservoir storage. When water must be withdrawn from reservoir storage under the COA, the CVP is responsible for providing 75 percent and the SWP 25 percent of the water to meet Delta Standards. When unstored water is available for export (*i.e.*, under balanced conditions) the sum of CVP stored water, SWP stored water, and the unstored water for export is allocated at 55/45 percent to the CVP and SWP, respectively.

The COA has evolved considerably since 1986 with changes to facilities and operating criteria. New flow standards such as those imposed by the SWRCB have revised how the projects are operated. Also, additional ESA responsibilities (*i.e.*, temperature control on upstream operations) have been added to the projects. Although the burden of meeting these new responsibilities has been worked out internally between the CVP and SWP, the COA has never been officially amended or evaluated for consistency. Previous NOAA Fisheries' biological opinions (see Table 1) have evaluated operations with the internal changes that have taken place in the COA to date. Should the COA be modified in the future, a review will be completed to determine the need to re-initiate consultation under section 7 of the ESA.

2. Water Quality Control Plan Decision 1641

The 1994 Bay-Delta Accord committed the CVP and SWP to a set of Delta habitat objectives that were eventually incorporated by the SWRCB into the 1995 Water Quality Control Plan (WQCP) Decision 1641 (D-1641). Since these new beneficial objectives and water quality standards were more protective than those of the previous D-1485, they were adopted by amendment in 1995 into the WRO for the operation of the CVP and SWP (see amendments Table 1). However, the effects of adopting the new Delta standards (*i.e.*, D-1641) on upstream operations were not fully analyzed and did not consider spring-run and steelhead, since these species had not yet been listed under the ESA. Significant new elements of the WQCP D-1641 compared to D-1485 include: X2 salinity standards; export to inflow (E/I) ratios (which replaced the old QWEST standard in the 1993 WRO); Delta Cross Channel (DCC) gate closures; San Joaquin River standards; and a recognition of the CALFED Operations Coordination Group (Ops Group) process for operational flexibility in applying or relaxing certain protective standards.

On March 15, 2000, the SWRCB revised D-1641 amending the CVP and SWP water rights. In effect, D-1641 obligates the CVP and SWP to comply with the 1995 Bay-Delta Standards for fish and wildlife protection, municipal and industrial (M&I) water quality, agricultural water quality, and Suisun Marsh Salinity control. D-1641 also authorizes the CVP and SWP to use joint points of diversion (JPOD) in the southern Delta. The use of JPOD actions to enhance the beneficial uses of the project requires a Water Level Elevation Plan, a Fisheries Response Plan, and a Water Quality Plan (See OCAP BA Chapter 2 for a summary of Delta standards).

3. CVP Long-term Water Service Contracts

The proposed action includes Reclamation's continued efforts to negotiate with water users for long-term CVP contracts. There are approximately 250 long-term water service contracts that are dependant upon CVP operations to provide water for agricultural, or M&I uses. Most of these contracts are for a term of 40 years and now are in the process of renewal. These long-term contracts are interrelated to the proposed Project; therefore, the provision of water to these contracts is considered as part of the proposed Project. Once the water is diverted to a non-federal contractor it is not considered part of the Project; therefore, the screening of those diversions is up to the individual contractors and not the responsibility of Reclamation. However, under the ESA, NOAA Fisheries is still required to adequately analyze the impacts to listed fish species from unscreened diversions receiving contract water and the return of that water to the river. Subsequent to completing this BO, long-term water contracts will be renewed based on separate section 7 consultations. Therefore, facilities and operations of CVP and SWP contractors are not exempted from take included in this opinion unless specified in the incidental take statement.

4. 1993 Sacramento River Winter-run Chinook Salmon Biological Opinion

The jeopardy finding in the 1993 WRO required Reclamation and DWR to implement a reasonable and prudent alternate (RPA) consisting of 13 separate actions that changed the pattern of storage and withdrawal at Shasta, Trinity, and Whiskeytown Reservoirs for the purpose of improving temperature control and protecting Sacramento River winter-run Chinook salmon (NOAA Fisheries 1993a). Since that time many of the original RPA actions (*e.g.*, E/I ratio and DCC gate closures) have been amended or incorporated into the 1995 WQCP D-1641 previously described and are discussed in the Effects section. As such, these components of the RPA have become part of the Project's baseline conditions. Those actions that have not changed include:

1) water year forecasting based on a 90 percent probability of exceedence forecast

2) maintaining a minimum 3,250 cubic feet per second (cfs) flow below Keswick Dam from October 1 through March 30

3) implementing ramp down rates for Shasta Dam releases from July 1 through March 31

4) locating temperature compliance points based on annual plans

5) raising RBDD gates between September 15 and May 15 every year

6) monitoring of winter-run Chinook salmon juveniles in the Delta

7) monitoring entrainment loss of winter-run Chinook salmon juveniles at Rock Slough Pumping Plant

8) monitoring of incidental take at the CVP and SWP Delta pumping facilities

An Incidental Take Statement was included as part of the 1993 WRO which authorized the Project to take up to one percent of the estimated number of outmigrating smolts (based on adult escapement) entering the Delta. In 1995, this amount of take was amended to two percent based on consideration of several sources of inaccuracy in the direct loss calculation methodology adopted by Reclamation, DWR, and DFG in 1976 (See 1995 amendment Table 1). NOAA Fisheries identified several problems with the use of the size criteria at the Delta fish facilities which lead to a higher degree of uncertainty. These problems include: juvenile growth rates in the Delta differ from riverine habitat upon which the criteria is based; juvenile Chinook salmon selective predation in CCF; size selective screening efficiency at the louvers; size overlap with unmarked hatchery releases of yearling fall-run Chinook salmon (*i.e*., Mokelumne River and Merced Hatcheries); nonrandom sampling of primarily smolt size Chinook salmon; and reduced sampling periods when pumping rates are high or fish numbers are great. NOAA Fisheries concluded that the direct loss estimation methodology used at the Delta fish facilities does not provide a high level of accuracy and there was a need to incorporate additional flexibility when employing this method for evaluating incidental take.

Alternative methods for Chinook salmon race identification and improvements in the size criteria have been under development since 1995. DWR had funded a program to develop genetic discriminators from Central Valley stocks. Since 1999, 50 to 90 percent of the winter-run Chinook juveniles identified by the size-length criteria at the Delta Fish Facilities have been genetically determined as winter-run (DWR 2003a). DWR is currently developing a program to genetically identify spring-run Chinook salmon as well.

5. Trinity River Flows

The Trinity River Mainstem Fishery Restoration Program, Environmental Impact Statement (TRMFRP EIS) ROD issued December 19, 2000, allocates 369 to 815 thousand acre feet (TAF) annually for Trinity River flows. Although in litigation for several years a recent Federal court decisions will allow implementation of the Trinity ROD flows. Prior to this most recent decision, a previous court order directed the CVP to release 368.6 TAF in critically dry years and 452 TAF in all other years. Temperature objectives for the Trinity River are set forth in SWRCB Water Rights Order 90-5 (WR 90-5). Operationally, for the purposes of establishing the Trinity River flows, the water year type will be forecasted by Reclamation based on a 50 percent forecast on April 1. To avoid warming and to function most efficiently for temperature control, water is exported from the Trinity River Basin through Whiskeytown Reservoir and into the Sacramento River Basin during the late spring.

6. Central Valley Project Improvement Act

Since the CVPIA was passed in 1992, the CVP has been authorized to include fish and wildlife protection, restoration, and mitigation as project purposes equal in priority with water supply and power generation. Among the changes mandated by the CVPIA are:

- Dedicating 800 TAF of CVP water to fish and wildlife annually [*i.e*., CVPIA Section 3406 (b)(2), hereinafter referred to as (b)(2) water]

- Authorizing water transfers outside the CVP service area
- Implementing an anadromous fish restoration program
- Creating a restoration fund
- Providing a Shasta Temperature Control Device (TCD)
- Implementing fish passage at RBDD
- Implementing improvements at the Tracy Fish Collection Facility (TFCF)

The Final Programmatic EIS for the CVPIA was released in October 1999 and biological opinions from NOAA Fisheries and the FWS were issued in November 2000. Day-to-day operations of the CVP include the following provisions of the CVPIA: Section 3406(b)(1) re-operation of the project, Section 3406(b)(2) upstream releases to improve fish habitat and water quality standards, and Section 3406(b)(3) water acquisitions. Protective measures and flow objectives that meet CVPIA purposes and are consistent with the Anadromous Fisheries Restoration Plan (AFRP) are described in Appendix A of the November 20, 1997, Department of the Interior (Interior) Final Administrative Proposal on the Management of (b)(2) water. The management (b)(2) water has been further clarified by an Interior, Decision on Implementation (B2 Decision) issued May 9, 2003. The B2 Decision describes the means by which the amount of dedicated (b)(2) water is determined. This occurs when Reclamation takes a fishery protection action on behalf of the FWS and in consultation with DFG and NOAA Fisheries pursuant to the primary purpose of CVPIA Section 3406(b)(2) or which contributes to AFRP flows.

7. CALFED Record of Decision and Environmental Water Account

As specified in the 2000 CALFED ROD, the EWA has been implemented to provide sufficient water, and combined with the Ecosystem Restoration Program (ERP), to address CALFED’s fish protection and restoration/recovery needs while enhancing the predictability of CVP and SWP operations and improving the confidence in and reliability of water allocation forecasts. In the Delta environment, EWA resources and operational flexibility are used as both a real time fish management tool to improve the passage and survival of at-risk fish species in the Delta environment and for specific seasonal planned fish protection operations at the CVP and SWP Delta pumps.

The EWA agencies include Reclamation, FWS, NOAA Fisheries, DWR, and DFG, which have established protocols for the expenditure of water resources following the guidance given in the CALFED ROD. EWA resources may be used to temporarily reduce SWP Delta exports at Banks for fish protection purposes above SWRCB D-1641 requirements and to coordinate with the implementation of CVPIA Section 3406 fish actions. EWA resources may be used to temporarily reduce CVP Tracy Pumping Plant exports for fish protection purposes above the resources available through Section 3406(b)(2) of the CVPIA. The EWA is a cooperative management program, whose purpose is to provide protection to the at-risk native fish of the Bay-Delta estuary through environmentally beneficial changes in CVP/SWP operations at no uncompensated water cost to the Projects’ water users. It is a tool to increase water supply reliability and to protect and recover at-risk fish species.

The EWA described in the CALFED ROD is a four-year program, which the EWA agencies have been implementing since 2000. However, the EWA agencies believe a long-term EWA is critical to meet the CALFED ROD goals of increased water supply reliability to water users, while at the same time assuring the availability of sufficient water to meet fish protection and restoration/recovery needs. Thus, the EWA Agencies envision implementation of a long-term EWA as part of the operation of the CVP and SWP. However, inclusion of the EWA in this description does not constitute a decision on the future implementation of EWA. Future implementation of a long-term EWA is subject to National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

The EWA allows these EWA agencies to take actions to benefit fish. An example action would be curtailing project exports by reducing pumping during times when pumping could be detrimental to at-risk fish species. EWA assets are then used to replace project supplies that would have otherwise been exported, but for the pumping curtailment. Used in this way, the EWA allows the EWA agencies to take actions to benefit fish without reducing water deliveries to the projects' water users.

The commitment to not reduce project water deliveries resulting from EWA actions to benefit fish is predicated on three tiers of fish protection, as recognized in the CALFED ROD. These three tiers are described as follows:

- Tier 1 (*i.e.*, Regulatory Baseline). Tier 1 is baseline water and consists of water available under currently existing BOs, water right decisions and orders, (b)(2) water, and other regulatory actions affecting operations of the CVP and SWP. Also included in Tier 1 are other environmental statutory requirements such as Level 2 refuge water supplies.

- Tier 2 (*i.e.*, EWA). Tier 2 is the EWA and provides fish protection actions supplemental to the baseline level of protection (Tier 1). Tier 2 consists of EWA assets, which combined with the benefits of CALFED's ERP, will allow water to be provided for fish actions when needed without reducing deliveries to water users. EWA assets will include purchased (fixed) assets, operational (variable) assets, and other water management tools and agreements to provide for specified level of fish protection. Fixed assets are those water supplies which are purchased by the EWA agencies.[2] These purchased quantities are approximations and subject to some variability. Operational assets are those water supplies made available through CVP and SWP operational flexibility. Some examples include the flexing of the E/I ratio standard required for meeting Delta water quality and flows, and pumping at the SWP Banks Pumping Plant water resulting from upstream ERP releases. Water management tools provide the ability to convey, store, and manage water that has been secured through other means. Examples include dedicated pumping capacity, borrowing, banking, and entering into exchange agreements with water contractors. Chapter 8 of the CVP-OCAP BA contains a more detailed description of EWA operations, as characterized in the CALSIM modeling.

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[2] The year types are defined in SWRCB D-1641.

- Tier 3 (*i.e.*, Additional Assets). In the event that the EWA agencies deem Tier 1 and 2 levels of protection insufficient to protect at-risk fish species in accordance with ESA requirements, Tier 3 would be initiated. Tier 3 triggers a process based upon the commitment and ability of the EWA agencies to make additional water available, should it be needed. This Tier may consist of additional purchased or operational assets, funding to secure additional assets if needed, or Project water if funding or assets are unavailable. It is unlikely that protection beyond those described in Tiers 1 and 2 will be needed to meet ESA requirements. However, Tier 3 assets will be used when Tier 2 assets and water management tools are exhausted, and the EWA Agencies determine that jeopardy to an at-risk fish species is likely to occur due to project operations unless additional measures are taken. In determining the need for Tier 3 protection, the EWA agencies would receive input from an independent science panel.

With these three tiers of protection in place that are subject to changes based on NEPA/CEQA review, or new information developed through ESA/California Endangered Species Act (CESA), Natural Community Conservation Planning Act (NCCPA) review or the CALFED Science Program, the EWA agencies will provide long-term regulatory commitments consistent with the intent set forth in the CALFED ROD. The commitments are intended to protect the CVP and SWP exports at the Tracy and Banks Pumping Plants from reductions in water supplies for fish protection beyond those required in Tier 1.

C. Description of Central Valley Project Facilities, Upstream of the Delta

A condensed project description is provided below as it pertains to operational impacts on listed salmonids. A more detailed description of the project is provided in the OCAP BA dated May 24, 2004, and associated appendices A through J (Reclamation 2004a).

1. Trinity River Division

The Trinity River Division, completed in 1964, includes facilities to store and regulate water in the Trinity River, as well as facilities to divert water to the Sacramento River Basin. The main facilities of the division include the Trinity Dam and Powerplant; Trinity Reservoir (2.45 MAF capacity); Lewiston Dam, Lake, and Powerplant; Clear Creek Tunnel; Judge Francis Carr Powerhouse; Whiskeytown Dam and Lake (241 TAF capacity); Spring Creek Tunnel and Powerplant; and Spring Creek Debris Dam and Reservoir (5.8 TAF capacity).

Trinity Reservoir stores water for release to the Trinity River and for diversion to the Sacramento River via Lewiston Reservoir, Carr Tunnel, Whiskeytown Reservoir, and Spring Creek Tunnel where it commingles in Keswick Reservoir with Sacramento River water released from both the Shasta Dam and Spring Creek Debris Dam. Trinity Reservoir releases are re-regulated downstream at Lewiston Dam and Lake to meet downstream flow, in-basin diversion, and downstream temperature requirements. Lewiston Lake also provides a forebay for the out-of-basin diversion of flows through the Clear Creek Tunnel and the Judge Francis Carr Powerhouse into Whiskeytown Lake.

Water stored in Whiskeytown Lake includes exports from the Trinity River as well as runoff from the Clear Creek drainage. A majority of the water released from Whiskeytown Lake travels through the Spring Creek Tunnel and Powerplant and is discharged into Keswick Reservoir on the Sacramento River. A small amount of water is also released through the Whiskeytown Dam outlet and through the City of Redding Powerplant into Clear Creek which flows into the Sacramento River below Keswick Dam.

The Spring Creek Debris Dam (SCDD) is a feature of the Trinity Division of the CVP. It was constructed to regulate runoff containing debris and acid mine drainage from Spring Creek, a tributary to the Sacramento River that enters Keswick Reservoir. The SCDD can store approximately 5,800 af of water. Operation of SCDD and Shasta Dam has allowed some control of the toxic wastes with dilution criteria. In January 1980, Reclamation, the DFG, and the SWRCB executed a Memorandum of Understanding (MOU) to implement actions that protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds.

The MOU identifies agency actions and responsibilities, and establishes release criteria based on allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. The MOU states that Reclamation agrees to operate to dilute releases from SCDD (according to these criteria and schedules provided) and that such operation will not cause flood control parameters on the Sacramento River to be exceeded and will not unreasonably interfere with other project requirements as determined by Reclamation. The MOU also specifies a minimum schedule for monitoring copper and zinc concentrations at SCDD and in the Sacramento River below Keswick Dam. Reclamation has primary responsibility for the monitoring; however, the DFG and the RWQCB also collect and analyze samples on an as-needed basis. Due to more extensive monitoring, improved sampling and analyses techniques, and continuing cleanup efforts in the Spring Creek drainage basin, Reclamation now operates SCDD targeting the more stringent Central Valley Region Water Quality Control Plan (Basin Plan) criteria in addition to the MOU goals. Instead of the total copper and total zinc criteria contained in the MOU, Reclamation operates SCDD releases and Keswick dilution flows to not exceed the Basin Plan standards of 0.0056 mg/L dissolved copper and 0.016 mg/L dissolved zinc. Release rates are estimated from a mass balance calculation of the copper and zinc in the debris dam release and in the river.

In order to minimize the build-up of metal concentrations in the Spring Creek arm of Keswick Reservoir, releases from the debris dam are coordinated with releases from the Spring Creek Powerplant to keep the Spring Creek arm of Keswick Reservoir in circulation with the main water body of Keswick Lake. The operation of Spring Creek Debris Dam is complicated during major heavy rainfall events. Spring Creek Debris Dam reservoir can fill to uncontrolled spill elevations in a relatively short time period, anywhere from days to weeks. Uncontrolled spills at Spring Creek Debris Dam can occur during flood control events in the upper Sacramento River and also during non-flood control rainfall events. During flood control events, Keswick releases may be reduced to meet flood control objectives at Bend Bridge when storage and inflow at Spring Creek Reservoir are high.

Because SCDD releases are maintained as a dilution ratio of Keswick releases to maintain the required dilution of copper and zinc, uncontrolled spills can and have occurred from Spring Creek Debris Dam. In this operational situation, high metal concentration loads during heavy rainfall are usually limited to areas immediately downstream of Keswick Dam because of the high runoff entering the Sacramento River adding dilution flow. In the operational situation when Keswick releases are increased for flood control purposes, Spring Creek Debris Dam releases are also increased in an effort to reduce spill potential.

In the operational situation when heavy rainfall events will fill Spring Creek Debris Dam and Shasta Reservoir will not reach flood control conditions, increased releases from CVP storage may be required to maintain desired dilution ratios for metal concentrations. Reclamation has voluntarily released additional water from CVP storage to maintain release ratios for toxic metals below Keswick Dam. Reclamation has typically attempted to meet the Basin Plan standards but these releases have no established criteria and are dealt with on a case-by-case basis. Since water released for dilution of toxic spills is likely to be in excess of other CVP requirements, such releases increase the risk of a loss of water for other beneficial purposes.

a. *Trinity and Lewiston Dams*

Based on the TRMFR EIS ROD flow schedule, 369 TAF to 815 TAF of water is allocated annually for Trinity River flows. Until the most recent decision of the Federal court, flows had been set by the court at 369 TAF during critically dry years, and 452 TAF in all other years. Exports of Trinity River water to the Sacramento River Basin are determined after consideration is given to forecasted water supply conditions and Trinity River in-basin needs, including carryover storage.

Safety of dams (SOD) criteria are intended to prevent overtopping of Trinity Dam during large flood events (10 percent of years). The SOD criteria attempts to prevent storage from exceeding 2.1 MAF from November through March. Total releases to Trinity River below Lewiston Dam are limited to 6,000 cfs under the SOD criteria.

b. *Whiskeytown Dam and Reservoir*

Reclamation proposes to operate Whiskeytown Dam to regulate inflows for power generation and recreation; to support upper Sacramento temperature objectives; and to provide releases to Clear Creek consistent with AFRP flow objectives. Two agreements govern releases from Whiskeytown Lake to Clear Creek: 1) a 1960 Memorandum of Agreement (MOA) with DFG; and 2) the May 9, 2003, B2 Decision concerning (b)(2) water. The 1960 MOA with DFG established minimum flows to be released into Clear Creek from Whiskeytown Dam. Subsequently in 1963, a release schedule from Whiskeytown Dam was developed and implemented, but was never finalized. The 2003 B2 Decision allows for establishment of the target flow objectives described within Interior's November 20, 1997, Final Administrative Proposal on the Management of CVPIA section 3406 (b)(2) water, which includes the objectives of the AFRP [CVPIA section 3406 (b)(1)]. The AFRP identifies minimum instream flows for Clear Creek below Whiskeytown based upon stability criteria and Trinity Reservoir storage.

Target flows supported with (b)(2) water range from 100 to 200 cfs from October through May and from 85 to 150 cfs from June through September.

Releases from Whiskeytown Reservoir into Clear Creek that are above the pre-CVPIA base case (*i.e.*, 50 to 100 cfs) are usually made using (b)(2) water. The FWS and Reclamation determine the amount of water to be released in coordination with NOAA Fisheries and DFG during weekly CVPIA (b)(2) Interagency Team (B2IT) meetings.

Dedication of (b)(2) water on Clear Creek provides actual in-stream flows below Whiskeytown Dam greater than the fish and wildlife minimum flows specified in the 1963 proposed release schedule (OCAP BA Table 2-3). In-stream flow objectives are usually taken from the AFRP's plan, in consideration of spawning and incubation of fall-run Chinook salmon. Augmentation in the summer months is usually in consideration of water temperature objectives for steelhead and in late summer for spring-run Chinook salmon. The McCormick-Saeltzer Dam at River Mile (RM) 6.5 was removed by Interior in November 2000 to provide fish passage to upstream habitat below Whiskeytown Reservoir.

2. 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 Delta from intrusion of saline ocean water, agricultural water supplies, 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 (4.55 MAF capacity) is the largest storage reservoir on the Sacramento River. Completed in 1945, Shasta Dam controls flood water 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 TAF capacity) for Shasta Lake and Trinity River diversions.

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 Reclamation 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.

Reclamation operates the Shasta, Sacramento River, and Trinity River divisions of the CVP to meet, to the extent possible, the provisions of SWRCB Order 90-05 and the WRO. In 1990 and 1991, the SWRCB issued Water Rights Orders 90-05 and 91-01 modifying Reclamation's water rights for the Sacramento River. These SWRCB orders include temperature objectives for the Sacramento River including a daily average water temperature of 56^{o} F at RBDD during periods when higher temperatures would be harmful to the fishery. Under the SWRCB order, the compliance point may be changed when the objective cannot be met at RBDD. In addition, Order 90-05 modified the minimum flow requirements in the Sacramento River below Keswick Dam initially established in the 1960 MOA between Reclamation and DFG. Minimum flow requirements established by the 1993 WRO are higher than most of the minimum flow requirements of SWRCB Order 90-05 during critically dry to normal water years (see OCAP BA Table 2-4 for a comparison).

Flood control objectives for Shasta Lake require that releases are restricted to quantities that will not cause downstream flows or stages to exceed specified levels. Maximum flood space reservation is 1.3 MAF with variable storage space requirements based on an inflow parameter. The flood control criteria for Shasta specify that releases should not be increased more than 15,000 cfs or decreased more than 4,000 cfs in any two-hour period. In rare instances, the rate of decrease may have to be accelerated to avoid exceeding critical flood stages downstream.

a. *Shasta Dam and Reservoir*

Reclamation operates Shasta Reservoir to meet the needs of the CVP and to the extent possible, meet the provisions of SWRCB Order 90-05 and the 1993 WRO (see description under operating agreements). Reclamation proposes to provide release flows at Keswick Dam and RBDD that are equal to or exceed the AFRP flow objectives (see description under CVPIA criteria) during most months. From January through March flows are held at the minimum (3,250 cfs) requirement established in the WRO. The WRO did not require minimum flows from April through September; however, a minimum temperature criteria was established for these months resulting in the adaptive management of higher release flows by Reclamation to achieve temperature compliance.

Reclamation currently implements ramping criteria established in the WRO. Ramping constraints for Keswick release reductions are from July 1 through March 31 and include the following:

- Releases must be reduced between sunset and sunrise.
- When Keswick releases are 6,000 cfs or greater, decreases may not exceed 15 percent per night. Decreases may also not exceed 2.5 percent per hour.
- For Keswick releases between 4,000 to 5,999 cfs, decreases may not exceed 200 cfs per night. Decreases may also not exceed 100 cfs per hour.
- For Keswick releases between 3,999 and 3,250 cfs, decreases may not exceed 100 cfs per night.
- Variances to these release requirements are allowed under flood control operations.

From October 15 to December 31, Reclamation attempts to minimize changes in releases from Keswick Dam to provide stable flow conditions for fall-run Chinook salmon spawning. Normally, releases from Keswick Dam are reduced to the minimum fishery release requirement (either WRO or AFRP) by October 15 of each year. Flood control operations and other emergencies (such as flushing flows to dilute acid mine runoff from Spring Creek Dam) are not affected by the release change limitations.

(1) ***Temperature control in the Upper Sacramento River***. Reclamation will continue to develop annual operation plans for the CVP (except for establishing Trinity River flows) based on the more conservative 90 percent exceedence forecast. The use of this more conservative forecasting approach will substantially reduce the risk of adverse temperature conditions occurring in the spawning and incubation habitat of the Sacramento River winter-run Chinook salmon. However, Reclamation is not assuming a minimum end-of-September (EOS) carryover storage in Shasta Reservoir as previously required under the RPA of the WRO.

The temperature control device (TCD), built in 1997 at Shasta Dam, was designed to selectively withdraw water from elevations within 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. Due to several changes in project operations since the 1993 WRO (*i.e.*, CVPIA B2 Decision, SWRCB D-1641, Trinity ROD flows), and actual operating performance of the TCD (see OCAP BA, Appendix B), Reclamation proposes to adaptively manage releases from Shasta Dam to target temperature compliance (56° F) downstream to Ball's Ferry, in all but the most adverse drought years.

In Chapter 2 (Project Description) of the Biological Assessment, Reclamation presents Proposed Upper Sacramento River Temperature Objectives. On Pages 2-35 and 2-36, and in Appendix B, of the Biological Assessment, Reclamation has provided information that indicates that targeting water temperature compliance at Ball's Ferry may be preferable to targeting downstream locations, particularly early in the season and in years of low storage and dry hydrology. Reclamation ends the discussion on page 2-36 by proposing this change in Sacramento River temperature control objectives to be consistent with the capability of the CVP to manage coldwater resources and to use the process of annual planning in coordination with the Sacramento River Temperature Control Task Group (SRTTG) to arrive at the best use of that capability. NOAA Fisheries has interpreted the discussion to indicate Reclamation is implementing a change to the Ball's Ferry location for future temperature control early in the season and moving it downstream later as hydrologic and fishery conditions become better known. Although the analysis suggests that proposal has merit, Reclamation does indicate in the Project Description that it will continue compliance with Water Rights Orders 90-05 and 91-01 requirements.

Pursuant to SWRCB Water Rights Order 90-05 and 91-01, the SRTTG was convened by Reclamation to formulate, monitor, and coordinate temperature control plans for the upper Sacramento and Trinity rivers with representatives from SWRCB, NOAA Fisheries, FWS, DFG, Western Area Power Administration (WAPA), DWR, and the Hoopa Valley Indian Tribe. Additionally, Reclamation devised and now implements the Sacramento-Trinity Water Quality Monitoring Network (see page 2-33 to 2-37 of the OCAP BA), which is used to monitor temperature and other parameters at key locations in the Sacramento and Trinity rivers.

(2) ***Wilkins Slough Requirement.*** Wilkins Slough is located on the mainstem Sacramento River immediately upstream of the confluence with the Feather River. While maintaining conditions for commercial navigation is no longer a concern on the lower Sacramento River due to construction of the Sacramento Deep Water Ship Channel, the 5,000 cfs minimum flow established for navigation up to Chico Landing served as the basis for the design of many irrigation pumping stations in the upper Sacramento River. Diverters are able to operate for extended periods down to 4,000 cfs at Wilkins Slough, as mentioned above (gaging station on the Sacramento River), but pumping operations become severely affected below that flow. The CVP usually operates to below the Wilkins Slough criteria from November through February in order to conserve storage.

(3) ***Anderson-Cottonwood Irrigation District Dam.*** The ACID dam and fish ladder are located in Redding on the Sacramento River. Reclamation proposes to meet their contractual obligations with ACID by manipulating Keswick Dam releases to the extent reasonably needed to facilitate installation, removal, or adjustment of the flashboards on the diversion dam. Because work on the ACID dam can not be safely accomplished at flows greater than 6,000 cfs (in April and November), Reclamation proposes to limit Keswick releases at the request of ACID to 5,000 cfs for five days twice a year to facilitate installation or removal of the dam. Keswick Dam releases for ACID operations are limited by the ramp down criteria in the WRO, which is 15 percent each night and 2.5 percent in any one hour.

3. <u>Sacramento River Division</u>

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 RBDD, 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.

Reclamation proposes to continue to operate RBDD to meet the RPA identified in the WRO concerning gate operations. This RPA specifies that the RBDD gates must remain raised from September 15 through May 14 with a provision for intermittent gate closures (up to ten days, one time per year) approved on a case-by-case basis for critical diversion needs.

Reclamation has also proposed to convert the research Pilot Pumping Plant for the Tehama-Colusa Canal into a full-time pumping facility with the addition of a fourth fish-friendly centrifugal pump (*i.e.*, part of formal consultation). These pumps have been proven to adequately pass juvenile salmonids; however, they are not large enough to meet full irrigation demands. Therefore since 1992, Reclamation has used rediversions of CVP water stored in Black Butte Reservoir to supplement the water pumped at RBDD during the gates-out. This water is redirected with the aid of temporary gravel berms through an unscreened, constant head orifice (CHO) into the Tehama-Colusa Canal. This diversion of water from Stony Creek into the Tehama-Colusa Canal can at times directly take listed salmonids on Stony Creek.

4. <u>American River Division</u>

The American River Division includes the Folsom Unit, and Auburn-Folsom South Unit of the CVP. These facilities impound water on the American River for flood control, fish and wildlife protection, recreation, protection of the Delta from intrusion of saline ocean water, agricultural water supplies, M&I water supplies, and hydroelectric generation. The Folsom Unit consists of Folsom Dam and Lake (977 TAF capacity), Folsom Powerhouse, Nimbus Dam, Lake Natoma, and Nimbus Powerplant on the American River. The Folsom Unit was added to the CVP in 1949. In 1965, the Auburn-Folsom South Unit was authorized and includes Folsom South Canal.

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 TAF. Ninety percent of this upstream storage is contained by five reservoirs: French Meadows (136 TAF); Hell Hole (208 TAF); Loon Lake (76 TAF); Union Valley (271 TAF) and Ice House (46 TAF). 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). PCWA provides wholesale water to agricultural and urban areas within Placer County and on occasion to the CALFED EWA.

In addition, Reclamation operates the American River Division, to the extent possible, to meet the temperature objectives for the Nimbus Fish Hatchery and the American River Trout Hatchery, while maintaining suitable temperatures for instream salmonids. A work group called the American River Operations Group (AROG) was created in 1996. This group consisting of agency representatives and stakeholders provides input to Reclamation regarding the fishery status and water temperature conditions on the lower American River (LAR).

The Corps specifies flood control requirements and regulating criteria for the American River. From June 1 through September 30, no flood control storage restrictions exist. From October 1 through November 16 and from April 21 through May 31, reserved storage space for flood control is a function of the date, with full flood reservation space required from November 17 through February 7. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and current hydrologic conditions in the basin. Due to several significant flood events (*i.e.*, 1986 and 1997) review and planning efforts for a new flood control plan were sponsored by the Sacramento Area Flood Control Agency (SAFCA). Since 1996, Reclamation, in agreement with SAFCA, has operated to a modified flood control criteria, which reserves 400 to 670 TAF of flood control space in Folsom Reservoir and a combination of three upstream reservoirs (*i.e.*, Hell Hole, Union Valley, and French Meadows). In general, this modified flood control plan provides greater protection than the Corps flood control diagram for communities in the American River floodplain.

a. *Folsom Dam and Reservoir (Folsom Lake)*

Reclamation proposes to operate Folsom Reservoir levels to meet the flood control ; water delivery to downstream water rights, Delta water quality standards (*i.e.*, SWRCB 95-1WR and D-1641), fish and wildlife protection, and water supplies to CVP contractors. Folsom Dam releases into the American River are re-regulated approximately seven miles downstream by Nimbus Dam. Reclamation proposes to continue to adaptively manage flows with input from the AROG and using ramping rate criteria included in previous interim OCAP BOs to reduce the incidence of steelhead and Chinook salmon isolation and stranding events.

b. *Nimbus Dam and Reservoir (Lake Natoma)*

Reclamation proposes to operate the Nimbus Reservoir as a forebay for the diversion of water through the Folsom South Canal and to provide releases to the LAR. The Folsom South Canal serves water to agricultural and M&I users in south Sacramento County. Releases from Nimbus Dam to the American River pass through the Nimbus Powerplant (*i.e.*, 5,000 cfs capacity) or, at flows in excess of 5,000 cfs, through the spillway gates.

c. *Minimum Instream Flows in the Lower American River*

Reclamation proposes to provide monthly average release flows from Nimbus Dam that are equal to, or exceed AFRP flow objectives during most months. AFRP flow objectives in the American River are intended to decrease water temperatures and increase spawning, incubation, rearing, and emigration habitat for fall-run Chinook salmon and steelhead while providing benefits for Delta estuarine species as well. Currently, the only minimum flow standard on the American River is set by SWRCB Decision 893 (D-893). Therefore, flows above the D-893 standard and above the pre-CVPIA historical base case are maintained using (b)(2) water, when necessary. American River flows often are called upon to protect the Delta from intrusion of saline ocean water, as required by SWRCB D-1641. American River releases to meet Delta water quality standards are considered (b)(2) water.

Installation and removal of the Fish Diversion Weir for fall-run Chinook salmon spawning at the Nimbus Fish Hatchery requires Reclamation to reduce flows around mid-September and again in mid-January to between 500 and 1,000 cfs for up to two days.

d. *Temperature Control in the Lower American River*

Temperature goals within the LAR are to provide suitable temperatures during the summer months for Nimbus Fish Hatchery and for instream rearing juvenile steelhead, while minimizing the loss of the cold water pool left available for spawning fall-run Chinook salmon. Currently, Reclamation is required to control water temperatures between Nimbus Dam and Watt Avenue (RM 9.4) to less than or equal to 65 °F, from June 1 through November 30 each year (*i.e.*, as specified in previous interim OCAP BOs). However, meeting this objective is often not obtainable in years when storage in Folsom is low. In addition, Reclamation tries to provide 60 °F water for fall-run Chinook salmon spawning starting November 1.

Although Reclamation proposes to implement AFRP flow objectives supported by (b)(2) water, temperature control problems still exist for Chinook salmon and steelhead in the LAR, due to the small size of the cold water pool within Folsom Reservoir. Reclamation proposes to continue adaptively managing temperatures using a combination of flow releases and shutter operations (blending) on Folsom Dam.

The real-time implementation of the AFRP flow objectives and the SWRCB D-1641 Delta Standards has made the management of the limited cold water resources of Folsom Lake a difficult balancing act of trade-offs and risks. In most years, the volume of cold water is not sufficient to meet the summer temperature target at Watt Avenue and reserve cold water accessed by the final shutter raise for salmon in the fall. Reclamation consults with FWS, NOAA Fisheries, and DFG through the B2IT process and coordinates with the AROG when making compromising decisions on operations. In 2003, Reclamation installed an Urban Water Supply TCD at Folsom Dam to provide additional flexibility. The objective of the TCD is to allow Reclamation to draw warm water off the top of Folsom Reservoir without impacting the cold water pool. Each year, a temperature control management plan is developed that balances conservation of cold water during the summer with the need for later use in the fall.

Reclamation is participating in continuing discussions with the Sacramento Water Forum, FWS, NOAA Fisheries, DFG, and other interested parties regarding integration of a revised flow standard for the lower American River into CVP operations and water rights. Reclamation intends to accomplish such incorporation, including associated revisions to the OCAP Project Description, in coordination with the parties. That revised project description, amending the lower American River flows to make them consistent with the revised flow standard, will be presented to the agencies, together with supporting material and analysis needed for review under ESA Section 7. Until such an action is presented to and adopted by the SWRCB, minimum flows will be limited by D-893. Releases of additional water are made pursuant to Section 3406 (b)(2) of the CVPIA.

5. Eastside Division

The New Melones Unit of the Eastside Division includes facilities that conserve water on the Stanislaus River for flood control, fish and wildlife protection, Bay-Delta flow requirements, dissolved oxygen requirements, Vernalis water quality, water right supplies, CVP contract water supplies, and hydroelectric generation. Facilities consist of New Melones Dam, Reservoir (2.4 MAF), and Powerplant. Other water storage facilities in the Stanislaus River include the Tri-Dam project, a hydroelectric generation project that consists of Donnells and Beardsley dams located upstream of New Melones Reservoir on the Middle Fork Stanislaus River, and Tulloch Dam and Powerplant, located approximately six miles below New Melones Dam on the mainstem Stanislaus River. Releases from Donnells and Beardsley dams affect inflows to New Melones Reservoir. Under contractual agreements between Reclamation and the Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), Tulloch Reservoir provides afterbay storage to re-regulate power releases from New Melones Powerplant. Approximately 1.9 miles downstream of Tulloch Dam is Goodwin Dam and Reservoir. Goodwin Dam, constructed by OID and SSJID in 1912, creates a re-regulating reservoir for releases from Tulloch Powerplant. Goodwin Reservoir is the main water diversion point for the Stanislaus River and includes diversions through two canals running north and south of the Stanislaus River for delivery to OID and SSJID. Water impounded behind Goodwin Dam may also be pumped into the Goodwin Tunnel for deliveries to the Central San Joaquin Water Conservation District and the Stockton East Water District. Goodwin Reservoir also provides releases to the lower mainstem Stanislaus River.

The operating criteria for New Melones Reservoir are governed by water rights, flood control, instream fish and wildlife requirements, Bay-Delta flow requirements (SWRCB D-1641), dissolved oxygen requirements, Vernalis water quality, and CVP contracts.

a. *New Melones Dam and Reservoir*

Reclamation proposes to operate the New Melones Reservoir level to meet the needs of the CVP (*i.e.*, water delivery to downstream water right holders, flood control, compliance with D-1641, water quality standards, fish and wildlife protection, water supplies to CVP contractors, Vernalis water quality, recreation, etc.). New Melones Dam releases pass through the New Melones Powerplant into the Stanislaus River where flows are re-regulated approximately 6 miles downstream by Tulloch Dam. Tulloch Dam releases pass through the Tulloch Powerplant into the Stanislaus River where flows are re-regulated approximately 1.9 miles downstream at Goodwin Dam.

Goodwin Reservoir serves as a forebay for the diversion of water to several irrigation districts and it also provides releases to the lower Stanislaus River. Diversions from Goodwin Reservoir include two canals running north and south of the Stanislaus River that serve water to the OID and SSJID, and the Goodwin Tunnel that delivers water to the Central San Joaquin Water Conservation District and the Stockton East Water District.

b. *Minimum Flows and Temperature Control in the Stanislaus River*

A long-term plan of operations has never been developed for New Melones Reservoir. Water supplies are over- allocated and thus are unable to meet all beneficial uses designated for the project. Reclamation operates New Melones Dam according to the 1997 New Melones Interim Plan of Operations (NMIPO). Although meant to be a short-term plan, the NMIPO continues to be the guiding operations criteria.

AFRP flow volumes on the lower Stanislaus River, as part of the NMIPO, are determined based on New Melones end-of-February storage plus forecasted March-to-September inflow as shown in the NMIPO. The AFRP volume is then initially distributed based on modeled AFRP distributions and patterns used in the NMIPO. The final AFRP flow distributions are determined based on Reclamation and FWS coordination and consultation with DFG. CVPIA Section 3406 (b)(2) releases from New Melones Reservoir consist of that portion of the fishery flow management volume utilized that is greater than the 1987 DFG Agreement and the volume used in meeting the Vernalis flow requirement in the San Joaquin River.

SWRCB D-1641 sets flow standards in the San Joaquin River at Vernalis from February to June. Reclamation is committed to meeting these flow requirements with releases from New Melones Reservoir. In addition, SWRCB D-1422 requires water to be released in order to maintain the dissolved oxygen (DO) standard in the Stanislaus River near Ripon and the total dissolved solids (TDS), measured as electrical conductivity, in the San Joaquin River at Vernalis. In dry years there is not enough water supply to operate to the NMIPO and meet these standards.

The current water temperature objective for the lower Stanislaus River is 65 °F at Orange Blossom Bridge (RM 58.5) for steelhead incubation and rearing from late spring through summer (NOAA Fisheries 2004). This objective has been met since 1999, but may not be obtainable in critically dry years or drought periods.

c. *Vernalis Adaptive Management Plan and the San Joaquin River Agreement*

The San Joaquin River Agreement (SJRA), adopted by SWRCB in D-1641, includes the Vernalis Adaptive Management Plan (VAMP) as part of a 12-year experimental program to provide for pulse flows and export curtailments during the spring time (April-May) to increase fall-run salmon survival through the Delta. The parties to the SJRA include agencies that contribute flow or divert water from tributaries to the San Joaquin River. These parties coordinate to determine the target flow at Vernalis each year adapted to the prevailing hydrologic conditions. Target flows range from 2,000 to 7,000 cfs determined by a Technical Committee. This committee oversees two subgroups, one each for biology and hydrology, that are responsible for the implementation of the flow schedule. At the same time, a combination of State and Federal export reductions limit Delta pumping. The VAMP export targets for the April 15 through May 15 period vary from 1,500 to 3,000 cfs depending on the target flow at Vernalis. Typically, Federal pumping is reduced using (b)(2) water and the State project is reduced using EWA actions; however, in 2003, EWA also provided coverage for a portion of the Federal pumping reduction.

6. Friant Division

This division operates separately from the rest of the CVP and is not integrated into the CVP OCAP, but its operation is part of the CVP for purposes of this project description. Friant Dam is located on the San Joaquin River, 25 miles northeast of Fresno where the river exits the Sierra foothills and enters the San Joaquin valley. The drainage basin is 1,676 square miles in size and has an average annual runoff of 1.774 MAF. Although the dam was completed in 1942, it was not placed into full operation until 1951.

The dam provides flood control on the San Joaquin River, provides downstream releases to meet senior water rights requirements above Mendota Pool, and provides water storage as well as diversion into Madera and Friant-Kern Canals. Water is delivered to a million acres of agricultural land in Fresno, Kern, Madera, and Tulare Counties in the San Joaquin Valley via the Friant-Kern Canal south into Tulare Lake Basin and via the Madera Canal northerly to Madera and Chowchilla Irrigation Districts. A minimum of 5 cfs is required to pass the last water right holding located about 40 miles downstream near Gravelly Ford.

Flood control storage space in Millerton Lake behind Friant Dam is based on a complex formula, which considers upstream storage in the Southern California Edison reservoirs. It has a total capacity of 520,528 af.

D. Description of SWP Facilities, Upstream of the Delta

1. Feather River Division

The Oroville-Thermalito Complex of the SWP includes facilities that conserve water on the Feather River for power generation, flood control, recreation, and fish and wildlife protection. The Oroville-Thermalito Complex includes the following: Oroville Dam and Lake (3.5 MAF capacity), and Edward-Hyatt Powerplant; Thermalito Diversion Dam, Power Canal, Diversion Pool, Diversion Dam Powerplant, Forebay and Afterbay; and the Fish Barrier Dam (see Figure 2-11 in OCAP BA). A maximum of 17,000 cfs can be released from Oroville Dam through the Edward-Hyatt Powerplant. Approximately four miles downstream from the Oroville Dam/Edward-Hyatt Powerplant is the Thermalito Diversion Dam. The Thermalito Diversion Dam creates the Thermalito Diversion Pool which acts as a water diversion point and includes diversions to the Thermalito Power Canal on the north side of the Oroville-Thermalito Complex (*i.e*., majority of the flow; up to 17,000 cfs) and to the historical Feather River channel (*i.e*., low flow channel [LFC]) on the south side. Flows typically are a constant 600 cfs through this eight-mile LFC section except when flood control releases from Lake Oroville occur. The Fish Barrier Dam at the upstream end of the LFC is an impassable barrier that diverts water for use by the DFG Feather River Fish Hatchery.

The Thermalito Power Canal hydraulically links the Thermalito Diversion Pool to the Thermalito Forebay (11,768 AF capacity; offstream regulating reservoir for the Thermalito Powerplant). Water from the Thermalito Forebay exits through the Thermalito Powerplant into the Thermalito Afterbay where it either is diverted for agricultural use or is released back into the Feather River approximately 8 miles downstream of its original diversion point. Thermalito Afterbay provides water for local diversions that can require up to 4,050 cfs during peak demands. In addition, excess water conserved in storage within the Thermalito Afterbay can be used for pumpback operations through both the Thermalito and Edward-Hyatt Powerplants when economically feasible. The Thermalito Diversion Pool serves as a forebay when the Edward-Hyatt Powerplant is pumping water back into Lake Oroville.

An August 1983 agreement between DWR and DFG, *Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife*, sets criteria and objectives for flow and temperatures in the LFC and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement: (1) establishes minimum flows between the Thermalito Afterbay Outlet and Verona which vary by water year type; (2) requires flow changes under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood control, levee failures, etc.; (3) requires flow stability during the peak of the fall-run Chinook salmon spawning season; and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the late spring and summer for shad and striped bass.

The Corps' flood control diagram specifies flood control requirements and regulating criteria for Lake Oroville. From June 15 through September 15, no flood control restrictions exist. Full flood reservation space is required from November 17 through February 7. From September 16 through November 16 and from April 20 through May 31, reserved storage space for flood control is a function of the date. Beginning February 8 and continuing through April 20, flood reservation space is a function of both date and wetness.

a. *Oroville-Thermalito Complex*

DWR proposes to operate the reservoir level to meet the needs of the SWP (*i.e*., water delivery to irrigation districts, flood control, power generation, recreation, D-1641 water quality standards for the Delta, and fish and wildlife protection). Flows are released from Oroville primarily through the Edward-Hyatt Powerplant where most flows are then diverted through the Thermalito Power Canal and Powerplant with the exception of 600 cfs diverted to the LFC. The Edward-Hyatt Powerplant and the Thermalito Powerplant are operated in tandem to maximize power generation. During periods of peak power demands, water releases in excess of local and downstream requirements are conserved in storage at Thermalito Forebay and are pumped back during off-peak hours through both Powerplants into Lake Oroville to generate additional power. Pumpback operations only occur when it is economically advantageous and commonly occur during periods when energy prices are high during on-peak hours of the weekdays and low during the off-peak hours or on weekends.

(1) Feather River minimum stream flows. DWR proposes to provide a year-round minimum flow requirement of 600 cfs, in the historical river channel (LFC) of the Feather River, based upon criteria in the 1983 agreement between DWR and DFG (*i.e*., *Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife*). This eight-mile reach contains the known extent of spring-run Chinook salmon and steelhead spawning and rearing habitat on the Feather River.

DWR also proposes to provide at least the minimum flow requirements that were established in this agreement for the reach of the Feather River downstream of the Thermalito Afterbay to Verona. Minimum flow requirements between the Thermalito Afterbay and Verona vary for different times of the year, but can go as low as 750 cfs when storage falls below 1.5 MAF. Typically, SWP releases a monthly average of 1,250 cfs from December through May, with higher flows to meet water contracts during the summer months (*i.e.*, range from 3,000 to 7,000 cfs).

(2) Feather River seasonal fluctuations and ramping of stream flows. DWR has not proposed any ramping criteria for Oroville releases within the LFC; however, previous interim OCAP opinions have required ramping criteria below 5,000 cfs in the LFC (NOAA Fisheries 2004). Flows below the Thermalito Afterbay, according to the 1983 agreement, when less than 2500 cfs, can not be reduced by more than 200 cfs during any 24-hour period.

(3) Feather River temperature control. DWR proposes to meet temperature criteria established in the 1983 agreement between DWR and DFG. Varying temperature criteria were specified in the agreement for two different locations; the Feather River Hatchery (FRH), and the reach of the Feather River between the Thermalito Afterbay and Verona. Criteria for the FRH were specified to provide suitable temperatures within the hatchery for raising Chinook salmon and steelhead. The hatchery is located at the upstream end of the LFC; therefore, temperatures within the LFC are influenced by the FRH temperature requirements. Temperature criteria between Thermalito and Verona were specified to provide suitable temperatures during the fall months (after September 15) for fall-run Chinook salmon and suitable temperatures from May through August for other anadromous species (*e.g*., American shad and striped bass).

The current water temperature objective for the Feather River LFC is a daily average of 65°F between the Fish Barrier Dam and Robinson's Riffle (RM 61.6) for steelhead incubation and rearing from June 1 through September 30 (NOAA Fisheries 2004).

(4) Department of Water Resources Fish Studies. DWR initiated fisheries studies in 1991 in the LFC. As part of the interim OCAP opinions, DWR was required to report the effects of stranding and isolation resulting from flow fluctuations on listed salmonids (*i.e*., spring-run Chinook salmon and steelhead). These studies focused on collecting presence or absence, rearing, spawning, and emigration data in coordination with DFG and NOAA Fisheries. In 2003, the focus and methods of these studies shifted in order to gather information for the upcoming Federal Energy Regulatory Commission (FERC) dam relicensing process. In 2004, NOAA Fisheries consulted with DWR and issued a biological opinion on proposed fish studies specifically designed to meet the needs of the FERC requirements (DWR 2004b).

E. Description of Delta Facilities

The CVP and SWP use the Sacramento and San Joaquin Rivers and channels in the Delta to transport natural river flows and reservoir storage to two large water export facilities in the south Delta. The CVP Tracy Pumping Plant and the SWP Harvey O. Banks Delta Pumping Plant (Banks Pumping Plant) are operated to meet the water supply needs in the San Joaquin Valley, Southern California, central coast, and southern San Francisco Bay area.

SWRCB decisions and orders largely determine delta operations of CVP and SWP facilities. Reclamation and DWR currently operate CVP and SWP facilities in coordination with the water export facilities in the south Delta to comply with the terms and conditions of SWRCB Decisions . On December 29, 1999, the SWRCB adopted D-1641. D-1641 implements flow objectives for the Bay-Delta Estuary, approves a petition to change points of diversion of the CVP and SWP in the southern Delta *(i.e.*, JPOD [see *Coordinated Operating Agreements*]), and approves a petition to change places of use and purposes of use of the CVP.

Operations of the CVP reflect actions taken in accordance with provisions of the CVPIA, particularly Sections 3406(b)(1), (b)(2), and (b)(3). The 2003 B2 Decision combined with the AFRP Plan provide the basis for implementing upstream and Delta fish actions utilizing CVP yield. The FWS has identified actions that contribute to the CVPIA goal of doubling the natural production of anadromous fish and FWS anticipates selecting actions from this list for the annual management of the 800 TAF of CVP yield dedicated under Section 3406 (b)(2). Not all the actions on this list will be implemented in any given year, but instead FWS will annually select the appropriate actions for use of (b)(2) water supplies based on biological needs, hydrologic circumstances, and water availability. The B2IT will assist Reclamation and FWS in the accounting methodology, and the procedures for management and implementation of annual actions with (b)(2) water supplies.

WY 2004 includes the fourth year of implementation of the EWA as specified in the CALFED Framework Agreement, dated June 9, 2000. The management agencies, NOAA Fisheries, DFG, and FWS, are charged with managing these assets in coordination with project operators, the Water Operations Management Team (WOMT), and the CALFED Operations Group (CALFED Ops Group). Recently, through the use of the *Salmon Decision Process* (formerly known as the Spring-run Protection Plan), the EWA has been used to protect juvenile spring-run Chinook salmon in the Delta and adult steelhead spawning in the American River.

1. CVP Export Facilities and Tracy Fish Collection Facility

The Tracy Pumping Plant, (Alameda County) 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 pumping capacity permitted by the SWRCB is 4,600 cfs. The capacity is also limited by the freeboard constriction in the Delta-Mendota Canal (DMC). 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 (San Joaquin County) into the DMC. A portion of the water conveyed through the DMC flows into O'Neill Forebay and from there is pumped into San Luis Reservoir (Merced County) for storage (see OCAP BA Chapter 2 for map of South of Delta Facilities).

The Tracy Fish Collection Facility (TFCF), at the intake to the DMC, is designed to intercept fish before they pass through the DMC 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 (fps) from May 15 through October 31, and for Chinook salmon of approximately 3 fps from November 1 through May 14. Channel velocity criteria are a function of bypass ratios (*i.e.*, the ratio of the mean bypass entrance velocity to the mean approach channel velocity) 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.

The *Salmon Decision Process* establishes a set of criteria based on real-time monitoring (*i.e.*, upstream and at the Fish Collection Facilities) as a requirement of the WRO and SWRCB D-1641 for the Delta. These criteria were established to protect juvenile spring-run and winter-run Chinook salmon as they passed through the Delta. The *Salmon Decision Process* was later revised to protect juvenile steelhead and YOY spring-run Chinook salmon. These criteria or fish protection triggers guide DCC gate closures and export reductions at the Delta pumping facilities to protect listed salmonids.

Fish passing through the TFCF will be sampled at intervals of no less than 10 minutes every 2 hours. Fish observed during sampling intervals will be identified to species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to release sites away from the pumps. All other non-sampled fish that enter the facility will be collected and transported by tanker truck to downstream Delta release sites.

Reclamation recognizes that Delta export operations must be coordinated with other actions and programs in the Delta and Central Valley. Through the CALFED Ops Group, Data Assessment Team (DAT), and Water Operations Management Team (WOMT), NOAA Fisheries and the other CALFED agencies will be updated weekly on CVP operations and participate in decisions which involve change in export rates, barrier operations, or reservoir releases. The CALFED Ops Group will also serve to distribute information regarding CVPIA fish actions and EWA actions.

2. <u>State Water Project Export Facilities and Skinner Fish Protection Facility</u>

The Banks Pumping Plant (Banks), consists of 11 pumps, including two rated at 375 cfs, five at 1,130 cfs, and four at 1,067 cfs. Water is pumped from the Clifton Court Forebay (CCF) through the Banks Pumping Plant into the California Aqueduct, which has a nominal capacity of 10,300 cfs. Average daily pumping at the Banks Pumping Plant is constrained by diversion limitations at the CCF intake gates. Water in the California Aqueduct flows to O'Neill Forebay, from which a portion of the flow is lifted to the joint CVP/SWP San Luis Reservoir for storage. From O'Neill Forebay, the joint-use portion of the aqueduct, San Luis Canal, extends south to the southern end of the San Joaquin Valley. The SWP portion of the aqueduct continues over the Tehachapi Mountains to the South Coast Region.

Delta water inflows to the CCF are controlled by radial arm gates, which are generally operated during the tidal cycle to reduce approach velocities, prevent scour in adjacent channels, and minimize water level fluctuation in the south Delta by taking water in through the gates at times other than low tide. When a large head differential exists between the outside and inside of the gates, theoretical inflow can be as high as 15,000 cfs for a short period of time. However, existing operating procedures identify a maximum design rate of 12,000 cfs, which prevents water velocities from exceeding 3 fps to control erosion and prevent damage to the facility.

The Skinner Fish Protection Facility (SFPF) located between Banks and CCF, intercepts fish, which are collected and transported by tanker truck to downstream release sites. This facility uses behavioral barriers, similar to the TFCF, consisting of primary and secondary louvers to guide targeted fish into holding tanks for subsequent transport by truck to release sites within the Delta. When compatible with export operations, the louvers are operated with the objective of achieving water approach velocities for striped bass of approximately 1 fps from May 15 through October 31, and for Chinook salmon of approximately 3 fps 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. The SWP maintains two permanent release sites in the Delta: one at Horseshoe Bend on the Sacramento River and the other at Curtis Landing on the San Joaquin River.

DWR proposes to operate the Banks and SFPF in compliance with SWRCB D-1641, the 1993 WRO, the 1995 FWS delta smelt biological opinion, the Salmon Decision Process, and the COA (see *Operating Agreements and Constraints*). DWR operations includes implementing Delta and upstream reservoir actions as described in the latest B2 Decision, in a manner that reduces potential water supply impacts on Delta actions. Although management of (b)(2) water changed in 2003 (B2 Decision), the fisheries protection actions have generally remained the same for spring-run Chinook salmon and steelhead (NOAA Fisheries 2004), and a process to facilitate implementation and ensure that (b)(2) water actions do not adversely affect the SWP remains in place. DWR recognizes that (b)(2) water actions in the Delta cannot be successfully implemented without the coordination and cooperation of the SWP and thus, DWR remains fully engaged in the process to coordinate operations and develop tools to avoid or minimize water supply impacts. Since the CALFED ROD was completed in 2000, the EWA has been used in conjunction with the CVPIA (b)(2) actions to protect endangered fish species. For purposes of *early consultation*, use of a long-term EWA has been modeled based on its use over the last four years. Typically, EWA actions are taken to curtail exports during key fish migration intervals with most of the EWA cost being applied to the SWP while CVPIA (b)(2) actions are applied to the CVP. Additionally, some benefit to listed salmonids may occur when EWA water is released (e.g. improved spawning flows, improved water temperatures, increased rearing habitat, etc)

The Banks Pumping Plant will operate up to its maximum permitted rate of 6,680 cfs except during periods of low Delta inflow, curtailments for fish protection, implementation of CVPIA (b)(2) actions, curtailments for water quality exceedence (D-1641), or reduced demand. During the period between December 15 and March 15, the Banks Pumping Plant may operate above 6,680 cfs to export one-third of the total flow of the San Joaquin River as measured at Vernalis when its total flow exceeds 1,000 cfs. DWR proposes to operate CCF and Banks to a higher rate (*i.e*., 8500 cfs) in the future. This higher rate of Banks pumping is described within the early consultation portion of this opinion. Upon filling the SWP portion of San Luis Reservoir, pumping at Banks will be reduced to a lower level to support exports for the CVP Cross Valley supplies and delivery of an undetermined amount of interruptible supplies (referred to as Article 21 water) to SWP contractors.

The Skinner Fish Protection Facility will be operated to intercept fish before they pass down the California Aqueduct to the Banks Pumping Plant. Fish passing through the facility will be sampled (similar to TFCF) at intervals of no less than 10 minutes every 2 hours. Fish observed during sampling intervals will be identified to species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to release sites away from the pumps. All other non-sampled fish passing through the facility will be collected and transported by tanker truck to Delta release sites.

DWR also recognizes that Delta export operations must be coordinated with other actions and programs in the Delta and Central Valley. Through the CALFED Ops Group, WOMT, and DAT meetings, NOAA Fisheries and the other CALFED agencies will be updated weekly on SWP Delta operations and participate in decisions which involve change in export rates, barrier operations, or reservoir releases. The CALFED Ops Group will also serve to distribute information regarding CVPIA (b)(2) and EWA water actions.

3. San Luis Reservoir Operations

The San Luis Reservoir (SLR), part of the West San Joaquin Division, is jointly operated by the SWP and the CVP. Water demands from San Luis Reservoir primarily are composed of three types: water service contractors, exchange contractors, and wildlife refuge contracts. Exchange contractors have "exchanged" their senior water rights from the San Joaquin River for a CVP water supply taken from the Delta. The fill and drawdown cycle of SLR is an important part of CVP operations. Typically, water is jointly stored in SLR during the fall and winter months when the two pumping plants can export more water from the Delta than is needed to meet scheduled demands. During the spring and summer, water demands are greater than Reclamation's and DWR's capability to pump water (*e.g.*, due to reductions for fish protection and VAMP described earlier); therefore, water stored in SLR is released to make up the difference. Irrigation demands are greatest during this period, and SLR continues to decrease in storage until it reaches a low point late in August. This low point in storage capability causes a water quality problem for diverters dependant upon SLR for M&I supplies (e.g., Santa Clara and San Benito counties). A solution to the low point problem in SLR is proposed as part of the long-term operation of the project and identified in the CALFED ROD as a complementary action. This action to reduce the low point problem is considered part of the future operations under early consultation and will be addressed in a separate consultation (See OCAP BA Chapter 2 for a more detailed description of SLR water and power supply coordination).

4. North Bay Aqueduct Intake at Barker Slough

The SWP uses the North Bay Aqueduct intake at Barker Slough to divert water from the north Delta near Cache Slough for agricultural and municipal uses in Napa and Solano counties. The North Bay Aqueduct is located ten miles from the mainstem Sacramento River. Maximum pumping capacity is about 175 cfs. Daily pumping rates typically range from 20 to130 cfs. The intake has a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inch. The facility is operated to maintain a screen approach velocity of no greater than 2 fps.

5. Delta Cross Channel Gates Operation

The Delta Cross Channel (DCC) is a controlled diversion channel located in the northern Delta between the Sacramento River and Snodgrass Slough, a tributary to the Mokelumne River. Reclamation operates the DCC gates to improve the transfer of water from the Sacramento River to the central Delta and export facilities at the Banks and Tracy Pumping Plants. To reduce scour in the channels on the downstream side of the DCC gates and to reduce potential flood flows that might occur from diverting water from the Sacramento River into the Mokelumne River system, the radial gates are closed whenever flows in the Sacramento River at Freeport reach 25,000 to 30,000 cfs on a sustained basis. Flows through the gates are determined by Sacramento River stage and are not affected by export rates in the south Delta.

The DCC gates can be closed by Reclamation for the protection of fish, provided that water quality is not a concern in the Central or South Delta. From February 1 through May 20, the

SWRCB D-1641 requires that the DCC gates remain closed for the protection of emigrating juvenile Chinook salmon in the Sacramento River. An optional closure up to 45 days can be requested by the fish agencies during the November through January period and 14 days during the May 21 through June 15 period. The timing and duration of these closures shall be determined by Reclamation in consultation with FWS, DFG and NOAA Fisheries.

Consultation with the CALFED Ops Group will also satisfy the SWRCB D-1641 requirement for DCC gate closures. The CALFED Ops Group uses the *Salmon Decision Process* (see OCAP BA Appendix B for complete description) developed to comply with the California Fish and Game Commission Special Order related to spring-run Chinook incidental take authorization under the CESA. The *Salmon Decision Process* includes monitoring of juvenile salmon movements in the lower Sacramento River and Delta (*e.g*., using the Knights Landing and Sacramento Catch Indexes), data assessment procedures, specific indicators of spring-run Chinook salmon vulnerability to impacts from Delta pumping, and operation responses to minimize the effects of Delta export pumping. Three specific actions are presented in the plan: (1) First Alert requires the DAT to analyze and report the results of fisheries monitoring programs; (2) Second Alert requires the closure of the DCC gates for specific periods of time dependant on the Sacramento River Catch Index; and (3) DAT recommends export curtailments in five day increments to WOMT, dependant on fish salvage and loss results at the CVP/SWP facilities. Whether or not exports are reduced and to what degree depend upon the amount of EWA assets available for that month. Exports can only be reduced if there is no impact to the CVP/SWP. The WOMT is made up of agency management, including NOAA Fisheries, who weekly review the availability and priority regarding the use of EWA and (b)(2) water to compensate for curtailments.

6. Suisun Marsh and Salinity Control Gates

The Suisun Marsh is managed by DWR to provide water to privately managed wetlands. A system of levees, canals, gates and culverts were constructed from 1979 to1980 to lower the salinity into these wetlands as part of the *Plan of Protection for the Suisun Marsh*. Included in the Suisun Marsh operations is the Roaring River Distribution System (5,000 acres), the Morrow Island Distribution System, the Goodyear Slough Outfall, Lower Joice Island Unit, and the Cygnus Unit. Most of these systems have either screened intakes or have no impacts to fish.

The Suisun Marsh Salinity Control Gates (SMSCG) are located about 2 miles northwest of the eastern end of Montezuma Slough, near Collinsville. The radial gates, which span the entire 465 foot width of Montezuma Slough, include permanent barriers adjacent to the levee on each side of the channel, flashboards, and a boat lock. The structure is operated from September through May to lower the salinity from Collinsville through Montezuma Slough into the eastern and central portion of Suisun Marsh. The SMSCG also serve to retard the movement of higher salinity water from Grizzly Bay into the western marsh. During full gate operation, the SMSCG open and close twice each tidal day. During ebb tides, the gates are open to allow the normal flow of lower salinity water from the Sacramento River to enter Montezuma Slough. During flood tides, the gates are closed to retard the upstream movement of higher salinity water from Grizzly Bay.

DWR operates the SMSCG to meet water quality standards in SWRCB D-1641 and the Suisun Marsh Preservation Agreement. The non-operation configuration of the SMSCG during this period typically consists of the flashboards installed, but the radial gate operation is stopped and held open. Flashboards will be removed if it is determined that salinity conditions at all trigger stations would remain below standards for the remainder of the control season through May 31.

The 1993 WRO required DWR to implement fish studies at the SMSCG designed to address diversion rates of juvenile Chinook salmon into Montezuma Slough, predation of juveniles at the structure, survival through Montezuma Slough, and adult passage. Testing of gate operations to allow for greater passage of adult salmon without delays began in 1998. Results from these studies determined that slots in the gates did not result in increasing adult passage. Further studies evaluating the use of the boat lock as a means of providing unimpeded passage were conducted in 2001-2002, 2002-2003, and are planned for 2003-2004.

7. Contra Costa Canal and Rock Slough Pumping Plant

The Contra Costa Canal was built by Reclamation in 1948 and is currently operated by the Contra Costa Water District (CCWD). The CCWD uses three intakes (*i.e.*, Rock Slough, Old River and Mallard Slough) to divert water from the Delta into the Contra Costa Canal for irrigation and M&I uses in central and northeastern Contra Costa County. The unscreened Rock Slough intake consists of four pumping plants that lift diverted water 127 feet into the Contra Costa Canal. This 47.7 mile long canal terminates into Martinez Reservoir. In addition, two short canals called Clayton and Ygnacio are integrated into the distribution system. Rock Slough has a diversion capacity of 350 cfs, which gradually decreases to 22 cfs at the terminus.

Prior to 1997, Rock Slough was the primary diversion facility for CCWD in the Delta and pumping ranged from 50 to 250 cfs with seasonal variation. In 1997, CCWD began additional diversions from the Delta at a new 250 cfs screened intake diversions on Old River, which is part of the recently completed Los Vaqueros Project. The Old River facility allows CCWD to directly divert up to 250 cfs of CVP water into a blending facility with the existing Contra Costa Canal, which allows for reduced diversion needs at Rock Slough. In addition, the Old River facility can divert up to 200 cfs of CVP water and Los Vaqueros water rights for storage into the new 100 TAF Los Vaqueros Reservoir. The much smaller Mallard Slough Intake (50 cfs capacity?) was screened in 2002 and is used only during the winter months when water quality is sufficient to allow additional pumping.

Pursuant to the FWS biological opinion for Los Vaqueros Project (FWS 1993), the Old River Facility is now the primary diversion point for CCWD during January through August of each year. All three intakes are operated as an integrated system to minimize impacts to listed fish species. Both the NOAA Fisheries (1993b) and FWS opinions for the Los Vaqueros Project require CCWD to cease all diversions from the Delta for 30 days during the spring if stored water is available for use in Los Vaqueros above emergency storage levels. Additionally, the 1993 biological opinions require monitoring of incidental take at all three intakes.

Construction of a fish screen for the Rock Slough Pumping Plant intake was required in the 1993 NOAA Fisheries biological opinion for the Los Vaqueros Project and again under the CVPIA. Reclamation and CCWD have responsibility for building the fish screen; however, due to a series of problems with land acquisition and high costs, the screen was never built. Reclamation requested from FWS and was granted another extension of the fish screen project until December 2008, in order to allow for additional CALFED studies concerning future use of this diversion.

F. Delta-Mendota Canal and California Aqueduct Intertie

Reclamation and DWR are proposing the construction and operation of a pipeline and 400 cfs pumping plant between the Delta-Mendota Canal (DMC) and the California Aqueduct. The Intertie alignment is proposed for milepost 7.2 on the DMC and mile post 9.0 on the California Aqueduct, where the two canals are approximately 500 feet apart. The Intertie would be used in a number of ways to facilitate improved capacity of the SWP and CVP and allow for maintenance and repair of the CVP export and conveyance facilities. The Intertie would allow flow in both directions, which would provide additional flexibility for project operations. Up to 950 cfs could be conveyed from the California Aqueduct to the DMC using gravity flow. The Intertie would be owned by Reclamation and operated by the San Luis and Delta Mendota Water Authority.

The operations of the Intertie would occur under the following scenarios:

- 400 cfs would be pumped from the DMC to the California Aqueduct to meet CVP contractors supply demands. This would allow Tracy Pumping Plant to meet it’s 4,600 cfs capacity.

- 400 cfs would be pumped from the DMC to the California Aqueduct to minimize reductions due to maintenance or emergency shutdowns.

- 950 cfs would be conveyed from the California Aqueduct to the DMC to minimize reductions due to maintenance or emergency shutdowns.

Water conveyed through the Intertie could include pumping of CVP water at Banks or SWP water at Tracy Pumping Plant through the use of JPOD. In accordance with COA and Stage 2 conditions for JPOD in SWRCB D-1641 (see discussion in Section II.B.2.), JPOD could be used to replace lost conveyance opportunities due to unforseen outages.

G. Freeport Regional Water Project

Reclamation and the Freeport Regional Water Authority (FRWA) are proposing to construct and operate a new water supply intake and treatment plant located on the Sacramento River at Freeport, approximately 10 miles downstream of Sacramento and the mouth of the American River. The FRWA is a joint powers agency formed by Sacramento County Water Agency and East Bay Municipal Utility District (EBMUD). Reclamation proposes to deliver CVP water to meet its respective water supply contracts with the two entities. This consultation just looks at the effects of the operation of the Freeport Project as it pertains to the OCAP. A separate consultation will consider the construction effects of facility, its facility operations, and associated infrastructure.

The Freeport Project has a design capability of 286 cfs, of which 132 cfs would be diverted by Sacramento County and 155 cfs by EBMUD. The water treatment facility at Freeport would connect to the already built Folsom South Canal (part of the CVP American River Division) and extend the canal to the Mokelumne Aqueduct which transfers water to the San Francisco Bay Area. EBMUD would divert its portion of CVP contract water (133 TAF) in any year when EBMUD's March Forecast for October is less than 500 TAF total storage. Deliveries to EBMUD are subject to the usual CVP contract allocations and shortage conditions. In addition, EBMUD would be limited to no more than 165 TAF in any consecutive three year drought period. Average annual deliveries to EBMUD are approximately 23 TAF, and the maximum delivery in any one year is approximately 99 TAF.

Part of EBMUD's diversion from the Freeport Project would be used to improve flows in the Mokelumne River downstream of Camanche Dam. Up to 20 percent (*i.e.*, 20 TAF) of dry year water diverted at Freeport will be made available for Camanche Reservoir releases. When this water is made available, it will be released at the discretion of DFG and FWS.

H. Water Transfers

The Project promotes water transfers as a means of addressing water shortages and providing protection to source areas. Water is generally acquired from willing sellers who can pump groundwater instead of using surface water, idle crops, or use less water in order to reduce consumptive use of surface diversions. Transfers usually are exported at the Delta pumping plants during times when pumping and conveyance capacity exist. DWR and Reclamation operate several water acquisition programs that rely on water transfers to provide additional supplies to environmental programs and water service contractors. These programs include DWR's Dry Year Program, Drought Water Bank Program, CALFED EWA and ERP programs, CVPIA Water Acquisition Program, Reclamation's forbearance program, and the Sacramento Valley Water Management Agreement (i.e., formerly referred to as Phase 8 Water). In addition, CVP and SWP contractors can independently acquire water and arrange for pumping through the SWP when capacity exists.

The project may provide Delta export pumping for transfers when surplus capacity is available and within the existing operational constraints (*e.g.*, E/I ratio, conveyance capacity, water quality standards, etc). The majority of transfers occur during the July-September period and would increase Delta exports from 200-600 TAF. In the 20 percent of years which are critically dry both Banks and Tracy have surplus capacity, in these years water transfers may range as high as 800 TAF to1 MAF depending on upstream supplies, however, the range anticipated for this project is 200-600 TAF. Transfers that are above the typical range or outside the July-September season would be implemented as needed to avoid increased incidental take of listed fish species. Reclamation and DWR would coordinate transfer timing through the B2IT, Environmental Water Account Team (EWAT), and WOMT to ensure that changes in upstream flows and Delta exports are not disruptive to planned fish protection actions. Project capacity for transfers is highest in dry years when the demand is high and lowest in wet years when capacity is limited and demand is low.

I. Adaptive Management Process

Reclamation and DWR work closely with FWS, DFG, and NOAA Fisheries to coordinate the operation of the CVP and SWP with fishery needs. To achieve this coordination several agency and public groups are discussed below.

1. CALFED Operations Group

The CALFED Ops Group was organized in 1995 and consists of staff from Reclamation, DWR, FWS, DFG, NOAA Fisheries, SWRCB, and the Environmental Protection Agency (EPA). The group meets once a month in an open public setting to discuss the operations of the CVP and SWP, implementation of the CVPIA, and ESA protections. The group is recognized within the SWRCB D-1641, and elsewhere, as a decision making group when it comes to flexibility incorporated into certain Delta standards (e.g., E/I ratio, DCC gate closures, JPOD, etc). Several teams were established to assist the group in this management process. These are listed below.

a. *Operations and Fish Forum*

The Operations and Fish Forum (OFF) was established as a stakeholder driven process to disseminate information regarding recommendations and decisions about project operations. An OFF member is considered the contact person for the interest group they represent when issues need to be addressed by the CALFED Ops Group. Alternatively, the OFF group may be called upon by the CALFED Ops Group to develop recommendations on issues of concern to operations.

b. *Data Assessment Team*

The DAT is a technical group consisting of project operators, biologists and stakeholders that review on a weekly basis information on project operations and fish movement at the various monitoring locations in the Central Valley. The DAT assesses the information and makes recommendations regarding changes in operations to protect listed fish. These recommendations are a key element in implementation of the EWA.

The DAT uses the Salmon Decision Process (see OCAP BA Appendix B) to guide the recommendations used for protective fish actions. The Salmon Decision Process uses input from water quality, current hydrologic events, fish indicators (e.g., lifestage, size, and catch indexes), as well as current salvage and loss data from the Delta fish collection facilities. This coordinated process is then used to determine timing of DCC gate closures and export reductions.

c. *B2 Interagency Team*

The B2IT was established in 1999 to define and account for the use of (b)(2) water. The Team is made up of Reclamation, DWR, DFG, FWS and NOAA Fisheries staff members that meet weekly to coordinate the release of this water along with other CVPIA Section 3406 water [*i.e.*, (b)(1) re-operation, and (b)(3) acquired water] and the CALFED EWA.

d. *Environmental Water Account Team*

The EWAT was established in 2000 to keep track of and implement CALFED EWA actions. The team is made up of Reclamation, DWR, DFG, FWS and NOAA Fisheries staff members that meet weekly to make decisions on purchasing water and coordinating actions with the CVPIA and B2IT.

2. <u>Fisheries Technical Teams</u>

Several fisheries specific teams have been established to provide guidance on resource management issues that effect project operations.

a. *Sacramento River Temperature Task Group*

The SRTTG was established in 1987 as a multi-agency group to develop temperature operational plans for the Shasta and Trinity Divisions of the CVP pursuant to the SWRCB Water Rights Orders 90-5 and 91-1. These temperature plans consider the impacts to winter-run Chinook salmon and other races of Chinook salmon from project operations. Previous plans have included releases of water from the low level outlets at Shasta Dam and Trinity Dam, operation of the TCD, warm water releases, and manipulating the timing of Trinity River diversions through Spring Creek Powerplant. Warm water releases from the upper level outlets have been made to conserve cold water in Shasta Lake for temperature control in the late summer and to induce winter-run Chinook salmon to spawn as far upstream as possible. The SRTTG typically first meets in spring once the cold water availability in Shasta Reservoir is known.

b. *American River Operations Group*

In 1996, Reclamation established an operational working group for the Lower American River known as the AROG. This advisory group is open to the public and generally includes representatives from Reclamation, DWR, FWS, DFG, NOAA Fisheries, SAFCA, Water Forum, City of Sacramento, County of Sacramento, WAPA, and Save the American River Association. The AROG meets once a month, or more frequently when needed, with the purpose of providing fishery updates and information to Reclamation to better manage Folsom Reservoir operations.

c. *San Joaquin Technical Committee*

The San Joaquin Technical Committee (SJTC) meets for the purposes of planning and implementing the VAMP each year and oversees two subgroups: the Biology and Hydrology groups. These two subgroups are charged with certain responsibilities (see OCAP BA Chapter 2), and must coordinate with the SJTC as described under the San Joaquin River Agreement.

d. *Delta Cross Channel Project Work Team*

This is a multi-agency CALFED team made up of staff from Reclamation, EPA, U.S. Geological Survey (USGS), DWR and FWS. The purpose of the group is to determine and evaluate the impacts of DCC gate operations on Delta hydrodynamics, water quality, and fish migration. The project work team coordinates with the DAT and OFF groups to conduct gate experiments and estimate impacts from real time gate operations.

3. Water Operations Management Team

To facilitate timely decision support and decision making at the appropriate level, a management-level team was established. The WOMT first met in 1999, and consists of management level participants from the Project and Management agencies. The WOMT meets frequently[3] in order to provide oversight and decision making that must routinely occur within the CALFED Ops Group process. The WOMT relies heavily upon the DAT and B2IT for recommendations on fishery actions. It also utilizes the CALFED Ops Group to communicate with stakeholders about its decisions. Although the goal of WOMT is to achieve consensus on decisions, the agencies retain their authorized roles and responsibilities.

a. *Process for Using Adaptive Management*

Decisions regarding CVP and SWP operations must consider many factors that include public safety, water supply reliability, cost, as well as regulatory and environmental requirements. To facilitate such decisions, the Project and Management Agencies have developed and refined a process to collect data, disseminate information, develop recommendations, and make decisions.

(1) ***A workgroup makes a recommendation for a change in CVP and SWP operations.*** Generally, operational adjustments to protect fish are initiated as the result of concern expressed over the interpretation of data that have been collected or as a part of an overarching strategic plan to improve habitat conditions. Examples of conditions that could signal concern include observance of large numbers of juvenile Chinook salmon entering the Delta, high salvage of delta smelt at the export facilities, or unfavorable distribution of delta smelt throughout the Delta. Examples of strategic plans include maintaining higher releases for in stream needs or closing the DCC gates to keep emigrating juvenile Chinook from entering the central Delta.

(2) ***The Project Agencies consider the recommendation and seek consensus with the Management Agencies***. Decisions regarding changes to the CVP and SWP operations must be made quickly to be effective. To accomplish this, recommendations are vetted with the management-level staff of the Project and Management Agencies. This provides for appropriate consideration of the many factors that must be taken into consideration.

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[3] As with the DAT, WOMT holds weekly meetings during the critical fish periods. In addition, it will hold impromptu meetings or conference calls to consider recommendations for changes in the operations of the CVP and SWP.

(3) ***The recommendations and decisions are disseminated.*** Numerous stakeholders have a keen interest in CVP and SWP operations. In fact, workgroups established through the CALFED Ops Group process (DAT and OFF are two prime examples) have significant stakeholder involvement. In addition, decisions regarding the projects can have significant policy-related implications that must be presented to the State and Federal administrations. To facilitate adequate feedback to stakeholders, Reclamation and DWR disseminate recommendations and the resulting decisions to agencies and stakeholders through the OFF and DAT.

(4) ***Annual reporting is performed to summarize when decision trees are used and results are updated***. (*e.g.*, the DAT determines adult delta smelt are migrating upstream to spawn in sufficient numbers to warrant a change in pumping levels. After careful consideration of the water supply costs to the EWA and CVPIA b(2) water assets, DAT recommends a five-day reduction in exports). The WOMT meets and considers the recommendation of the DAT, and after careful consideration of the recommendation, WOMT agrees that EWA and CVPIA b(2) assets may be used to implement the export reduction. Reclamation and DWR then implement the export reduction as prescribed.

In addition, South Delta barrier operations will be continually studied and refined by WOMT or DAT representatives, including Reclamation, DWR, DFG, NOAA Fisheries, delta stakeholders and representatives of the Delta Smelt Working Group. Representatives from these groups will meet to determine how best to operate South Delta barriers in order to balance fish needs with water levels and water quality needs. Forecast modeling as well as monitoring of real-time barrier operations will be used to modify operations as needed.

J. Interrelated and Interdependent Actions

1. Water Service Contracts and Deliveries

a. *Water Needs Assessment*

Water needs assessments have been performed for each CVP water contractor eligible to participate in the CVP long-term contract renewal process. Water needs assessments confirm a contractor’s past beneficial use and determine future CVP water supplies needed to meet the contractor’s anticipated future demands. The assessments are based on a common methodology used to determine the amount of CVP water needed to balance a contractor’s water demands with available surface and groundwater supplies.

As of September 2004, all but two of the contractor assessments have been finalized. These assessments remain under analysis and require additional information from the contractors to be completed. It is anticipated that all of the assessments will be concluded by November 1, 2004. Because of the remaining assessments, the total supply required to meet the all the demands for the CVP cannot be determined at this time.

For modeling purposes, assumptions for future conditions have been made, even though all water assessments are not completed. The 2020 LOD includes higher amounts than the 2001 LOD on the American River. Surface water deliveries from the American River are made by various water rights entities and CVP contractors. Total annual demands are estimated to increase from about 256 TAF in 2001 to about 688 TAF by 2020, including water deliveries expected for the FRWP. Reclamation is negotiating the renewal of 13 long-term water service contracts, four Warren Act contracts, and has a role in six infrastructure or Folsom Reservoir operations actions influencing the management of American River Division facilities and water use.

b. *Central Valley Project Municipal and Industrial Water Shortage Policy*

The CVP has 253 water service contracts (including Sacramento River Settlement Contracts). These water service contracts have had varying water shortage provisions (*e.g*., in some contracts, M&I and agricultural uses have shared shortages equally; in most of the larger M&I contracts, agricultural water has been shorted 25 percent of its contract entitlement before M&I water was shorted, and then both shared shortages equally). Since 1991, Reclamation has been attempting to develop an M&I Water Shortage Policy applicable to as many of the CVP contractors as appropriate.

For a contractor to receive the M&I minimum shortage allocation by means of the proposed policy, its water service contract must reference the proposed policy. For various reasons, Reclamation expects the proposed policy will not be referenced in contracts for the (1) Friant Division, (2) New Melones interim supply, (3) Hidden and Buchanan Units, (4) Cross Valley contractors, (5) Sugar Pine Units (subjects of title transfer legislation), (6) San Joaquin settlement contractors, and (7) Sacramento River settlement contractors. Any separate shortage-related contractual provisions will prevail.

The proposed policy provides a minimum shortage allocation for M&I water supplies of 75 percent of a contractor’s historical use, which is defined as the last three years of water deliveries unconstrained by the availability of CVP water. Historical use can be adjusted for growth, extraordinary water conservation measures, and use of non-CVP water as those terms are defined in the proposed policy. Before the M&I water allocation is reduced, the irrigation water allocation would be reduced below 75 percent of contract entitlement.

The proposed policy also provides that when the allocation of irrigation water is reduced below 25 percent of contract entitlement, Reclamation will reassess the availability of CVP water and CVP water demand; however, due to limited water supplies during these times, M&I water allocation may be reduced below 75 percent of adjusted historical use. Shortages for South of Delta and North of Delta irrigation allocations and M&I allocations are the same.

The proposed policy provides that Reclamation will deliver CVP water to all M&I contractors at not less than a public health and safety level if CVP water is available, if an emergency situation exists (i.e., taking into consideration water supplies available to the M&I contractors from other sources), and in recognition that the M&I allocation may, nevertheless, fall to 50 percent when the irrigation allocation drops below 25 percent due to limited CVP supplies. It should be noted the minimum shortage allocation of 75 percent, as proposed in the September 11, 2001, draft M&I Water Shortage Policy would apply only to that portion of CVP water identified as of September 30, 1994, as shown on Schedule A-12 of the 1996 M&I Water Rates book, and for those contract quantities specified in section 206 of Public Law 101-514. However, under the proposed policy a contractor may request an M&I minimum shortage allocation for post-1994 identified water that is transferred or assigned, converted, provided significant impacts upon irrigation supplies, or upon irrigation and M&I supplies, respectively, are mitigated.

Due to the development of policy alternatives generated by Reclamation after consideration of public comment, that portion of CVP water to which the minimum shortage allocation would apply could change prior to policy finalization. Prior to such finalization, Reclamation will meet the requirements of the NEPA and the Federal ESA. See OCAP BA Chapter 2 for a comparison of the most current assumptions for agricultural to M&I shortages under different water years.

2. Fish Hatcheries

In the Central Valley, six hatcheries have been established to offset the loss of salmon and steelhead due to construction of dams. Additionally, Trinity River Fish Hatchery mitigates for salmon and steelhead losses on the Trinity River. The Mokelumne River Hatchery, although not directly related to CVP or the SWP dams, does influence fall-run Chinook salmon and steelhead populations. Added together, Central Valley hatcheries annually produce approximately 250,000 winter-run Chinook salmon; 5 million spring-run Chinook salmon; 29.76 million fall-run Chinook salmon; and 1.5 million steelhead. Currently, most Central Valley hatcheries truck their salmon production to the Bay-Delta region for release. The exception to this is Coleman National Fish Hatchery which releases it’s production into the upper Sacramento River. Listed below are the production goals for each hatchery in the Project action area.

a. *Trinity River Fish Hatchery*

CVP mitigation for the loss of upstream riverine habitat caused by the construction of the Trinity and Lewiston Dams. The hatchery, operated by DFG, annually produces 1.4 million spring-run Chinook salmon, 2.9 million fall-run Chinook salmon, 500,000 coho salmon, and 800,000 steelhead.

b. *Nimbus Fish Hatchery*

The Nimbus Fish Hatchery and the American River Trout Hatchery were constructed to mitigate for the loss of riverine habitat caused by the construction of CVP Nimbus and Folsom Dams. The American River Trout Hatchery produces fish for stocking inland areas (i.e., above dams) and is therefore not considered in the production goals for the Central Valley. Nimbus Fish Hatchery, operated by DFG, is located below Nimbus Dam and produces 4 million fall-run Chinook salmon smolts and 430,000 steelhead yearlings.

c. *Feather River Fish Hatchery*

SWP mitigation for the loss of upstream riverine habitat caused by the construction of Oroville Dam and Thermalito Complex. The hatchery, operated by DFG, annually produces 8 million fall-run Chinook salmon, 5 million spring-run Chinook salmon, and 400,000 steelhead.

d. *Coleman National Fish Hatchery*

Located approximately 32 miles downstream of Keswick Dam and six miles up Battle Creek (tributary to Sacramento River). CVP mitigation for the loss of upstream riverine habitat caused by the construction of Shasta Dam and Keswick Dam. The hatchery, operated by the FWS is one of the largest in the United States, annually producing 12 million fall-run Chinook salmon, 1 million late fall-run Chinook salmon and 600,000 steelhead.

e. *Livingston Stone National Fish Hatchery*

This small conservation hatchery, built in 1996 and operated by the FWS, is located below Shasta Dam. The purpose of this hatchery is to recover Sacramento River winter-run Chinook salmon. A specific number of adults are allowed to be captured at RBDD fish ladders and Keswick Dam and trucked to the hatchery for spawning. Typically this hatchery releases up to 250,000 winter-run Chinook salmon smolts into the upper Sacramento River above Red Bluff in late January or early February.

K. Early Consultation Actions

The following actions have been proposed as part of the early consultation: 1) operational components of the South Delta Improvement Program, including permanent barriers; 2) water transfers; 3) CVP/SWP Project Integration; and 4) a long-term EWA. Generally, these actions could be implemented within three years after completion of their respective environmental reports. However, the SDIP would probably take longer, since it requires that permanent barriers be constructed first before increasing pumping to 8500 at Banks per the CALFED ROD.

1. Operational Components of the South Delta Improvement Program

DWR and Reclamation have agreed to jointly pursue the development of the CALFED South Delta Improvement Program (SDIP) to address regional and local water supply needs, as well as the needs of the aquatic environment. Overall, the SDIP components are intended to meet the project purpose and objectives by balancing the need to increase the current regulatory limit on inflow into CCF with the need to improve local agricultural diversions and migratory conditions for fall and late fall-run Chinook salmon in the San Joaquin River. Two key operational features of the SDIP are included as part of this project description.[4]

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[4] This project description does not include any aspect of the SDIP that is not explicitly identified in the text. Examples of SDIP actions that are not included are construction (*i.e.*, as opposed to operation) of permanent barriers and dredging. Both of these activities will be covered by subsequent consultation.

a. *8500 cfs Operational Criteria*

From March 16 through December 14, the maximum allowable daily diversion rate into CCF shall meet the following criteria: 1) the three-day running average diversion rate shall not exceed 9,000 cfs; 2) the seven-day running average diversion rate shall not exceed 8,500 cfs; and 3) the monthly average diversion rate shall not exceed 8,500 cfs.

From December 15 through March 15, the maximum allowable daily diversion rate into CCF shall meet the following criteria: 1) the seven-day running average shall not exceed 8,500 cfs or 6,680 cfs plus one-third of the seven-day running average flow of the San Joaquin River at Vernalis when the flow exceeds 1,000 cfs (whichever is greater); and 2) the monthly average diversion rate shall not exceed 8,500 cfs.

b. *Permanent Barrier Operations*

(1) Head of Old River Barrier. Barrier operation (*i.e.*, closing the barrier) would begin at the start of the VAMP spring pulse flow period, which typically begins around April 15. Operation is expected to continue for 31 consecutive days following the start of the VAMP. If, after consulting with the FWS, NOAA Fisheries, and DFG, the barrier needs to be operated at a different time or for a longer period, it may be operated provided the following criteria are met: The fishery agencies estimate that such operation would not increase take of species in excess of that authorized by the original proposed operation. The San Joaquin River flow at Vernalis is less than 10,000 cfs. There is a verified presence of out-migrating salmon or steelhead in the San Joaquin River. South Delta Water Agency agricultural diverters are able to divert water of adequate quality and quantity.

During the fall months of October and November, the barrier would be operated to improve flow in the San Joaquin River, thus assisting in avoiding historically-present (pre-Project) hypoxic conditions in the lower San Joaquin River near Stockton. Barrier operation during this period would be conducted at the joint request of DFG, NOAA Fisheries and FWS. The Head of Old River Barrier (HORB) may be operated at other times provided that the following criteria are met:

- NOAA Fisheries and DFG determine that such operation would not increase take of species in excess of that authorized by the BOs for OCAP. The San Joaquin River flow at Vernalis is not above 5,000 cfs. FWS, NOAA Fisheries, and DFG determine that any impacts associated with barrier operation during this period will not result in additional impacts to threatened and endangered (T&E) species that are outside the scope of impacts analyzed by the biological opinion for OCAP.

(2) Middle River, Old River near the DMC, and Grant Line Canal Barriers. From April 15 through November 30, barriers on the Middle River and Old River near the DMC and Grant Line Canal would be operated (*i.e.*, closed) on an as needed basis to protect water quality and stage for South Delta agricultural diverters (*i.e.*, low water levels in Middle River, Old River and Grant Line Canal would not drop below 0.0 mean sea level [MSL] and the 30-day running average electroconductivity [EC] in the San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge would not exceed 0.7 [mmhos/cm] April to August and 1.0 [mmhos/cm] Sept - March).

From December 1 through April 15, barriers on the Middle River and Old River near the DMC and Grant Line Canal would be operated (*i.e*., closed) on an as needed basis to protect water quality and stage for South Delta agricultural diverters (*i.e*., low water levels in Middle River, Old River and Grant Line Canal would not drop below 0.0 MSL and the 30-day running average EC in the San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge would not exceed 1.0 mmhos/cm). However, during this period, the barriers may only be operated with permission from the FWS, NOAA Fisheries, and DFG if the following criteria are met:

- FWS, NOAA Fisheries, and DFG determine that such operation would not increase take of listed species in excess of those authorized by the BOs for OCAP.

- The San Joaquin River flow at Vernalis is not above 5,000 cfs.

- FWS, NOAA Fisheries, and DFG determine that any impacts associated with barrier operation during this period will not result in additional impacts to T&E species that are outside the scope of impacts analyzed by the BO for OCAP.

DWR also is investigating whether the use of low head pumps at barrier locations can further improve water quality at Brandt Bridge. The amount of pumping and the precise location of the pumps have not been determined, nor has the benefit that might be realized by low head pumps been quantified. If DWR concludes there is a benefit to operating low head pumps, it will incorporate the proposed action into the SDIP Action Specific Implementation Plan (ASIP) process. Such an inclusion will require re-initiation of consultation with FWS, NOAA Fisheries, and DFG regarding potential effects on listed species.

c. *Long-term Environmental Water Account*

For the purposes of describing long-term operations, the CALSIM modeling assumes a long-term EWA will be in place for future conditions similar to the present-day level model runs (see OCAP BA Chapter 8 modeling assumptions). Purchase of EWA assets are the same in the present-day and future model runs, but variable assets may differ under the future proposed actions (See EWA description under *Operating Agreements and Constraints*).

2. Water Transfers under Early Consultation

The capability to facilitate water transfers is expanded by the implementation of the 8,500 cfs Banks capacity. Available surplus capacity for transfers will increase in most years. The early consultation includes the increased use of the SWP Delta export facilities for transfers that will derive from the increase in surplus capacity associated with implementation of the 8,500 cfs Banks. As mentioned in previously, in all but the driest 20 percent of water years, surplus capacity during the typical transfer season (i.e., July through September) usually is a factor limiting the number and size of water transfers that can be accomplished. With the 8,500 cfs Banks capacity, the range of surplus capability available for water transfers (in the wetter 80 percent of years) increases from approximately 60 to 460 TAF per year, to 200 to 600 TAF per year. Transfers in the drier 20 percent of years are not limited by available capacity, but rather by either supply or demand. In those years transfers could still range up to 800 to 1 MAF per year, either with or without the 8,500 cfs Banks capacity.

Reclamation and DWR have agreed to share water, up to 185 TAF per year, provided through the Sacramento Valley Water Management Agreement (*i.e*., water rights settlement) to alleviate in-basin requirements (*e.g*., Delta water quality standards). This program will provide new water supplies from the Sacramento Valley water rights holders for the benefit of the Project and export water users. The water will be split 60 percent for the SWP and 40 percent for the CVP.

3. CVP and SWP Operational Integration

For many years, Reclamation and DWR have considered and attempted to increase the level of their operational coordination and integration. Such coordination allows one project to utilize the other's resources to improve water supply reliability and reduce cost. As such, Reclamation and DWR plan to integrate the strengths of the CVP and SWP (storage and conveyance, respectively) to maximize water supplies for the benefit of both CVP and SWP contractors that rely on water delivered from the Bay-Delta in a manner that will not impair in-Delta uses, and will be consistent with fishery, water quality, and other flow and operational requirements imposed under the Clean Water Act (CWA) and ESA. The Project Agencies have agreed to pursue the following actions:

- Convey water for Reclamation at the SWP. Upon implementation of the increase in pumping capacity to 8,500 cfs at Banks, DWR will divert and pump 100 TAF of Reclamation's Level 2 refuge water before September 1. This commitment will allow Reclamation to commit up to 100 TAF of conveyance capacity at Tracy Pumping Plant, previously reserved for wheeling refuge supplies, for CVP supplies.

- Adjust in-basin obligations. Upon implementation of the increase to 8,500 cfs pumping capacity at Banks, Reclamation will supply up to 75 TAF from its upstream reservoirs to alleviate a portion of the SWP's in-basin obligation.

- Prior to implementation of the increase to 8,500 cfs pumping capacity at Banks, DWR will provide up to 50 TAF of pumping and conveyance of Reclamation's Level 2 refuge water. Likewise, Reclamation will supply up to 37.5 TAF from its upstream storage to alleviate a portion of SWP's obligation to meet in-basin uses. The biological effects analyzed in this document are for the full 100 TAF of conveyance and up to 75 TAF of storage, as may occur under the proposed increase to 8500 cfs. The effects of the 50 TAF of conveyance and up to 37.5 TAF of storage (*i.e*., which may occur at the existing permitted Banks capacity), are not analyzed separately, since it is assumed that those effects are encompassed by the analysis of the larger amounts and capacities that may occur when the 8,500 cfs Banks pumping capacity is operational.

- Upstream Reservoir Coordination. Under certain limited hydrologic and storage conditions, when water supply is relatively abundant in Shasta Lake, yet relatively scarce in Oroville Reservoir, SWP may rely on Shasta Lake storage to support February allocations based on a 90 percent exceedence projections. When the Project's February 90 percent exceedence forecast for EOS storage in Oroville Reservoir is projected to be less than 1.5 MAF, and CVP storage in Shasta Lake is greater than approximately 2.4 MAF, the SWP may, in order to provide allocations based on a 90 percent exceedence forecast, rely on water stored in Shasta Lake, subject to the following conditions.

  I. Should the actual hydrology be drier than the February 90 percent exceedence forecast, the SWP may borrow from Shasta Lake storage an amount of water equal to the amount needed to maintain the allocation made under the 90 percent exceedence forecast, not to exceed 200 TAF.

  ii. DWR will request CVP storage borrowing by April 1. Upon the request to borrow storage, Reclamation and DWR will develop a plan within 15 days to accomplish the potential storage borrowing. The plan will identify the amounts, timing, and any limitation or risk to implementation and will comply with conditions for Shasta Lake and Sacramento River operations imposed by applicable biological opinions. Water borrowed by the SWP shall be provided by adjustments in Article 6 accounting of responsibilities in the COA.

- Maximize use of San Luis Reservoir storage. DWR, in coordination with Reclamation and their respective contractors, will develop an annual contingency plan to ensure San Luis Reservoir storage remains at adequate levels to avoid water quality problems for CVP contractors diverting directly from the reservoir. This action is expected to continue for five years, at which time Reclamation and DWR will re-evaluate the need for the action. The plan will identify actions and triggers to provide up to 200 TAF of source shifting, allowing Reclamation to utilize the CVP share of San Luis Reservoir more effectively to increase CVP allocations.

Additionally, a solution to the San Luis Reservoir low point problem is also in the long-term operation of the CVP and SWP, and is also part of this consultation. Solving the low point problem in San Luis Reservoir was identified in the August 28, 2000, CALFED ROD as a complementary action which would avoid water quality problems associated with the low point and increase the effective storage capacity in San Luis Reservoir up to 200 TAF. This action, while not implemented at present, is part of the future proposed action on which Reclamation is consulting. All site-specific and localized actions of implementing a solution to the San Luis Reservoir low point problem, such as construction of any physical facilities in or around San Luis Reservoir and any other site-specific effects, will be addressed in a separate consultation.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following Federally listed species and designated critical habitat occur in the action area and may be affected by the proposed project:

Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) **–** endangered
Sacramento River winter-run Chinook salmon designated critical habitat
Central Valley spring-run Chinook (*O. tshawytscha*) – threatened
Central Valley steelhead *(O. mykiss)* – threatened
Central California Coast steelhead (*O. mykiss*) – threatened
Southern Oregon/Northern California Coast coho salmon (*O. kisutch*) – threatened
Southern Oregon/Northern California Coast coho salmon designated critical habitat

A. Species and Critical Habitat Listing Status

Sacramento River winter-run Chinook salmon were originally listed as threatened in August 1989, under emergency provisions of the ESA, and formally listed as threatened in November 1990 (55 FR 46515). The ESU consists of only one population that is confined to the upper Sacramento River in California's Central Valley. NOAA Fisheries designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). They were reclassified as endangered on January 4, 1994 (59 FR 440) due to increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 an 1993, and a 99 percent decline between 1966 and 1991. Critical habitat area was delineated as the Sacramento River from Keswick Dam, (RM 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta, including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration and protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing. In the areas west of Chipps Island, including San Francisco Bay to the Golden Gate Bridge, this designation includes the estuarine water column and essential foraging habitat and food resources utilized by winter-run Chinook salmon as part of their juvenile outmigration or adult spawning migrations.

CV spring-run Chinook salmon were listed as threatened on September 16, 1999 (50 FR 50394). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River Basin. Critical habitat has not been designated for spring-run Chinook salmon in the Central Valley.

SONCC coho salmon were listed as threatened under the ESA on May 6, 1997 (62 FR 24588). This ESU consists of populations from Cape Blanco, Oregon, south to Punta Gorda, California, including coho salmon in the Trinity River. NOAA Fisheries designated critical habitat for

SONCC coho salmon on May 5, 1999 (64 FR 24049) as accessible reaches of all rivers (including estuarine areas and tributaries) between the Elk River in Oregon and the Mattole River in California, inclusive). The 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.

CV steelhead were listed as threatened under the ESA on March 19, 1998 (63 FR 13347). This ESU consists of steelhead populations in the Sacramento and San Joaquin River (inclusive of and downstream of the Merced River) basins in California's Central Valley. Critical habitat has not been designated for steelhead in the Central Valley.

CCC steelhead were listed as threatened under the ESA on August 18, 1997 (62 FR 43937). This ESU consists of all naturally spawned populations of steelhead (and their progeny) in California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo Bay eastward to the Napa River (inclusive). The streams entering Suisun Marsh and Suisun Bay just to the east provide habitat similar to coastal drainages because they are small and not fed by snowmelt; therefore, steelhead occupying these drainages are considered part of the CCC steelhead ESU. Critical habitat has not been designated for this ESU.

1. Proposed Listing Status Changes

On of June 14, 2004, NOAA Fisheries is proposed to upgrade Sacramento River winter-run Chinook salmon from endangered to threatened status (69 FR 33102). This determination was based on three main points: 1) harvest and habitat conservation efforts have increased the ESU abundance and productivity over the past decade; 2) artificial propagation programs that are part of the ESU, the Captive Broodstock Programs at Livingston Stone National Fish Hatchery (LSNFH) and at the University of California Bodega Marine Laboratory contribute to the ESU's viability; and 3) CALFED ecosystem restoration plans underway in Battle Creek should provide the opportunity to establish a second winter-run Chinook salmon population.

In addition, NOAA Fisheries is proposing several changes involving West Coast salmon and steelhead hatchery populations. 1) The LSNFH population is proposed for inclusion in the listed Sacramento River winter-run Chinook salmon population. 2) The Feather River Hatchery (FRH) spring-run Chinook salmon population is proposed for exclusion from the spring-run Chinook salmon ESU, because of possible artificial selection and genetic introgression with fall-run Chinook salmon. 3) The Coleman NFH and FRH steelhead populations are proposed for inclusion in the listed population of steelhead. These populations previously were included in the ESU but were not deemed essential for conservation and thus not part of the listed steelhead population. 4) The Trinity River Hatchery coho salmon population is proposed for inclusion in the listed SONCC population. This population was previously not deemed essential for recovery and thus not included in the ESU. Proposed changes to the CCC steelhead ESU do not affect this consultation. Finally, NOAA Fisheries also has proposed to include resident *Oncorhynchus mykiss*, present below natural or long-standing artificial barriers, in all steelhead ESU's.

B. Species Life History and Population Dynamics

1. Chinook Salmon

a. *General Life History*

Chinook salmon exhibit two generalized fresh water life history types (Healey 1991). “Stream-type” Chinook salmon, enter fresh water months before spawning and reside in fresh water for a year or more following emergence, whereas “ocean-type” Chinook salmon spawn soon after entering fresh water and migrate to the ocean as fry or parr within their first year. Spring-run Chinook salmon exhibit a stream-type life history. Adults enter freshwater in the spring, hold over summer, spawn in fall, and the juveniles typically spend a year or more in freshwater before emigrating. Winter-run Chinook salmon are somewhat anomalous in that they have characteristics of both stream- and ocean-type races (Healey 1991). Adults enter freshwater in winter or early spring, and delay spawning until spring or early summer (stream-type). However, juvenile winter-run Chinook salmon migrate to sea after only four to seven months of river life (ocean-type). Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over summering by adults and/or juveniles.

Chinook salmon mature between 2 and 6+ years of age (Myers *et al.* 1998). Freshwater entry and spawning timing generally are 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 the actual time of spawning (Myers *et al.* 1998). Both spring-run and winter-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, 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).

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows also are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 ºF to 56 ºF (Bell 1991; DFG 1998). Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past Red Bluff Diversion Dam (RBDD) from mid-December through early August (NOAA Fisheries 1997a). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type. Adult spring-run Chinook salmon enter the Delta from the Pacific Ocean beginning in January and enter natal streams from March to July (Myers *et al.* 1998). In Mill Creek, Van Woert (1964) noted that of 18,290 spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30. Typically, spring-run Chinook salmon utilize mid- to high elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, and suitable water temperatures, depths, and velocities for redd construction and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (FWS 1995a). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad. Bell (1991, as cited in DFG 1998) identifies the preferred water temperature for adult spring-run Chinook salmon migration as 38 ºF to 56 ºF. Boles (1988, as cited in Reclamation 2004), recommends water temperatures below 65 ºF for adult Chinook salmon migration, and Lindley *et al.* (2004) report that adult migration is blocked when temperatures reach 70 ºF, and that fish can become stressed as temperatures approach 70 ºF. Reclamation reports that holding spring-run Chinook salmon prefer water temperatures below 60 ºF, although salmon can tolerate temperatures up to 65 ºF before they experience an increased susceptibility to disease. The upper preferred water temperature for spawning Chinook salmon is 55 ºF to 57 ºF (Chambers 1956; Reiser and Bjornn 1979). Winter-run Chinook salmon spawning occurs primarily from mid-April to mid-August, with the peak activity occurring in May and June in the Sacramento River reach between Keswick dam and RBDD (Vogel and Marine 1991). The majority of winter-run Chinook salmon spawners are three years old. Physical Habitat Simulation Model (PHABSIM) results (FWS 2003a) indicate winter-run Chinook salmon suitable spawning velocities in the upper Sacramento River are between 1.54 feet per second (ft/s) and 4.10 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter. Initial habitat suitability curves (HSCs) show spawning suitability rapidly decreases for water depths greater than 3.13 feet (FWS 2003a). Spring-run Chinook salmon spawning occurs between September and October depending on water temperatures. Between 56 and 87 percent of adult spring-run Chinook salmon that enter the Sacramento River basin to spawn are three years old (Calkins *et al.* 1940; Fisher 1994). PHABSIM results indicate spring-run Chinook salmon suitable spawning velocities in Butte Creek are between 0.8 ft/s and 3.22 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter (FWS 2004a). The initial HSC showed suitability rapidly decreasing for depths greater than 1.0 feet, but this effect was most likely due to the low availability of deeper water in Butte Creek with suitable velocities and substrates rather than a selection by spring-run Chinook salmon of only shallow depths for spawning (FWS 2004a).

The optimal water temperature for egg incubation is 44 ºF to 54 ºF (Rich 1997). Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation and poor water quality. Studies of Chinook salmon egg survival to hatching conducted by Shelton (1955) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. The length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable. Alderdice and Velsen (1978) found that the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 61 °F and 37 °F, respectively, when the incubation temperature was constant.

Winter-run Chinook salmon fry begin to emerge from the gravel in late June to early July and continue through October (Fisher 1994), generally at night. Spring-run Chinook salmon fry emerge from the gravel from November to March and spend about 3 to 15 months in freshwater habitats prior to emigrating to the ocean (Kjelson *et al.* 1981). Post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on small insects and crustaceans.

When juvenile Chinook salmon reach a length of 50 to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Stream flow and/or turbidity increases in the upper Sacramento River Basin are thought to stimulate emigration. Emigration of juvenile winter-run Chinook salmon past RBDD may begin as early as mid-July, typically peaks in September, and can continue through March in dry years (Vogel and Marine 1991; NOAA Fisheries 1997a). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001). Spring-run Chinook salmon emigration is highly variable (DFG 1998). Some may begin outmigrating soon after emergence, whereas others over summer and emigrate as yearlings with the onset of intense fall storms (DFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year (YOY) outmigrants passing through the lower Sacramento River and Sacramento-San Joaquin Delta during this period (DFG 1998).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, Sacramento-San Joaquin Delta, and their tributaries. Spring-run Chinook salmon juveniles have been observed rearing in the lower part of non-natal tributaries and intermittent streams during the winter months (Maslin *et al.* 1997; Snider 2001). Within the Sacramento-San Joaquin Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960, Dunford 1975). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson *et al.* 1982; Sommer *et al.* 2001; MacFarlane and Norton 2002). Shallow water habitats are more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer *et al.* 2001). Optimal water temperatures for the growth of juvenile Chinook salmon in the Sacramento-San Joaquin Delta are 54 to 57 ºF (Brett 1952). In Suisun and San Pablo Bays water temperatures reach 54 ºF by February in a typical year. Other portions of the Delta (*i.e.*, South Delta and Central Delta) can reach 70 ºF by February in a dry year, however, usually cooler temperatures are the norm until after spring runoff has ended.

Maturing Chinook salmon fry and fingerlings prefer to rear further downstream where ambient salinity is up to 1.5 to 2.5 parts per thousand (Healy 1980, 1982; Levings *et al.* 1986). Juvenile winter-run Chinook salmon occur in the Sacramento-San Joaquin Delta from October through early May based on data collected from trawls, beach seines, and salvage records at the CVP and

SWP pumping facilities (DFG 1998). The peak of listed juvenile salmon arrivals generally is from January to April, but may extend into June. Upon arrival in the Delta, winter-run Chinook salmon tend to rear in the more upstream freshwater portions of the Delta for about the first two months (Kjelson *et al.* 1981, 1982). CVP and SWP data indicate that most spring-run Chinook salmon smolts are present in the Delta from mid-March through mid-May depending on flow conditions (DFG 2000b).

Juvenile Chinook salmon follow the tidal cycle in their movements within the estuarine habitat, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levy and Northcote 1982; Levings 1982; Healey 1991).

As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tide into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Moyle *et al.* (1986) reported that Chinook salmon fry tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels. Kjelson *et al.* (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day into the upper three meters of the water column. Available data indicate that juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific ocean (Spaar 1988). Winter-run Chinook salmon fry remain in the estuary (Delta/Bay) until they reach a fork length of about 118 mm (*i.e.*, 5 to 10 months of age) and then begin emigrating to the ocean maybe as early as November and continue through May (Fisher 1994; Myers *et al.* 1998). Little is known about estuarine residence time of spring-run Chinook salmon. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (MaFarlane and Norton 2002). Based on the mainly ocean-type life history observed (*i.e.*, fall-run Chinook salmon) MacFarlane and Norton (2002) concluded that unlike populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependance and may benefit from expedited ocean entry. Spring-run Chinook yearlings are larger in size than fall-run Chinook and ready to smolt upon entering the Delta; therefore, they probably spend little time rearing in the Delta.

b. *Population Trend – Sacramento River Winter-run Chinook Salmon*

The distribution of winter-run Chinook salmon spawning and rearing historically was limited to the upper Sacramento River and tributaries, where spring-fed streams allowed for spawning, egg incubation, and rearing in cold water (Slater 1963, Yoshiyama *et al.* 1998). The headwaters of the McCloud, Pit, and Little Sacramento Rivers, and Hat and Battle Creeks, provided clean, loose gravel, cold, well-oxygenated water, and optimal flow in riffle habitats for spawning and incubation. These areas also provided the cold, productive waters necessary for egg and fry survival, and juvenile rearing over summer. Construction of Shasta Dam in 1943 and Keswick

Dam in 1950 blocked access to all of these waters except Battle Creek, which is blocked by a weir at the Coleman National Fish Hatchery and other small hydroelectric facilities (Moyle et al. 1989, NOAA Fisheries 1997a). Approximately, 299 miles of tributary spawning habitat in the upper Sacramento River is now blocked. (Yoshiyama 2001) estimated that the Upper Sacramento in 1938 had a "potential spawning capacity" of 14,303 redds. Most components of the winter-run Chinook salmon life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. The initial recovery was followed by a steady decline, subsequent to the construction of RBDD, from 1969 through the late 1980s (FWS 1999). Since 1967, the estimated adult winter-run Chinook salmon population ranged from 117,808 in 1969, to 186 in 1994 (DFG 2002c). The population declined from an average of 86,000 adults in 1967 to 1969 to only 1,900 in 1987 to 1989, and continued to remain low, with an average of 2,500 fish for the period from 1998 to 2000 (see Appendix, Figure B1). Between the time Shasta Dam was built and the listing of winter-run Chinook salmon as endangered, major impacts to the population occurred from warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Sacramento-San Joaquin Delta, acid mine drainage from Iron Mountain Mine, and entrainment at a large number of unscreened or poorly-screened water diversions (NOAA Fisheries 1997a).

Population estimates in 2001 (5,523), 2002 (7,337), and 2003 (9,757) show a recent increase. The 2003 run was the highest since the listing. Winter-run Chinook salmon abundance estimates and cohort replacement rates since 1986 are shown in Table 2. The population estimates from the RBDD counts has increased since 1986 (DFG 2004), there is an increasing trend in the five year moving average (491 from 1990-1994 to 5,451 from 1999-2003); and the five year moving average of cohort replacement rates has increased and appears to have stabilized over the same period (Table 2).

Table 2. Winter-run Chinook salmon population estimates from Red Bluff Diversion Dam counts, and corresponding cohort replacement rates for the years since 1986 (DFG 2004).

Year	Population Estimate (RBDD)	5 Year Moving Average of Population Estimate	Cohort Replacement Rate	5 Year Moving Average of Cohort Replacement Rate
1986	2596	-	-	-
1987	2186	-	-	-
1988	2886	-	-	-
1989	697	-	0.27	-
1990	431	1759	0.20	-
1991	211	1282	0.10	-
1992	1241	1093	2.00	-
1993	387	593	0.60	0.63
1994	186	491	0.30	0.64

1995	1287	662	1.10	0.82
1996	1337	888	2.80	1.36
1997	880	815	8.50	2.66
1998	3005	1339	1.60	2.86
1999	3288	1959	1.20	3.04
2000	1352	1972	1.10	3.04
2001	5523	2809	0.80	2.64
2002	7337	4101	9.30	2.80
2003	9757	5451	11.00	4.68

c. *Status - Sacramento River Winter-run Chinook Salmon*

Numerous factors have contributed to the decline of winter-run Chinook salmon through degradation of spawning, rearing and migration habitats. The primary impacts include blockage of historical habitat by Shasta and Keswick Dams, warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Sacramento-San Joaquin Delta, heavy metal contamination from Iron Mountain Mine, high ocean harvest rates, and entrainment in a large number of unscreened or poorly screened water diversions. Secondary factors include smaller water manipulation facilities and dams, loss of rearing habitat in the lower Sacramento River and Sacramento-San Joaquin Delta from levee construction, marshland reclamation, and interaction with and predation by introduced species (NOAA Fisheries 1997a).

Since the listing of winter-run Chinook salmon, several habitat problems that led to the decline of the species have been addressed and improved through restoration and conservation actions. The impetus for initiating restoration actions stem primarily from the following: 1) ESA section 7 consultation RPAs on temperature, flow, and operations of the CVP and SWP; 2) SWRCB decisions requiring compliance with Sacramento River water temperatures objectives which resulted in the installation of the Shasta Temperature Control Device in 1998; 3) a 1992 amendment to the authority of the CVP through the CVPIA to give fish and wildlife equal priority with other CVP objectives; 4) fiscal support of habitat improvement projects from the CALFED Bay-Delta Program (*e.g.*, installation of a fish screen on the Glenn-Colusa Irrigation District [GCID] diversion); 5) establishment of the CALFED EWA; 6) EPA actions to control acid mine runoff from Iron Mountain Mine; and 7) ocean harvest restrictions implemented in 1995.

The susceptibility of winter-run Chinook salmon to extinction remains linked to the elimination of access to most of their historical spawning grounds and the reduction of their population structure to a small population size. Recent trends in winter-run Chinook salmon abundance and cohort replacement are positive and may indicate some recovery since the listing; the ESU has been proposed by NOAA Fisheries for upgrading the species status from endangered to threatened. However, the population remains below the recovery goals established for the run (NOAA Fisheries 1997a). In general, the recovery criteria for winter-run Chinook salmon includes a mean annual spawning abundance over any 13 consecutive years to be 10,000 females and the geometric mean of the cohort replacement rate (CHR) over those same years to be greater than 1.0.

d. *Population Trend – Central Valley Spring-run Chinook Salmon*

Historically, spring-run Chinook salmon were predominant throughout the Central Valley occupying the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit Rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874; Rutter 1904; Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (DFG 1998). Before construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River alone (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries (*i.e.*, the Stanislaus and Mokelumne Rivers) was extirpated. Spring-run Chinook salmon no longer exist in the American River due to the operation of Folsom Dam. Naturally-spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (DFG 1998).

On the Feather River, significant numbers of spring-run Chinook salmon, as identified by run timing, return to FRH. In 2002, FRH reported 4,189 returning spring-run Chinook salmon, which is 22 percent below the 10-year average of 4,727 fish. However, coded-wire tag (CWT) information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run Chinook salmon populations in the Feather River due to hatchery practices. Because Chinook salmon are not temporally separated in the hatchery, spring-run Chinook and fall-run Chinook are spawned together, thus compromising the genetic integrity of the spring-run Chinook salmon. The number of naturally spawning spring-run Chinook salmon in the Feather River has been estimated only periodically since the 1960's, with estimates ranging from two fish in 1978 to 2,908 in 1964. The genetic integrity of this population is at question because there is significant temporal and spatial overlap between spawning populations of spring-run and fall-run Chinook salmon (NOAA Fisheries 2003b). For the reasons discussed previously, Feather River spring-run Chinook population numbers are not included in the following discussion of ESU abundance.

Since 1969, the Central Valley spring-run Chinook salmon ESU (excluding Feather River fish) has displayed broad fluctuations in abundance ranging from 25,890 in 1982 to 1,403 in 1993 (DFG unpublished data). Even though the abundance of fish may increase from one year to the next, the overall average population trend has a negative slope during this time period (see Appendix, Figure B2). The average abundance for the ESU was 12,499 for the period of 1969 to 1979, 12,981 for the period of 1980 to 1990, and 6,542 for the period of 1991 to 2001. In 2002 and 2003, total run size for the ESU was 13,218 and 8,775 adults respectively, well above the 1991-2001 average.

Evaluating the ESU as a whole, however, masks significant changes that are occurring among metapopulations. For example, while the mainstem Sacramento River population has undergone a significant decline, the tributary populations have demonstrated a substantial increase. Average abundance of Sacramento River mainstem spring-run Chinook salmon has recently declined from a high of 12,107 for the period 1980 to 1990, to a low of 609 for the period 1991 to 2001, while the average abundance of Sacramento River tributary populations increased from a low of 1,227 to a high of 5,925 over the same period. Although tributaries such as Mill and Deer Creeks have shown positive escapement trends since 1991, recent escapements to Butte Creek, including 20,259 in 1998, 9,605 in 2001 and 8,785 in 2002, are responsible for the overall increase in tributary abundance (DFG 2002a; DFG, unpublished data). The Butte Creek estimates, which account for the majority of this ESU, do not include prespawning mortality. In the last several years as the Butte Creek population has increased, mortality of adult spawner has increased from 21 percent in 2002 to 60 percent in 2003 due to over-crowding and disease associated with high water temperatures. This trend may indicate that the population in Butte Creek may have reached its carrying capacity (Ward *et al.* 2003) or are near historical population levels (*i.e*., Deer and Mill creeks; Grover *et al.* 2004).

The extent of spring-run Chinook salmon spawning in the mainstem of the upper Sacramento River is unclear. Very few spring-run Chinook salmon redds (less than 15 per year) were observed from 1989-1993, and none in 1994, during aerial redd counts (FWS 2003a). Recently, the number of redds in September has varied from 29 to 105 during 2001 though 2003 depending on the number of survey flights (DFG, unpublished data). In 2002, based on RBDD ladder counts, 485 spring-run Chinook adults may have spawned in the mainstem Sacramento River or entered upstream tributaries such as Clear or Battle Creek (DFG 2004b). In 2003, no adult spring-run Chinook were estimated to spawn in the mainstem river. Due to geographic overlap of ESUs and resultant hybridization since the construction of Shasta Dam, Chinook salmon that spawn in the mainstem Sacramento River during September are more likely to be identified as early fall-run rather than spring-run Chinook salmon.

e. *Status of Spring-run Chinook Salmon*

The initial factors that led to the decline of spring-run Chinook salmon were related to the loss of upstream habitat behind impassable dams. Since this initial loss of habitat, other factors have contributed to the instability of the spring-run Chinook salmon population and affected the ESU’s ability to recover. These factors include a combination of physical, biological, and management factors such as climatic variation, water management activities, hybridization with fall-run Chinook salmon, predation, and harvest (DFG 1998). Since spring-run Chinook salmon adults must hold over for months in small tributaries before spawning they are much more susceptible to the effects of high water temperatures.

During the drought of 1986 to 1992, Central Valley spring-run Chinook salmon populations declined substantially. Reduced flows resulted in warm water temperatures and impacted adults, eggs, and juveniles. For adult spring-run Chinook salmon, reduced instream flows delayed or completely blocked access to holding and spawning habitats. Water management operations, including reservoir releases, and unscreened and poorly-screened diversions in the Sacramento

River, Sacramento-San Joaquin Delta, and tributaries, compounded drought-related problems by further reducing river flows and warming river temperatures, and entraining juveniles.

Several actions have been taken to improve habitat conditions for spring-run Chinook salmon, including improved management of Central Valley water (*e.g.*, through use of CALFED EWA and CVPIA (b)(2) water accounts), implementing new and improved screen and ladder designs at major water diversions along the mainstem Sacramento River and tributaries, and changes in ocean and inland fishing regulations to minimize harvest. Although protective measures likely have contributed to recent increases in spring-run Chinook salmon abundance, the ESU is still below levels observed from the 1960s through 1990. Threats from hatchery production (*i.e.*, competition for food between naturally-spawned and hatchery fish, and run hybridization and homogenization), climatic variation, high temperatures, predation, and water diversions persist. Because the Central Valley spring-run Chinook salmon ESU is confined to relatively few remaining streams and continues to display broad fluctuations in abundance, the population is at a moderate risk of extinction.

2. Coho Salmon

a. *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 (Hassler 1987; Weitkamp *et al.* 1995). Coho salmon river entry timing is influenced by many factors, one of which appears to be river flow. In addition, many small coastal 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).

Although each native population appears to have a unique time and temperature for spawning that theoretically maximizes offspring survival, coho salmon generally spawn at water temperatures within the range of 50 to 55 °F (Bell 1991). Bjornn and Reiser (1991) saw that some spawning occurs in third order streams but most occurs in fourth or fifth order streams. Nickelson *et al.* (1992) found that spawning occurs in tributary streams with a gradient of 3 percent or less. Spawning occurs in clean gravel ranging in size from that of a pea to that of an orange (Nickelson *et al.* 1992). Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools with suitable water depth and velocity.

The favorable temperature range for coho salmon egg incubation is 50 to 55 °F (Bell 1991). Coho salmon eggs incubate for approximately 35 to 50 days, and fry 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).

Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although juveniles may move into streams of 4 percent or 5 percent gradient. At a length of 38-45 mm, the fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965; Nickleson *et al.* 1992). Rearing requires temperatures of 68 °F or less, preferably 53.1 to 57.9 °F (Reiser and Bjornn 1979; Reeves *et al.* 1989; Bell 1991). Coho salmon fry are most abundant in backwater pools during the spring. 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 banks (Hassler 1987; Heifetz *et al.* 1986). The ideal feeding area for maximum coho production would have shallow depth (7 to 60 cm), fairly swift mid-stream flows (60 cm/sec), numerous marginal eddy currents, narrow width (3 to 6 cm), abundant overhanging mixed vegetation (to reduce water temperatures, provide leaf-fall, and contribute terrestrial insects to the waterway), and banks that provide hiding places (Boussu 1954). Juvenile coho salmon primarily eat aquatic and terrestrial insects (Sandercock 1991).

Little is known about residence time or habitat use by juvenile coho salmon in the estuaries during seaward migration, although Nickelson *et al.* (1992) assume that coho salmon spend only a short time in the estuary before entering the ocean. Growth is very rapid once the smolts reach the estuary (Fisher *et al.* 1984). 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).

b. *Population Trend – Southern Oregon/Northern California Coast Coho Salmon*

Available historical and most recent published coho salmon abundance information are summarized in the NOAA Fisheries coast-wide status review (Weitkamp *et al.* 1995). The following are 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 1940’s, 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 River 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 populations 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. The California Department of Fish and Game (DFG 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 1940s, and have experienced at least a 79 percent decline in the 1960s.' 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 the 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."

Schiewe (1997) summarized updated and new data on trends in abundance for coho salmon from the northern California and Oregon coasts. The following are excerpts from this document regarding the status and trends of the SONCC coho salmon ESU:

> "Information on presence/absence of coho salmon in northern California streams has been updated since the study by Brown *et al.* (1994) cited in the status review. More recent data indicates that the proportion of streams with coho salmon present is lower than in the earlier study (52 percent vs. 63 percent). In addition, the BRT received update estimates of escapement at the Shasta and Willow Creek weirs in the Klamath River Basin, but these represent primarily hatchery production and are not useful in assessing the status of natural populations.
>
> New data on presence/absence in northern California streams that historically supported coho salmon are even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contain coho salmon compared to the percentage presence in an earlier study. However, it is unclear whether these new data represent actual trends in local extinction or are biased by sampling effort."

NOAA Fisheries (2001) updated the status review for coho salmon from the Central California Coast (CCC) and the California portion of the Southern Oregon/Northern California Coast ESUs. The following is a summary of the updated status review:

> "In the California portion of the SONCC coho salmon ESU, there appears to be a general decline in abundance, but trend data are more limited in this area and there is variability among streams and years. In the California portion of the SONCC coho salmon ESU, Trinity River Hatchery maintains large production and is thought to create significant straying to natural populations. In the California portion of the SONCC coho salmon ESU, the percent of streams with coho present in at least one brood year has shown a decline from 1989-1991 to the present. In 1989-1991 and 1992-1995, coho were found

> in over 80 percent of the streams surveyed. Since then, the percentage has declined to 69 percent in the most recent three-year interval.
>
> Both the presence-absence and trend data presented in this report suggest that many coho salmon populations in this ESU continue to decline. Presence-absence information from the past 12 years indicates fish have been extirpated or at least reduced in numbers sufficiently to reduce the probability of detection in conventional surveys. Unlike the CCC ESU, the percentage of streams in which coho were documented did not experience a strong increase in the 1995-1997 period. Population trend data were less available in this ESU, nevertheless, for those sites that did have trend information, evidence suggests declines in abundance."

The Trinity River Basin historically supported abundant coho salmon runs (Weitkamp *et al.* 1995). Prior to the construction of Trinity and Lewiston Dams coho salmon were present in the Hoopa Valley by October but not common in the Trinity River above Lewiston. The U.S. Fish and Wildlife Service (FWS) and California Department of Fish and Game (DFG) (1956) indicated that approximately 5,000 fish migrated past Lewiston prior to the Trinity Dam 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 upstream of the North Fork Trinity River.

Since 1978, escapement estimates upstream of Willow Creek ranged from 558 to 32,373 with an average of 10,192 coho salmon. These data, which are derived from adult coho salmon counts at the DFG Willow Creek weir, may not be representative of the natural coho salmon population for two reasons. First, this weir is operated for the purposes of counting fall-run Chinook salmon and is removed prior to the completion of the coho salmon migration. Second, the majority of coho salmon in the Trinity River system are of hatchery origin. One hundred percent marking of hatchery coho salmon has only recently occurred, so estimates of naturally-produced coho salmon are only available since the 1997 return year (DFG 2000a). The DFG survey estimated 198, 1001, and 491 naturally produced adult coho salmon for the 1997-1998, 1998-1999, and 1999-2000 seasons, respectively (DFG 2000a). The Trinity River Restoration Program identifies 1,400 as the in-river escapement goal for coho salmon in the Trinity River. Incidental juvenile trapping of coho salmon does occur on the Trinity River and it's tributaries, but is not useful for population trend analysis.

c. *Status - Southern Oregon/Northern California Coast Coho Salmon*

Based on the very depressed status of current coho salmon populations discussed above as well as insufficient regulatory mechanisms and conservation efforts over the ESU as a whole, NOAA Fisheries concluded that the ESU is likely to become endangered in the foreseeable future (May 6, 1997, 62 FR 24588). A more recent status update (NOAA Fisheries 2003) indicates a continued low abundance with no apparent trend and possible continued declines in several California stream populations. The relatively strong 2001 brood year, likely due to favorable conditions in both freshwater and marine environments, was viewed as a positive sign, but was a single strong year following more than a decade of generally poor years (NOAA Fisheries 2003).

3. Steelhead

a. *General Life History*

Steelhead can be divided into two life history types, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration: stream-maturing and ocean-maturing. Stream-maturing steelhead enter freshwater in a sexually immature condition and require several months to mature and spawn, whereas ocean-maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two life history types are more commonly referred to by their season of freshwater entry (*i.e.* summer [stream-maturing] and winter [ocean-maturing] steelhead). Only winter steelhead currently are found in Central Valley rivers and streams (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 1940s (Interagency Ecological Program [IEP] Steelhead Project Work Team 1999). At present, summer steelhead are found only in North Coast drainages, mostly in tributaries of the Eel, Klamath, and Trinity River systems (McEwan and Jackson 1996).

Winter steelhead generally leave the ocean from August through April, and spawn between December and May (Busby *et al.* 1996). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The preferred water temperature for adult steelhead migration is 46 °F to 52 °F (McEwan and Jackson 1996; Myrick 1998; and Myrick and Cech 2000). Thermal stress may occur at temperatures beginning at 66 °F and mortality has been demonstrated at temperatures beginning at 70 °F. The preferred water temperature for steelhead spawning is 39 °F to 52 °F, and the preferred water temperature for steelhead egg incubation is 48 °F to 52 °F (McEwan and Jackson 1996; Myrick 1998; and Myrick and Cech 2000). The minimum stream depth necessary for successful upstream migration is 13 cm (Thompson 1972). Preferred water velocity for upstream migration is in the range of 40-90 cm/s, with a maximum velocity, beyond which upstream migration is not likely to occur, of 240 cm/s (Thompson 1972; Smith 1973).

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; Nickleson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Most steelhead spawning takes place from late December through April, with peaks from January though March (Hallock *et al.* 1961). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity, and may spawn in intermittent streams as well (Barnhart 1986; Everest 1973, Titus *et al.* 1999).

The length of the incubation period for steelhead eggs is dependent on water temperature, dissolved oxygen concentration, and substrate composition. In late spring and following yolk sac absorption, fry emerge from the gravel and actively begin feeding in shallow water along stream banks (Nickelson *et al.* 1992).

Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-the-year also are 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. Cover is an important habitat component for juvenile steelhead both as velocity refuge and as a means of avoiding predation (Shirvell 1990; Meehan and Bjornn 1991). Some older juveniles move downstream to rear in large 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.

Steelhead generally spend two years in freshwater before emigrating downstream (Hallock *et al.* 1961; Hallock 1989). Rearing steelhead juveniles prefer water temperatures of 45 to 58 °F and have an upper lethal limit of 75 °F. They can survive up to 81 °F with saturated dissolved oxygen conditions and a plentiful food supply. Reiser and Bjornn (1979) recommended that dissolved oxygen concentrations remain at or near saturation levels with temporary reductions no lower than 5.0 mg/l for successful rearing of juvenile steelhead. During rearing, suspended and deposited fine sediments can directly affect salmonids by abrading and clogging gills, and indirectly cause reduced feeding, avoidance reactions, destruction of food supplies, reduced egg and alevin survival, and changed rearing habitat (Reiser and Bjornn 1979). Bell (1973) found that silt loads of less than 25 mg/l permit good rearing conditions for juvenile salmonids.

Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows (Colleen Harvey-Arrison, DFG, pers. comm. 1999). Emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Barnhart (1986) reported that steelhead smolts in California range in size from 140 to 210 mm (fork length). Hallock *et al.* (1961) found that juvenile steelhead in the Sacramento Basin migrate downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

b. *Population Trends – Central Valley Steelhead*

Steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems (now inaccessable due to Shasta and Keswick Dams) south to the Kings and possibly the Kern River systems (now inaccessible due to extensive alteration from water diversion projects) and in both east and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles. Historically, steelhead probably ascended Clear Creek past the French Gulch area, but access to the upper basin was blocked by Whiskeytown Dam in 1964 (Yoshiyama *et al.* 1996). Steelhead also occurred in the upper drainages of the Feather, American and Stanislaus rivers which are now inaccessible (McEwan and Jackson 1996, Yoshiyama *et al.* 1996).

Historic Central Valley steelhead run size is difficult to estimate given the paucity of data, but may have approached 1 to 2 million adults annually (McEwan 2001). By the early 1960s the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally-spawned steelhead populations in the upper Sacramento River have declined substantially (see Appendix, Figure B3). Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River. Steelhead counts at the RBDD declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990's, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998-2001 to estimate that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the draft *Updated Status Review of West Coast Salmon and Steelhead* (NOAA Fisheries 2003), the Biological Review Team (BRT) made the following conclusion based on the Chipps Island data:

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

The only consistent data available on steelhead numbers in the San Joaquin River basin come from DFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data (see Appendix, Figure B4) indicate a decline in steelhead numbers in the early 1990's, which have remained low through 2002 (DFG 2003). In 2003, a total of 12 steelhead smolts were collected at Mossdale (DFG, unpublished data).

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996).

Recent snorkel surveys (1999 to 2002) indicate that steelhead are present in Clear Creek (J. Newton, FWS, pers. comm. 2002, as reported in NOAA Fisheries 2003). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other streams previously thought to be void of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al.* 2000). After two years of operating a fish counting weir on the Stanislaus River no adult steelhead have been observed moving upstream, although several large rainbow trout have washed up on the weir in late winter (Demko 2004). It is possible that naturally spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999).

c. *Status - Central Valley Steelhead*

Both the BRT (NOAA Fisheries 2003) and the Artificial Propagation Evaluation Workshop (69 FR 33102) concluded that the Central Valley steelhead ESU presently is "in danger of extinction". However, in the proposed status review NOAA Fisheries concluded that the ESU in-total is "not in danger of extinction, but is likely to become endangered within the foreseeable future" citing unknown benefits of restoration efforts and a yet to be funded monitoring program(69 FR 33102). Steelhead already have been extirpated from most of their historical range in this region. Habitat concerns in this ESU focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, and water allocation problems. Widespread hatchery steelhead production within this ESU also raises concerns about the potential ecological interactions between introduced stocks and native stocks. Because the Central Valley steelhead population has been fragmented into smaller isolated tributaries without any large source population and the remaining habitat continues to be degraded by water diversions, the population is at high risk of extinction.

d. *Population Trends – Central California Coast Steelhead*

Analyses of CCC steelhead abundance across the ESU indicate that naturally reproducing stocks are suffering severe and long-term population declines, range-wide, particularly within streams draining into the San Francisco Estuary. Few estimates of historic (pre-1960s) abundance specific to this ESU are available. An average of about 430 adult steelhead occurred in Waddell Creek in the 1930s and 1940s (Shapovalov and Taft 1954), and 20,000 steelhead occurred in the San Lorenzo River before 1965 (62 FR 43937). In the mid-1960s, 94,000 adult steelhead spawners were estimated ESU-wide, including 50,000 fish in the Russian River and 19,000 fish in the San Lorenzo River (Busby *et al.* 1996). The Russian River, the largest in the ESU, once boasted steelhead runs ranked as the third largest in California behind only the Klamath and Sacramento rivers. Difficulties in assessing current run sizes in both the Russian and San Lorenzo rivers include the inability to distinguish the relative proportions of hatchery and wild fish. Based on the best available data, NOAA Fisheries has estimated that Russian River steelhead currently number about 7,000 fish, including hatchery fish which are currently not considered part of the listed population because these fish were not considered essential for conservation (Busby *et al.* 1996; NOAA Fisheries 1997b). San Lorenzo River steelhead are thought to number approximately 1,000 to 2,500 fish (Alley 2000), including hatchery fish, which are considered part of the listed population in this river because these fish are considered genetically similar to the natural population. These estimates suggest that total abundance in these rivers has declined to less than 15 percent of their abundance in the 1960s.

Abundance estimates for smaller coastal streams in the ESU indicate low but stable levels (NOAA Fisheries 1997b), with recent estimates for several streams (*e.g.*, Lagunitas Creek, Waddell Creek, Scott Creek, San Vincente Creek, Soquel Creek, and Aptos Creek) of individual run sizes of 500 fish or less (62 FR 43937). Presence/absence data show that in a subset of streams sampled in the central California coast region, most contain steelhead (NOAA Fisheries 1997b). Of the streams within the ESU for which there is current presence/absence data on steelhead, 218 of 264 streams currently support steelhead. NOAA Fisheries believes it is generally a positive indicator that there is a relatively broad distribution of steelhead in smaller streams throughout the ESU, even though these recent data may have included an unknown number of hatchery fish. (NOAA Fisheries 1997b).

Steelhead in most tributaries to San Francisco and San Pablo Bays have been virtually extirpated (McEwan and Jackson 1996). In a survey of 30 San Francisco Bay watersheds conducted from 1994 through 1997, steelhead occurred in small numbers at 41 percent of the sites, including in the Guadalupe River, San Lorenzo Creek, Corte Madera Creek, and Walnut Creek (Leidy 1997). Additional historical and recent published steelhead abundance data are summarized in NOAA Fisheries' west coast steelhead status review (Busby *et al.* 1996) and status review update (NOAA Fisheries 1997b). Information on the status of steelhead in tributaries to Suisun Bay is sparse. Restoration project monitoring in Green Valley Creek indicates increasing numbers of steelhead (City of Fairfield 2003). Adult and juvenile steelhead have been documented in Suisun Creek (Hanson 2001). Two smolt-sized (Barnhart 1986) steelhead also were collected in Montezuma Slough in 1982 by University of California-Davis (UCD) researchers.

Overall, the abundance of the CCC steehead ESU has declined precipitously, from an estimated 94,000 returning adults in the 1960s to estimates of less than 10,000 in recent times (Busby *et al.* 1996; NOAA Fisheries 1997b). These numbers represent over an 85 percent decline in the population.

e. *Status - Central California Coast Steelhead*

Precipitous steelhead population declines have been attributed to longstanding human induced factors that exacerbate the adverse effects of natural environmental variability (NOAA Fisheries 1996a). NOAA Fisheries (2003) concludes that steelhead in the CCC steelhead ESU remain likely to become endangered in the foreseeable future and are at a moderate risk of extinction. Small and declining run sizes within the ESU are a serious concern, because small populations are at a greater risk of extirpation and extinction (Pimm *et al.* 1988).

C. Habitat Condition and Function for Species' Conservation

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

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

Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the Sacramento-San Joaquin system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]). However, the channelized, leveed, and rip-rapped river reaches and sloughs that are common in the Sacramento-San Joaquin and Suisun Marsh systems typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Loss of habitat complexity and habitat fragmentation also have negatively impacted rearing habitats on the Trinity River.

D. Factors Affecting the Species and Habitat

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley, Suisun Marsh, and Trinity River. For example, NOAA Fisheries prepared range-wide status reviews for west coast Chinook salmon (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996). Also, the NOAA Fisheries BRT published a draft updated status review for west coast Chinook salmon and steelhead in November 2003 (NOAA Fisheries 2003). Information also is available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (*e.g.*, 58 FR 33212; 59 FR 440; 62 FR 24588; 62 FR 43937; 63 FR 13347; 64 FR 24049; 64 FR 50394; 65 FR 7764). The Final Programmatic Environmental Impact Statement/Report (EIS/EIR) for the CALFED Bay-Delta Program (CALFED 1999), the Final Programmatic EIS for the CVPIA (DOI 1999), and the Final EIS/EIR for the Trinity River Mainstem Fishery Restoration project (Reclamation and FWS 2000) provide an excellent summary of historical and recent environmental conditions for salmon and steelhead in the Central Valley and Trinity River system.

The following general description of the factors affecting Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Central California Coast steelhead, and Southern Oregon/Northern California Coast coho salmon and their habitat is based on a summarization of these documents. Because the project action area is so large, and most of the Central Valley populations are contained within it, this desciption will serve as the *Environmental Baseline* for Central Valley species as well.

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

1. <u>Habitat Blockage</u>

Hydropower, flood control, and water supply dams of the CVP, SWP, and other municipal and private entities 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.

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and Sacramento-San Joaquin Delta block salmon and steelhead access to the upper portions of the respective watersheds. On the Sacramento River, Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud, and Pit rivers. Whiskeytown Dam blocks access to the upper watershed of Clear Creek. Oroville Dam and associated facilities block passage to the upper Feather River watershed. Nimbus Dam blocks access to most of the American River basin. Friant Dam construction in the mid-1940's has been associated with the elimination of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River (DOI 1999). On the Stanislaus River, construction of New Melones Dam and Goodwin Dam blocked both spring and fall-run Chinook salmon (DFG 2001a).

Impassable dams in northern California also have blocked substantial portions of suitable spawning and rearing habitat for coho salmon. These include Copco and Iron Gate Dams on the Klamath River, and Lewiston Dam on the Trinity River. Lewiston Dam blocks access to one-fourth of the watershed historically utilized by coho salmon.

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

The Suisun Marsh Salinity Control Gates (SMSCG), located on Montezuma Slough, were installed in 1988, and are operated with gates and flashboards to decrease the salinity levels of managed wetlands in Suisun Marsh. The SMSCG have delayed or blocked passage of adult Chinook salmon migrating upstream (Edwards *et al.* 1996; Tillman *et al.* 1996; DWR 2002a). CCC steelhead rearing habitat in Montezuma Slough may be altered by SMSCG operations as well.

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted stream flows 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. Furthermore, more uniform flows year round have resulted in diminished natural channel formation, altered foodweb processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Ayers 2001) and caused spawning gravels to become embedded, and reduced channel width, which has decreased the available spawning and rearing habitat below dams.

Depletion and storage of natural flows have drastically altered natural hydrologic cycles in the Trinity River as well. Alteration of streamflows has resulted in a variety of impacts to juvenile salmonids; including migration delays from insufficient flows or habitat blockages, loss of rearing habitat due to dewatering and blockage, stranding of fish from rapid flow fluctuations, and increased mortality resulting from increased water temperatures.

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

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

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley and Trinity River basin. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for four or five miles (California Resources Agency 1989). By 1979, riparian habitat along the Sacramento River had diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The degradation and fragmentation of riparian habitat had resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture (Jones and Stokes Associates, Incorporated 1993). Removal of vegetation through timber harvest in the Trinity River basin has reduced sources of large woody debris (LWD) needed to form and maintain stream habitat that coho salmon depend on for various life stages.

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation (NOAA Fisheries 1996a). Sedimentation has occurred in the Trinity River basin primarily from timber harvest activities and associated road building (Weitkamp *et al.* 1995). Sedimentation can adversely affect salmonids during all freshwater life stages by; clogging, or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961); burying eggs or alevins; scouring and filling in pools and riffles; reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961); and affecting intergravel permeability and dissolved oxygen levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning, and egg and fry survival (Hartmann *et al.* 1987).

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 water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation resulting in increased streambank erosion (Meehan 1991). Urban stormwater and agricultural runoff may be contaminated with herbicides and pesticides, petroleum products, sediment, *etc.* Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NOAA Fisheries 1998). LWD influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979; Bilby 1984; Robison and Beschta 1990).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Sacramento-San Joaquin Delta downstream and upstream of Chipps Island, respectively (Monroe *et al.* 1992; Goals Project 1999). In Suisun Marsh, salt water intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs, which first were established in the 1870s in western Suisun Marsh (Goals Project 1999).

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by DWR on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and an increase in the clarity of the water (Zach Hymanson, pers comm., IEP Workshop 2002). These conditions have contributed to increased mortality of juvenile Chinook salmon and steelhead as they move through the Delta.

4. Hatchery Operations 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 salmon 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 primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (DOI 1999). For example, Nimbus Hatchery on the American River rears Eel River steelhead stock and releases these fish in the Sacramento River. The Trinity River Hatchery continues to release high numbers of coho salmon juveniles (90 percent of total escapement) into the Klamath Basin, which is thought to create significant straying to natural populations (NOAA Fisheries 2001b). One of the recommendations in the Joint Hatchery Review Report (DFG and NOAA Fisheries 2001) was to identify and designate new sources of steelhead brood stock to replace the current Eel River origin brood stock.

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring- and fall-run fish have led to the hybridization and homogenization of some subpopulations (DFG 1998). As early as the 1960’s, Slater (1963) observed that early fall- and spring-run Chinook salmon were competing for spawning sites in the Sacramento River below Keswick Dam, and speculated that the two runs may have hybridized. Feather River Hatchery (FRH) spring-run Chinook salmon have been documented as straying throughout the Central Valley for many years (DFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon (Colleen Harvey-Arrison and Paul Ward, DFG, pers. comm., 2002), an indication that FRH spring-run Chinook salmon may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and counted at RBDD contain hybridized fish.

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

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally-produced fish in the 1950s (McEwan 2001) to an estimated 23 to 37 percent naturally-produced fish currently (Nobriga and Cadrett 2001). DFG estimated that natural-origin coho salmon comprised 66 percent of the total Klamath River estuary juvenile coho salmon catch in 1997, 39 percent in 2000, and 27 percent in 2001 (DFG 2000a, 2001b). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NOAA Fisheries 2001a). Thus, the ability of natural populations to successfully reproduce has likely been diminished.

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

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown effective in bolstering the numbers of naturally spawning fish in the short term under certain conditions, and in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels, such as Sacramento River winter-run Chinook salmon. However, relative abundance is only one component of a viable salmonid population.

5. <u>Commercial and Sport Harvest</u>

a. *Ocean 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 salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement. Coded wire tag returns indicate that Sacramento River salmon congregate off the coast between Point Arena and Morro Bay.

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

Ocean fisheries have affected the age structure of spring-run Chinook salmon through targeting large fish for many years and reducing the number of four- and five-year-olds (DFG 1998). There are limited data on spring-run Chinook salmon ocean harvest rates. An analysis of six tagged groups of FRH spring-run Chinook salmon by Cramer and Demko (1997) indicates that harvest rates of three-year-olds ranged from 18 percent to 22 percent, four-year-olds ranged from 57 percent to 84 percent, and five-year-olds ranged from 97 percent to 100 percent. The almost complete removal of five-year-olds from the population effectively reduces the age structure of the species, which reduces its resiliency to factors that may impact a year class (*e.g.*, pre-spawning mortality from lethal instream water temperatures).

Retention of coho salmon has been prohibited in California ocean commercial fisheries since 1993, and in ocean recreational fisheries since 1995. California's inland waters explicitly have been closed by regulation to coho salmon retention since 1998. Ocean commercial harvest of coho salmon in California peaked during the period from 1961 through 1980, when five-year averages ranged from 150,280 to 361,660 fish. Since 1986, total harvest had not exceeded 83,000 fish annually (DFG 2003b). Non-retention of coho salmon, starting in 1995, has greatly reduced the harvest, although there continue to be a small number (less than 1000) of fish incidentally caught and illegally landed (DFG 2003b). It has not been possible to determine the composition of California's contribution to the coho salmon ocean harvest from coded-wire tagged recoveries of landed fish because of inadequate and inconsistent tagging rates among its hatchery- and naturally-produced fish. The impact that commercial and recreational ocean fishing has had on the long-term decline of coho salmon populations is not clear.

b. *Freshwater Sport Harvest*

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

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

In-river recreational fisheries historically have taken spring-run Chinook salmon throughout the species' range. During the summer, holding adult spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of spring-run Chinook salmon in Mill, Deer, Butte and Big Chico creeks were added to the existing DFG regulations in 1994. The current regulations, including those developed for winter-run Chinook salmon, provide some level of protection for spring-run fish (DFG 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 ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. Staley (1975) estimated the harvest rate in the American River during the 1971-1972 and 1973-74 seasons to be 27 percent. The average annual harvest rate of adult steelhead above Red Bluff Diversion Dam for the three year period from 1991-92 through 1993-94 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams (DFG 2004a). Overall, this regulation has greatly increased protection of naturally produced adult steelhead.

6. Predation

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

On the mainstem Sacramento River, high rates of predation are known to occur at RBDD, ACID, GCID, areas where rock revetment has replaced natural river bank vegetation, and at south Delta water diversion structures (*e*.g., Clifton Court Forebay; DFG 1998). Predation at RBDD on juvenile winter-run Chinook salmon is believed to be higher than normal due to factors such as water quality and flow dynamics associated with the operation of this structure. Due to their small size, early emigrating winter-run Chinook salmon may be very susceptible to predation in Lake Red Bluff when the RBDD gates remain closed in summer and early fall (Vogel *et al.* 1988). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly susceptible to predation by fish or birds. Sacramento pikeminnow

(*Ptychocheilus grandis*) and striped bass (*Morone saxatilis*) congregate below the dam and prey on juvenile salmon.

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

Other locations in the Central Valley where predation is of concern include flood bypasses, post-release sites for salmonids salvaged at the State and Federal fish facilities, and the Suisun Marsh Salinity Control Structure. Predation on salmon by striped bass and pikeminnow at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967; Pickard *et al.* 1982). Predation rates at these sites are difficult to determine. DFG conducted predation studies from 1987-1993 at the Suisun Marsh Salinity Control Structure to determine if the structure attracts and concentrates predators. The dominant predator species at the structure was striped bass, and juvenile Chinook salmon were identified in their stomach contents (NOAA Fisheries 1997a).

Predation is not believed to be a major cause in coho salmon population declines and has not been identified as a concern for the Trinity River coho salmon population.

7. <u>Environmental Variation</u>

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare *et al*. 1999, Mantua and Hare 2002). This phenomenon has been referred to as the Pacific Decadal Oscillation (PDO). In addition, large-scale climatic regime shifts, such as El Niño, appear to change ocean productivity. During the first part of the 1990's, much of the Pacific Coast was subject to a series of very dry years.

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

Salmon and steelhead are exposed to high rates of natural predation, particularly during freshwater rearing and migration stages. Ocean predation may also contribute to significant natural mortality, although it is not known to what degree. In general, salmonids are prey for pelagic fishes, birds, and marine mammals, including harbor seals, sea lions, and killer whales. There have been recent concerns that the rebound of seal and sea lion populations following their protection under the Marine Mammal Protection Act of 1972 has caused a number of salmonid deaths.

Finally, unusual drought conditions may warrant additional consideration in California. Flows in 2001 were among the lowest flow conditions on record in the Central Valley. The available water in the Sacramento watershed and San Joaquin watershed was 70 percent and 66 percent of normal, according to the Sacramento River Index and the San Joaquin River Index, respectively. Back-to-back drought years could be catastrophic to small populations of listed salmonids that are dependent upon reservoir releases for their success (*e.g.*, winter-run Chinook salmon). Therefore, reservoir carryover storage (usually referred to as end-of-September storage) is a key element in providing adequate reserves to protect salmon and steelhead during extended drought periods. In order to buffer the effect of drought conditions and over allocating resources, NOAA Fisheries has in the past recommended that a minimum carryover storage be maintained in Shasta and Trinity Reservoirs.

8. <u>Ecosystem Restoration</u>

a. *California Bay-Delta Authority (CALFED)*

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

A sub-program of the ERP called the Environmental Water Program (EWP) has been established to support ERP projects through enhancement of instream flows that are biologically and ecologically significant. This program is in the development stage and the benefits to listed salmonids are not yet clear. Clear Creek is one of five watersheds in the Central Valley that has been targeted for action during Phase I of this program.

The Environmental Water Account (EWA) is geared to providing water at critical times to meet ESA requirements and incidental take limits without water supply impacts to other users. In early 2001, the EWA released 290 TAF of water at key times to offset reductions in south Delta pumping to protect winter-run Chinook salmon, delta smelt, and splittail. However, the benefit to winter-run Chinook salmon in terms of number of fish saved was very small. The anticipated benefits to Delta fisheries from the use of the EWA were much higher than what has actually occurred for salmonids.

b. *Central Valley Project Improvement Act*

The CVPIA implemented in 1992 requires that fish and wildlife get equal consideration with water allocations from the Central Valley Project. From this act arose several programs that have benefitted listed salmonids: the Anadromous Fish Restoration Program (AFRP), the Anadromous Fish Screen Program (AFSP), and the Water Acquisition Program (WAP). The AFRP has engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines federal funding with state and private funds to prioritize and construct fish screens on major water diversions mainly in the upper Sacramento River. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the Department of the Interior’s ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for spring-run Chinook salmon and steelhead by maintaining or increasing instream flows in Butte and Mill Creeks and the San Joaquin River at critical times.

c. *Iron Mountain Mine Remediation*

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

d. *SWP Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

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

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

The provisions of funds to cover over-budget costs for the Durham Mutual/Parrot Phelan Screen and Ladders project expedited completion of the construction phase of this project which was completed during 1996. The project continues to benefit salmon and steelhead by facilitating upstream passage of adult spawners and downstream passage of juveniles.

The Mill and Deer Creek Water Exchange projects are designed to provide new wells that enable diverters to bank groundwater in place of stream flow, thus leaving water in the stream during critical migration periods. On Mill Creek several agreements between Los Molinos Mutual Water Company (LMMWC), Orange Cove Irrigation District (OCID), DFG, and DWR allows DWR to pump groundwater from two wells into the LMMWC canals to pay back LMMWC water rights for surface water released downstream for fish. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement for a well capacity of 25 cfs, only 12 cfs has been developed to date (Reclamation and OCID 1999). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult spring-run Chinook salmon in Mill Creek (Reclamation and OCID 1999). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult spring-run Chinook salmon and downstream migrating juvenile steelhead and spring-run Chinook salmon. However, the current arrangement does not ensure adequate flow conditions will be maintained in all years. DWR, DFG, and FWS have developed the Mill Creek Adaptive Management Enhancement Plan to address the instream flow issues. A pilot project using one of the ten pumps originally proposed for Deer Creek was tested in summer 2003. Future testing is planned with implementation to follow.

e) *Trinity River Mainstem Fishery Restoration*

In 1981, the Secretary of the Interior directed the FWS to conduct a study of the effectiveness of increased flows in restoring salmon and steelhead population on the Trinity River. As part of CVPIA, Congress directed the Secretary to complete the study and implement accordingly with concurrence from the Hoopa Valley Tribe. The purpose of the project is to restore and maintain the natural production of anadromous fish on the Trinity River mainstem downstream of Lewiston Dam. Based on the December 19, 2000, Trinity River ROD, 369 to 815 TAF is allocated annually for Trinity River flows. Due to ongoing litigation, the Federal District Court issued a order dated December 10, 2002, directing the CVP to release 368 TAF during critical Trinity River inflow years and 452 TAF during all other inflow conditions. A more recent Federal Court decision is allowing implementation of the Trinty River ROD. Flow releases are scheduled in coordination with the FWS to meet fish habitat, water temperature, and sediment transport objectives in the Trinity basin.

9. Summary

For Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead, the construction of high dams for hydropower, flood control, and water supply resulted in the loss of a vast amount of upstream habitat (*i.e.*, approximately 80 percent, or a minimum linear estimate of over 1000 stream miles), and often caused affected populations to plummet. For example, the completion of Friant Dam has been linked with the extirpation of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River within just a few years. The reduced populations that remain below dams are forced to spawn in lower elevation habitat of mainstem rivers previously not used for this purpose. This habitat is entirely dependent on managing reservoir releases to maintain cool water temperatures suitable for spawning, and this has been difficult to achieve in all years for all species. Steelhead in particular seem to require the small tributary habitat similar to what they historically used for spawning, habitat that is largely unavailable. All species considered in this consultation have been adversely affected by the production of hatchery fish (*e.g.*, from genetic impacts, increased competition, *etc*.) associated with the mitigation for the habitat lost to dam construction.

Land use activities such as road construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for Chinook salmon, coho salmon, and steelhead through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation resulting in increased streambank erosion. Human-induced habitat changes such alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators. Harvest activities, ocean productivity, and drought conditions provide added stressors to listed salmonid populations. In contrast, various ecosystem restoration activities have contributed to improved conditions for listed salmonids (*e.g.*, various fish screens). However, some important restoration activities (*e.g.*, Battle Creek) have not yet been initiated. Benefits to listed salmonids from the EWA have been smaller than anticipated.

E. Existing Monitoring Programs

Salmon focused monitoring efforts are taking place throughout the Sacramento, San Joaquin and Trinity river basins, and Suisun Marsh. Many of these programs gather information on steelhead but a comprehensive steelhead monitoring program has not been funded or implemented in the Central Valley or Trinity River basin. The existing salmonid monitoring efforts are summarized in the Appendix (Table A1) by geographic area and target species. Information for this summary was derived from a variety of sources; 1999 IEP Steelhead Project Work Team report on monitoring, assessment, and research on steelhead: status of knowledge, review of existing programs, and assessment of needs (IEP 1999), DFG Plan (2001c), U.S. Forest Service Sierra Nevada Framework monitoring plan, ESA section 10 and section 4(d) scientific research permit applications, Trinity River Restoration Program biological monitoring, and Suisun Marsh Monitoring Program.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species within the action area. The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR § 402.02).

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

Since the action area is so large and includes a large portion of each Central Valley ESU within it, essentially section *III. Status of the Species and Critical Habitat* in this Opinion also describes the status in the action area for Central Valley species. However, the following overview of the environmental baseline for Sacramento River winter-run Chinook, Central Valley spring-run Chinook salmon, Central Valley steelhead, Southern Oregon/Northern California Coast coho salmon, and Central California Coast steelhead establishes the importance of the action area to the species and the species' condition in the action area. More detailed information on the species' biology, ecology, and background can be found in section *III. Status of the Species and Critical Habitat* of this Opinion.

1. Sacramento River winter-run Chinook salmon

The Sacramento River winter-run Chinook salmon ESU is restricted to one population entirely contained within the action area. Construction of the Livingston Stone National Fish Hatchery in 1996 has safeguarded the natural population since the critically low abundance of the 1990's. Improvements in CVP operations since 1993 include: changes in operations pursuant to the WRO, construction of a temperature control device on Shasta Dam in 1998, opening the gates at RBDD for longer periods of time, and periodic closures of DCC gates. These required actions have helped to bring the run back from the brink of extinction to within 50 percent of the recovery goal (NOAA Fisheries 1997a). In addition, improvement of critical habitat from CVPIA gravel augmentation projects and increased restrictions on recreational and commercial ocean harvest of Chinook salmon since 1994, likely have had a positive impact on winter-run Chinook salmon adult returns to the upper Sacramento River (NOAA Fisheries 2003, 69 FR 33102).

2. Central Valley spring-run Chinook salmon

The spring-run Chinook salmon ESU is comprised mainly of three self-sustaining wild populations (*i.e.*, located in Mill, Deer and Butte Creeks) which are outside of the action area; however, all migratory life stages must past through the Project action area. These three populations have been experiencing positive growth rates since the low abundance levels of the late 1980s. Restrictions on ocean harvest to protect winter-run Chinook salmon and improved ocean conditions have likely had a positive impact on spring-run Chinook salmon adult returns to the Central Valley (NOAA Fisheries 2003, 69 FR 33102). Abundance for the key indicator streams, Mill, Deer and Butte Creeks, are at historical levels. Current risks to the remaining populations include continuing habitat degradation related to water development and use, high water temperatures during the summer adult holding period, and the operations of the Feather River Hatchery.

3. Southern Oregon/Northern California Coast coho salmon

No new information has been provided that suggests risks beyond those identified in previous status reviews for SONCC coho salmon. The Trinity River portion of the ESU is predominately of hatchery origin. Termination of hatchery production of coho salmon at the Mad River and Rowdy Creek facilities has eliminated further potential adverse risks associated with hatchery releases from these facilities. Likewise, restrictions on recreational and commercial harvest of coho salmon since 1994 likely have had a positive impact on coho salmon adult returns to SONCC coho salmon streams (NOAA Fisheries 2003, 69 FR 33102). The DFG has also developed a state-wide coho salmon recovery plan in 2004.

4. Central Valley steelhead

The majority of Central Valley steelhead are restricted to non-historical spawning and rearing habitat below dams within the action area. Smaller populations of steelhead are known to occur outside the action area (*i.e.*, Yuba River, Deer Creek, Mill Creek, Antelope Creek), but the abundance of these fragmented populations is unknown. Existing spawning and rearing habitat within the action area has only enough carrying capacity to sustain steelhead at a population level that would be considered endangered. Chipps Island Trawl data and Delta Fish Facility salvage and loss data suggest that the natural population is continuing to decline and that hatchery steelhead dominate the catch entering the Bay-Delta region (NOAA Fisheries 2003; 69 FR 33102).

5. Central California Coast steelhead

Within the CCC steelhead ESU, two significant habitat blockages are the Coyote and Warm Springs Dams in the Russian River watershed. Other smaller fish passage problems are widespread in the geographic range of the ESU. Additional impacts to this ESU include: urbanization and poor land-use practices; catastrophic flooding in 1964 that caused habitat degradation; and dewatering due to irrigation and diversion. Principal hatchery production in the region comes from the Warm Springs Hatchery on the Russian River, and the Monterey Bay

Salmon and Trout Project on a tributary to Scott Creek (NOAA Fisheries 2003; 69 FR 33102).

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

Profound alterations to the riverine habitat of the Central Valley began with the discovery of gold in the 1850s. Dam construction, water diversion, and hydraulic mining soon followed, launching the Central Valley into an era of water manipulation and coincident habitat degradation. Information describing the most recent trends in abundance and factors affecting the species, including those in the Project action area, can be found in section *III. Status of the Species and Critical Habitat* in this Opinion, the latest version of the OCAP BA dated June 30, 2004 and in the Supplemental EIS/EIR for the Trinity River Mainstem Fishery Restoration Program dated February 2004. Also, more recent information on the status of Central Valley steelhead is discussed by McEwan (2001) in *Contributions to the Biology of Central Valley Salmonids*, DFG, Fish Bulletin 179, Volume 1. Below we also present focused information on certain watersheds where proposed Project actions may have a greater impact on local populations based on current information on the population's status.

1. Habitat Blockage

Project dams block access to 95 percent of the salmon and steelhead habitat in the Central Valley. At present there are no means of fish passage on any Project dams and fish hatcheries are operated as mitigation for the loss in habitat and fish numbers. The remaining limited habitat below dams is managed for multiple fish species and lacks the suitability to maintain natural populations.

Large reservoirs such as Shasta and Oroville with stratified water columns have allowed for management of water temperatures below dams. Reservoir releases typically are managed to create beneficial habitat conditions for winter-run and fall-run Chinook salmon, but neglect the needs of steelhead and spring-run Chinook salmon. In some rivers, such as the upper Sacramento River, stable year round releases of cold water have created an exceptional resident rainbow trout fishery which may act to displace the former steelhead population (Cramer 2000). Other reservoirs, such as Folsom, do not have adequate minimum pool storage to provide releases for steelhead rearing through the summer and fall periods. For example in 2004, storage in Folsom was significantly drawn down to meet water quality standards in the Delta, causing a shift in targeted temperature compliance from 65 ^{o}F to 69 ^{o}F for the summer rearing period (Reclamation 2004a). In contrast, on Whiskeytown Reservoir, Reclamation's temperature control efforts on Clear Creek have avoided significant losses of spring-run Chinook salmon eggs and fry below the former McCormick-Saeltzer Dam site, showing that flexibility in real time operations and the use of work groups, such as B2IT, can reduce temperature related impacts.

In the San Joaquin River reduced flows and agricultural return water create a water quality barrier in the Stockton Ship Channel due to low dissolved oxygen and high temperatures (Hallock *et al.* 1970; Lee 2003). This barrier blocks or delays early returning steelhead and Chinook salmon to San Joaquin tributaries. Although no adult steelhead have been observed passing the fish counting weir on the Stanislaus River in the last two years, four steelhead carcasses were recovered from the upstream side of the of the weir in February and March 2003 (SPCA 2004). A persistent resident population continues to produce a small number of smolts every year (Demko *et al.* 2000). The presence of smaller resident rainbow trout with adult steelhead supports the theory that resident and anadromous steelhead form a single, interbreeding population with a polymorphic life-history structure (McEwan and Jackson 1996, McEwan 2001).

In addition, blockage and delays to listed salmonids occur at the following Project facilities: RBDD, the SMSCG, the DCC gates, and at the temporary agriculture barriers in the Delta. RBDD is especially significant because it increases the likelihood that spring-run Chinook salmon adults will be exposed to sublethal water temperatures before they spawn and because it impedes access to newly restored areas, such as Battle Creek and Clear Creek, that have increased habitat availability and carrying capacity.

2. Water Development Activities

Operationally, water development is constrained by the CVPIA, SWRCB water quality control plans, 1993 WRO and 1995 Delta Smelt Opinion, the COA, and many other agreements (see *Operating Agreements and Constraints*). These constraints have now become the operating baseline for the CVP and SWP. As such they incorporate many actions that minimize losses for listed species (*i.e.*, minimum flow standards on the Sacramento River, temperature compliance points on all project rivers, and diversion gate closures when listed fish are present). However, many of these restrictions placed on project operations primarily have focused on winter-run Chinook salmon, since they were the first species to be listed in the action area. For areas in the Central Valley where winter-run Chinook salmon are not present, there are fewer constraints. For example there is no minimum stream flow on the Stanislaus River, and the American River standard (*i.e.*, SWRCB D-893) is not protective of steelhead. Most flow standards that do exist are based on the needs of Chinook salmon in the fall and neglect the need for summertime flows for steelhead (*e.g.*, Calaveras River, Tuolumne River). In the San Joaquin River, the only flow requirement is maintenance of 5 cfs downstream to Gravelly Ford, after which the river is dry until it reaches the Mendota Pool (approximately 15 miles downstream) where agricultural drain water re-enters the river. Therefore, these areas have little habitat value within the action area for steelhead.

In the Delta, the effect of changing the hydrodynamics so that the direction of water flows in a southward (towards the pumps) instead of westward direction (towards the Suisun Bay) is pronounced and is expected to increase as the capacity for pumping Delta water increases and conveyance of that water is increased through operation of temporary barriers and dredging of channels. Kjelson and Brandes (1989) found that habitat changes due to water development in the Delta significantly affect Sacramento River Chinook salmon, with fall-run Chinook survival being highly correlated to river flow, temperature and percent flow diverted. Recent efforts at quantifying the effects on Chinook salmon survival through the Delta show an increase in mortality associated with increased predation, higher temperatures that reduce growth, and lower water quality that affect smolting (Baker et. al. 2001; Brandes and McLain 2001; Rice and

Newman 1997, as cited in Kimmerer 2001). These indirect effects reduce the habitat value for areas of the South and Central Delta to the point where all operational means (*i.e.*, use of DCC gate closures, installing the HORB, and export curtailments) currently are used to keep salmonids in the mainstem rivers during the winter and spring outmigration period. However, the value of the interior Delta can be significant for rearing YOY Chinook salmon in wet years when large numbers are pushed out of tributaries by high flows. For steelhead and many older juvenile Chinook salmon that have reached the smolt stage, Delta habitat is used very little as they pass quickly through to the ocean (MacFarlane and Norton 2002) and therefore is of less importance to them than the upstream spawning and rearing areas.

3. Invasive Species

Invasive species greatly impact the growth and survival of juvenile salmonids, especially in the Delta. Non-native predators such as striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), and other sunfish species (*Lepomis* and *Pomoxis* spp) present an additional risk to the survival of juvenile salmonids migrating through the Delta that was not historically present prior to their introduction. These introduced species are often better suited to the changes that have occurred in the Delta habitat than are the native salmonids. The presence of the Asian clam (*Potamocorbula amurensis)* has led to alterations in the levels of phyto- and zooplankton found in water column samples taken in the Delta. This species of clam efficiently filters out and feeds upon a significant number of these planktonic organisms, thus reducing the populations of potential forage species for juvenile salmonids. Likewise, introductions of invasive plant species such as the water hyacinth (*Eichhornia crassipes*) and *Egeria densa* have diminished access of juvenile salmonids to critical habitat (Peter Moyle, University of California, Davis, personal communication. April 25, 2002). *Egeria densa* forms thick “walls” along the margins of channels in the Delta. This growth prevents the juvenile salmonids from accessing their preferred shallow water habitat along the channel’s edge. In addition, the thick cover of *Egeria* provides excellent habitat for ambush predators, such as sunfish and bass, which can then prey on juvenile salmonids swimming along their margins. Water hyacinth creates dense floating mats that can impede river flows and alter the aquatic environment beneath the mats. DO levels beneath the mats often drop below sustainable levels for fish due to the increased amount of decaying vegetative matter produced from the overlying mat. Like *Egeria*, water hyacinth is often associated with the margins of the Delta waterways in its initial colonization, but can eventually cover the entire channel if conditions permit. This level of infestation can produce barriers to salmonid migrations within the Delta. The introduction and spread of *Egeria* and water hyacinth have created the need for aquatic weed control programs that utilize herbicides targeting these species. Even in dilute concentrations, these compounds are thought to have indirect effects, such as reduced reproductive output or ability to avoid predators, on listed salmonids in the action area, but increased regulation generally is expected to improve the water quality in the Delta.

4. Freshwater Sport Harvest

The Central Valley steelhead ESU is the only listed salmonid that is greatly impacted by fishing in the action area; Sacramento River winter-run Chinook salmon, Central Valley spring-run

Chinook salmon, and Southern Oregon/Northern California Coast coho salmon are sufficiently protected by fishing regulations, and Central California Coast steelhead occur only in a very small portion of the action area. In the upper Sacramento River, anglers are allowed to keep one wild trout per day above Deschutes Road Bridge during the winter months when steelhead are known to be spawning, and no distinction is made between trout and steelhead that occur in the same area. Below the Deschutes Road Bridge to five miles above Red Bluff, anglers are allowed to keep one wild trout/steelhead all year. Since 1998, all hatchery steelhead have been marked with an adipose fin clip, allowing anglers to tell the difference between hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams, except in the upper Sacramento River as mentioned previously. Overall, marking has greatly increased protection of naturally-produced adult steelhead.

DFG conducted angler surveys in the Central Valley from 1998 through 2000 for the Sacramento, American, Feather, Yuba, San Joaquin, Mokelumne, and Stanislaus rivers. Most of the steelhead angler effort was focused on the American and Feather rivers. Peak angling effort occurred in January on the American River, but much earlier (*i.e.*, in October and November) on the Feather River. The surveys show an increasing trend in angler harvest and effort, from 210 steelhead caught in 1998 to 1,014 steelhead caught in 2000 (DFG 1999, 2000b, 2001d). The steelhead run in the Stanislaus River is believed to be very small (less than10 adults based on weir counts). A few steelhead greater than 24 inches are reported caught by anglers and seen in adult surveys; however, a review of DFG angler surveys from 1998 through 2001 showed none had been reported caught on the Stanislaus River.

Current sport fishing regulations do not prevent wild steelhead from being caught and released many times over, while on the spawning grounds where they are more vulnerable to fishing pressure. Pre-1998 harvest rates varied from 16 to 45 percent in the American and upper Sacramento Rivers (Hallock et al 1961; Staley 1976; McEwan and Jackson 1996). Recent studies on hooking mortality based on spring-run Chinook salmon have found a 12 percent mortality rate for Oregon inriver sport fishery (Lindsay *et al.* 2004). Applying a 30 percent contact rate for Central Valley rivers (*i.e.*, the average of the above harvest rates), approximately 3.6 percent of adult steelhead die before spawning from being caught and released in the recreational fishery. Studies have consistently demonstrated that hooking mortality increases with water temperatures, and since California rivers are typically warmer then Oregon rivers hooking mortality would be expected to be greater in California.

In addition, survival of steelhead eggs is reduced by fishermen walking on redds in spawning areas while targeting hatchery steelhead or salmon. There are no regulations protecting essential spawning areas for steelhead within the action area; however, recently DWR has taken steps by posting signs on the Feather River asking fishermen to avoid the area below the hatchery used by naturally spawning steelhead. Overall, the in-river sport harvest of hatchery steelhead reduces the value of the habitat for natural spawners.

5. Ecosystem Restoration

Ecosystem restoration activities and various funding sources (*e.g.*, CALFED, CVPIA, *etc.*) are described in section *III. Status of the Species and Critical Habitat*. Many projects in the Central Valley are still in the planning stages, but the following have actually been implemented in the action area and hence are part of the environmental baseline:

- Spawning gravel replacement (*e.g.*, Clear Creek, Sacramento River, American River, and Stanislaus River)
- McCormick-Saeltzer Dam removal (Clear Creek)
- Numerous fish screen installations (*e.g.*, GCID, Banta Carbona, and eight diversions in Suisun Marsh)

Since the 1993 WRO, Project operations have been altered to provide protection for winter-run Chinook salmon. These protective actions have also provided benefits to spring-run Chinook salmon and steelhead through changes in gate operations at RBDD and the DCC. The WRO has been amended five times as conditions changed and more protective Delta Standards (D-1641) were adopted (see *Operating Agreements and Constraints*). 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. Since 2001, improvements in fish passage at the ACID diversion dam, 5 miles downstream of Keswick Dam, have allowed winter-run Chinook salmon greater access to the spawning areas below Keswick Dam. Winter-run Chinook salmon have shown a substantial increase in spawning distribution upstream of ACID due to the access provided by fish ladders (OCAP BA Table 5-5).

The implementation of CALFED’s EWA (4 year experiment) in 2000 and the VAMP (12 year experiment), have reduced exports at the SWP and CVP Delta Pumping Plants which have reduced the entrainment losses of older juvenile Chinook salmon. Although the significance of these protective actions to listed species is difficult to distinguish at the population level, these actions have reduced incidental take and the total number salmon loss due to Delta pumping (CALFED 2003). The use of CVPIA (b)(2) water, and to a lesser extent EWA water, upstream below project dams and on the Yuba River have increased the quality of spawning and rearing habitat at critical times for steelhead by increasing flows, decreasing temperatures, or stabilizing flow fluctuations. These actions have not increased the carrying capacity of the habitat in the action area, but have reduced impacts from project operations that are a known source of mortality of steelhead and salmon.

Since 1984, the Trinity River Basin Fish and Wildlife Management Act has been improving salmonid habitat below Lewiston Dam by controlling sediment input from tributaries and constructing 27 channel rehabilitation projects on the mainstem. The value of critical habitat below Lewiston Dam for coho salmon has increased since these projects were undertaken and is expected to continue to increase over the long-term with the implementation of the 47 habitat rehabilitation projects scheduled to be completed under the TRMFR Program (TRMFR EIS/EIR 2004). The quantity and quality of coho salmon habitat has increased due to the implementation of the 2000 Trinity River ROD flows, TRMFR channel restoration projects, water temperature objectives, and sediment transport objectives in the Trinity Basin.

Suitable spawning gravel for adult spring-run Chinook salmon and steelhead has been supplied at several sites on Clear Creek below Whiskeytown Dam in recent years; these projects were funded by Reclamation. However, additional supplementation is needed. NOAA Fisheries believes that some spring-run Chinook salmon may fail to spawn in the reach between Whiskeytown Dam and the Clear Creek Road Bridge in particular because of the shortage of spawning gravel adjacent to a large amount of excellent over-summer holding habitat (Howard Brown, NOAA Fisheries, pers. obs.).

6. Section 10 Permits

ESA section 10 permits cover research and monitoring programs in the Central Valley project area. These include DFG monitoring programs, DWR studies and sampling, the Interagency Ecological Program, and various private consulting firms that conduct fish sampling. Both lethal and non-lethal take is associated with these programs. A summary of the estimated take incidental to these programs is included in the Appendix (Table A2). If listed populations are reduced to very low abundance levels, incidental take associated with these monitoring can have an effect on the survival and recovery of the species.

C. Summary of Environmental Baseline

The greatest factor affecting all listed salmonids within the action area is the loss of spawning and rearing habitat due to the construction of impassable dams. As a result of these dams, salmon and steelhead are confined to lower elevation mainstem reaches that historically were only used for migration. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. High water temperatures at these lower elevations during late-summer/fall are a major stressor to adult and juvenile life stages. Currently, the limiting factors in the action area that affect the likelihood of survival and recovery for these species are high temperatures, low flows, limited spawning and rearing habitat, blocked or delayed passage at RBDD, unscreened diversions, and flow fluctuations.

Recent studies indicate that large numbers of incubating and rearing salmonids can be lost due to isolation and stranding events (DWR 2000a, 2002c; Snider 2001). This is of particular significance given that spring-run Chinook salmon and steelhead spawning habitat has been reduced to only a few miles below CVP and SWP dams. This is habitat that was never historically used for spawning, but must now be manipulated and controlled by project operations to provide the only habitat that can perpetuate the species. For spring-run Chinook salmon there are non-project tributaries in the Central Valley that provide appropriate spawning habitat, but for winter-run Chinook salmon and steelhead the majority of the populations reside within the project area (*i.e.*, American, Feather, and Sacramento rivers). It is therefore important that flow fluctuations from project reservoirs, including those required for flood control, be minimized through timing, modified flood control curves or ramp down criteria for all stages of salmon and steelhead life history.

Through the CALFED ERP, other state programs, and local cost sharing (*i.e.*, water users and irrigation districts) funding has been provided to facilitate the removal of small dams and diversions which will increase the quantity of spawning and rearing habitat available in the Cental Valley. Although, many projects are only in the planning stages, some examples of projects that have been implemented are the removal of McCormick-Saeltzer Dam on Clear Creek in 2000, the removal of Clough Dam on Mill Creek in 2002, and new fish ladders on the ACID diversion in 2001 that improved passage for winter-run Chinook salmon. In addition, numerous other actions are making strides at improving the quality of habitat for listed salmonids, such as the TRMFR program, CVPIA habitat restoration programs (*e.g.*, AFRP, WAP), the Delta Pumping Plant mitigation agreements, the SWRCB water quality standards (D-1641), the VAMP, use of EWA and CVPIA (b)(2) water, the Corps' flood-plain inundation projects, EPA's action to control heavy metal contamination from Iron Mountain Mine, and certain project operations (*i.e.*, increased Trinity River ROD flows, RBDD gate operations, DCC gate operations, and HORB temporary barriers in the Delta). These programs and actions have likely improved the survival of listed salmonids by reducing the impacts of project operations; however, it is difficult to assess the value of these actions individually. Rather it is more probable that for some species (*e.g.*, winter-run Chinook salmon) a combination of positive ocean conditions, increased ocean and freshwater harvest restrictions, in-river temperature control, and increased freshwater survival have led to recent increases in abundance (Figure B1).

The protective actions and conservation programs mentioned above, along with the regulatory criteria in NOAA Fisheries and FWS existing biological opinions, have improved conditions for some listed species (*e.g.*, winter-run Chinook salmon) but not for others (*e.g.*, steelhead). Most restoration activities are focused on improving fall-run Chinook salmon habitat. Passage problems at RBDD and on the San Joaquin River prevent or delay listed salmonids from utilizing newly restored areas. Listed salmon and steelhead still compete among themselves and among a long list of introduced species for a limited amount of cold water habitat below project reservoirs. Current management practices attempt to provide benefits for multiple species to the detriment of a few listed species under the ESA. Large-scale habitat restoration projects, like that proposed for Battle Creek, likely will be necessary to insure recovery of at risk species.

The value of the habitat (critical habitat for Sacramento River winter-run Chinook salmon and SONCC coho salmon) in the action area varies depending on the species. For winter-run Chinook salmon, the population level is still relatively low (*i.e.*, 5,000 females), yet the carrying capacity below Keswick Dam is above the recovery goal (*i.e.*, enough spawning habitat exists for 10,000 females above Balls Ferry Bridge). Johnson (2000) found at low population densities, reductions in habitat quality (*i.e.*, water temperature-related mortality) will not always have a measurable effect on a species reproduction, numbers, or distribution because the species is so far below the carrying capacity (*i.e.*, density dependence is not a factor).

For SONCC coho salmon, the value of critical habitat has increased in quantity and quality through the restoration activities that have taken place over the last several years. Implementation of the TRMFR program (considered separately from the proposed action) is expected to further increase the value of the habitat below Lewiston Dam over the next 20 years (NOAA Fisheries 2000b).

For spring-run Chinook salmon, the carrying capacity of the habitat within some parts of the action area may be exceeded. The value of the spawning area on the mainstem Sacramento River appears to have diminished since operations have been changed to benefit winter-run Chinook salmon survival. On the Feather River, operations of the Oroville Dam and Thermalito Complex have reduced the natural river flows by 60 percent within the low flow channel and have altered the water quality below that reach, thus decreasing the value of the remaining spawning and rearing habitat for spring-run Chinook salmon and steelhead. The habitat that remains has been reduced to such a small area (approximately 3 miles below the fish barrier weir) that any further appreciable decrease in habitat value would be expected to reduce the population.

For steelhead, the limited habitat below project dams has declined to a point where it can only support low population levels. As with winter-run Chinook salmon, effects on steelhead reproduction, abundance, or distribution may not be measurable because the species abundance is below the carrying capacity of the remaining habitat. However, unlike the winter-run Chinook salmon population, the availability of habitat is so reduced for steelhead within the action area that the remaining habitat likely cannot support a recoverable population. Although there is no recovery goal for the steelhead population, this analysis is based on the available data from spawning surveys and adult counts (Hannon *et al.* 2004, DWR 2003, Demko 2004) on selected rivers subject to greater effects from project operations. Abundance estimates for steelhead in three of the five project rivers in the action area (*i.e.*, the Stanislaus, Feather, and American Rivers) presently are so low that continued viability of the populations is questionable (McElhany *et al.* 2000). The resilience of these populations to any further adverse impacts to individuals or habitat is likely to be impaired.

V. EFFECTS OF THE ACTION

The Project is likely to adversely affect listed Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Southern Oregon/Northern California Coast (SONCC) coho salmon, Central Valley steelhead, and Central California Coast steelhead, and the critical habitat of Winter-run Chinook salmon and SONCC coho salmon primarily on three fronts: (1) fish passage to hundreds of miles of upstream habitat above high dams will remain blocked on all Project streams (see section *III. Status of the Species and Critical Habitat*); (2) impacts to flows and water temperatures are expected to reduce the suitability and availability of habitat in the upstream areas of the Sacramento River (including critical habitat of winter-run Chinook salmon), Feather River, American River, Stanislaus River, and San Joaquin River (*i.e.*, all Project streams except for the Trinity and Mokelumne Rivers and Clear Creek); and (3) large numbers of juvenile winter-run Chinook salmon, spring-run Chinook salmon, and steelhead are expected to be drawn into the Central and South Delta as a result of operations of the DCC and the CVP/SWP pumps, where they may be killed through direct entrainment in Project diversions, other unscreened diversions, or otherwise experience lower survival compared to individuals remaining in the mainstem Sacramento and San Joaquin Rivers (see *Assumptions Underlying this Assessment*, below). The habitat impacts are likely to harm, harass, or kill winter-run Chinook salmon, spring-run Chinook salmon, and steelhead by impacting food availability, feeding and growth rates, movement within and among habitats, competitive and predatory interactions, energy expenditures, egg production, ability to find a mate, and spawning success. NOAA Fisheries anticipates that these impacts will occur continually at the levels described at least until the year 2020, the endpoint of this analysis. Some impacts are reduced as a result of adaptive management of DCC gates and temperature control in the upstream areas and under early consultation from the construction of permanent barriers in the South Delta.

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

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

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

For critical habitat, we identify the condition and function of the habitat, and determine if Project effects to the habitat alter its condition and function to the extent that its value to species' conservation is diminished. Habitat condition is assumed to be related to availability and suitability, which, for listed salmonids, often is determined by water temperature, flow, passage conditions, amount of spawning gravel, etc. Habitat function often is determined by life stage presence and use.

A. Approach to the Assessment

1. Information Available for the Assessment

To conduct this assessment, NOAA Fisheries examined an extensive amount of evidence from a variety of sources. Detailed background information on the status of these species and critical habitat has been published in a number of documents including species status reviews and scientific literature. Project effects on listed species were analyzed by reviewing revised drafts of the BA (dated June 2003, January 8, 2004, February 13, 2004, March 18, 2004, March 22, 2004, May 22, 2004, June 30, 2004, and a clarification letter from C. Bowling [Reclamation] to R. McInnis [NOAA Fisheries], dated September 14, 2004), as well as model results from a variety of qualitative and quantitative models. Models are necessary for understanding Project effects due to the very large size of the action area (*i.e.*, hundreds of miles of waterways), and complex and long-term effects (*i.e.,* until 2020) of the Project (see below).

For this biological opinion, NOAA Fisheries used results from the CALSIM II model, Reclamation's Sacramento River Salmon Mortality Model, and the Sacramento Basin Temperature Model to predict Project effects on listed salmon and steelhead in upstream areas. In the Delta region, several modeling approaches were used, starting with a conceptual model (Brandes 2004) to identify key areas of concern, a spreadsheet model to calculate a juvenile production estimate (JPE) for winter-run Chinook salmon for use in calculating incidental take at the Delta pumps, a Gaming Model to examine daily operations (*e.g.,* involving use of the EWA and operating Banks at 8500), CALSIM II to examine the effect of water year-type, and finally a Particle Tracking Model to examine trends in juvenile outmigration expected from water movement patterns. In addition, DWR developed a monthly spreadsheet analysis on Federal and State Pumping rate changes, and Surface Water Resources Inc. (SWRI) conducted a similar analysis of (b)(2) water changes on the American River for recent years, which were used to define the assumptions used in the CALSIM II model. Various Chinook salmon models (*e.g.,* SALMOD, CPOP, EACH, and CRISP) were not used due to limitations in their application or knowledge gaps. For a discussion on the limits of these models see Kimmerer *et al.* (2001). Other, newer Chinook salmon models are being developed (*e.g.,* Lindley and Newman 2001; Cramer 2004), but are still under review and may be used in the future to aid in the assessment of effects to listed salmon.

(1) JPE. In order to derive incidental take at the Delta pumps, NOAA Fisheries has used a simple spreadsheet model to calculate a JPE (see OCAP BA, Table 6-7 dated May 24, 2004) for winter-run Chinook salmon based on adult escapement counts. The limitation of the JPE is that it calculates only one life history stage (*i.e.*, the number of juveniles entering the Delta).

(2) Gaming. Gaming involves computer simulations of real world operations using historical daily salvage and reservoir data to analyze the effects of new actions (*e.g.*, EWA or 8500 Banks) on a weekly time-step. NOAA Fisheries used Gaming exercises to support the information gained from CALSIM II modeling (JSA 2002, 2003).

(3) CALSIM II. CALSIM II is a planning model with a monthly time step developed by DWR and Reclamation (OCAP BA, Chapt. 8) to simulate the CVP and SWP water operations from water year 1922 to 1994. It uses optimization techniques to route water through a network. In this consultation, NOAA Fisheries has used CALSIM II results provided by DWR and Reclamation primarily to evaluate the effect of various Project actions on (1) entrainment rate of listed salmonids at the CVP and SWP pumps, and (2) reservoir storage both currently (*i.e*., assuming a year 2001 LOD) and in the future (*i.e*., assuming a year 2020 LOD). Reservoir storage is assumed to be tightly linked to salmonid habitat availability and suitability due to flow and temperature effects downstream of Project dams.

For estimating future entrainment loss at the Delta pumping facilities, NOAA Fisheries assumes that pumping rates are positively correlated with fish salvage rates (See section *2. Assumptions Underlying This Assessment*. Therefore, fish salvage rates are expected to increase at the same rate as the pumping rate increase. This may be true for some species like steelhead, fall-run Chinook salmon and splittail (OCAP BA Fig. 4-3), but is not as apparent for others like winter-run Chinook salmon and delta smelt. Winter-run Chinook salmon entrainment tends to be high when smolts are migrating through the Delta, regardless of pumping rates.

In addition, calculated entrainment rates are based on monthly pumping averages which do not represent real world conditions and export reductions. Typically, episodes of high take of listed fish species occur in short two week periods and export reductions to minimize take are applied for 3-5 days at a time. These day-to-day operations are not represented in a monthly time step model like CALSIM II. Also, CALSIM II cannot represent variable assets acquired, shoulders on VAMP[5], or relaxation of the E/I Ratio. In an attempt to simulate real world effects of day-to-day operating conditions with Banks at 8500 cfs and EWA in place, NOAA Fisheries relied on Gaming simulations.

CALSIM II as used for the OCAP BA studies has the most current assumptions for the (b)(2) water policy and EWA program (assumption dates May 2003 and October 2003, respectively; see OCAP BA, Chapter 8). CALSIM II represents the best available planning model for the CVP/SWP system. It was peer reviewed in April of 2004 by the CALFED Science Program, and found to meet the need for a large-scale, relatively versatile operations planning model that can provide for a statewide analysis of the movement of Central Valley water. Therefore, it represents the best available data for predicting environmental effects. That said, the CALSIM Model and the implied (b)(2) water policy assumptions, have a high degree of uncertainty associated with them as stand alone predictive power analysis to CVP/SWP operations. There is no measure of the confidence limits, because it is impossible to verify policy/water regulations against historical hydrology and project operations. The best use of such a model is in a comparative analysis framework, where in theory, the inherent bias and inaccuracies don’t affect relative changes in project dynamics being assessed. For example, as certain assumptions are changed in the model the overall trend of the change (*i.e*., in both time and magnitude effects) to the environment should become apparent. Second order planning models, such as water temperature models, mortality models, gaming, or economic decision making models, have substantial uncertainty in predictive power because they rely on and use CALSIM results (high

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[5] Refers to export curtailments at the CVP/SWP pumps usually taken before the VAMP period to protect delta smelt.

degree of uncertainty) as a basis. Models such as the water temperature model are calibrated against historical project performance (like the Shasta TCD and coldwater usage), so if these are reasonable the uncertainty falls mainly in the assumed operation of the CVP/SWP facilities from the CALSIM model. Therefore predicting environmental effects based on CALSIM results, requires knowledge of the limitations of portraying absolute numbers (*e.g.*, temperature control capability or flow regimes) and best professional judgement to filter out the significance of changes and likely effects.

The six major changes in CVP and SWP operations relative to current conditions that were incorporated into CALSIM II for analysis of Project impacts are:

- Trinity River releases (*i.e*., 340 TAF, 368.6-452.6 TAF to 368.6-815 TAF annually)
- Freeport Regional Water Project
- 2020 Level of Development
- Project Integration Agreement (*i.e*., 100 TAF dedicated CVP Refuge Level 2 Pumping at Banks and 75 TAF of CVP releases for SWP)
- The SWP/CVP Intertie
- South Delta Improvement Project (*i.e*., increased Banks capacity from 6,680 cfs-8,500 cfs)

Results from seven model runs (Table 3) developed by Reclamation and DWR were used by NOAA Fisheries to evaluate the impacts of these changes in Project operations on listed salmonids.

Table 3. Summary of assumptions in the OCAP CALSIM II model for seven studies. (from OCAP BA Table 8-2).

	Trinity Min Flows	**CVPIA 3406 (b)(2)**	**Level of Development**	**EWA**	**SDIP**	**CVP/SWP Integration**	**Freeport**	**Intertie**
Study 1 D1641 with b(2) (1997)	340 TAF	May 2003	2001					
Study 2 Today b(2)	368.6-452.6 TAF	Same as above	Same as above					
Study 3 Today EWA	Same as above	Same as above	Same as above	X				
Study 4 Future SDIP	368.6-815 TAF	Same as above	2020		X	X	X	X
Study 4a Future b(2)	Same as above	Same as above	Same as above				X	X
Study 5 Future EWA	Same as above	Same as above	Same as above	X	X	X	X	X
Study 5a Future EWA 6680	Same as above	Same as above	Same as above	X			X	X

In general, model runs 1, 2, and 3 represent different scenarios of baseline or current conditions (*i.e.*, using year 2001 level of development), whereas model runs 4, 4a, 5, and 5a represent different scenarios of future conditions (*i.e.*, using year 2020 level of development). Studies 2 (without EWA) and 3 are the closest to current conditions and are used as the baseline for this Opinion.

Study 1 is used to evaluate how the operations and regulations have been impacted since implementing the terms and conditions of the FWS Delta Smelt Biological Opinion, with (b)(2) water operations acting as a surrogate for the 2:1 VAMP restrictions. Studies 2, 4, and 4a are to evaluate the CALFED Tier 1 environmental regulatory effects that are mandated by law. Studies 3, 5, and 5a were run to evaluate the EWA costs as the modeling can best simulate the current actions taken by the EWA program. The current EWA program may be regarded as representative of foreseeable future EWA operations. However, NOAA Fisheries recognizes that the future EWA has not been finalized with a long-term plan of operations.

Studies 4a and 5a represent the models that evaluate effects of the formal consultation studies, whereas studies 4 and 5 represent the early consultation simulations. Therefore, the "difference" between the results of 4 and 4a, for example, equal the effects of early consultation actions. The formal consultation studies take Studies 4 and 5 and remove the South Delta Improvement Project (SDIP) and Project Integration components considered as early consultation assumptions. Studies 4a and 5a include the proposed operations for formal consultation. The formal consultation components include Delta-Mendota Canal (DMC) Intertie, Trinity at 368.6 to 815 TAF, and Freeport Project, and Banks is held at 6,680 cfs. More detailed descriptions of CALSIM II can be seen in the OCAP BA Chapters 8 and 11.

For effects on listed salmonids NOAA Fisheries used Study 3 as the baseline (considered most representative of conditions today) to compare with Study 5 (Future condition with EWA) for the early consultation. For formal consultation, Study 3 was compared to Studies 4a and 5a to see the future effects of long-term operations without the early consultation actions (*i.e.*, Banks at 8500 pumping and SDIP).

(4) Water Temperature Model. Reclamation has developed temperature models (Reclamation 1997) for all Project rivers based on monthly reservoir temperatures, hydrologic and climatic data, and operations from the 72 year period of record in the CALSIM model. These models incorporate the operations of the TCD's which generally conserve cold water for the summer and fall months when river temperatures become critical for fisheries. Temperature changes in the regulating reservoirs downstream (*e.g.*, Keswick and Natomas) are computed from equilibrium temperature decay equations. The river temperature calculations are based on regulated reservoir release temperatures, river flows, and climatic data (*i.e.*, historical monthly mean air temperatures and long-term averages obtained from National Weather Service records). In addition to the limitations described above there is also uncertainty regarding the performance characteristics of the Shasta TCD. Due to leakage, overflow, and performance of the side intakes this model tends to underestimate water temperatures. In the real-time operations a more conservative approach is taken that is not fully represented in these models.

(5) Salmon Mortality Model. 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 were input to Reclamation's salmon mortality model. Also used as model input were spatial and temporal spawning distributions of winter-run, spring-run, fall-run, and late fall-run Chinook salmon which were updated from surveys 2001- 2003 (DFG 2004d, OCAP work group results, OCAP BA Appendix F). From this model, losses of Chinook salmon eggs and fry were estimated for all Chinook salmon runs in the Sacramento, Feather, American, Stanislaus and Trinity Rivers. This model is limited to early life stage mortality. It does not evaluate potential impacts on later life stages, such as emergent fry, smolts or juvenile out-migrants or adults. Also, it does not consider other factors that may affect mortality, such as in-stream flows, diversions, predation, etc. Since the salmon mortality model operates on a daily time-step, a procedure is required to convert the monthly temperature output. The mortality model computes daily temperatures based on a linear interpolation, which are assumed to occur on the 15th day of the month. For the purposes of the temperature analysis, the performance of the Shasta TCD was updated based on recent efficiency tests (OCAP BA, Appendix B). For steelhead in the Sacramento River, there is no similar temperature model available. However, the temporal and spatial spawning distribution of steelhead and late fall-run Chinook salmon are relatively similar. Thus, we assumed that temperature effects and 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.

(6) Particle Tracking Model (PTM). DWR has produced a series of particle tracking model runs for the SDIP (Chu 2004), all assuming a year 2020 level of development (*i.e.*, future conditions) that examine the fate of neutrally buoyant particles injected at given points in the Delta system. NOAA Fisheries used comparisons of these model runs to examine the impacts of 8500 cfs pumping and operation of the DCC and permanent barriers in the Delta on the transport and fate individual particles, assuming that particle movement tracks hydrodynamics. The PTM was run for three different water year (WY) types, critical (WY 1988), below normal (WY 1979), and wet (WY 1984). The underlying assumption in the PTM modeling is that listed juvenile salmonids migrating through the Delta will behave in a similar fashion to passive particles injected into the Delta. NOAA Fisheries assumes that neo-natal salmonids (*i.e.*, yolk-sac and button-up fry) will behave in a fashion similar to neutrally buoyant particles and follow the water current patterns in the Delta, but these life stages are not expected to occur in the Delta in great numbers except after high-flow events. Although NOAA Fisheries believes that older juvenile fish with more volitional locomotion will move at different rates than the particles, the overall movement of the particles in the PTM represents how masses of water, or cells, will move within the Delta. If each cell contains independently moving fish, representing individual behaviors (*i.e.*, foraging, rearing, *etc*.) and we assume that fish do not move between cells, then the *gross* movement of water and fish can be assumed from the PTM results.

2. Assumptions Underlying This Assessment

In addition to assumptions associated with the different modeling approaches described above, NOAA Fisheries also made assumptions concerning impact measurement and assessment:

a. *Habitat Availability and Suitability*

For this consultation, we define habitat availability as the quantity of habitat available; when possible we relied on instream flow studies (*i.e.*, the instream flow incremental methodology [IFIM]) to assess habitat availability. We define habitat suitability as the quality of habitat available, usually described in terms of water temperature, velocity, depth, substrate, or extent of riparian habitat. NOAA Fisheries assumes that the spatial and temporal distribution of listed salmonids throughout the action area will vary on a population- and life stage-specific basis as indicated in section *III. Status of the Species and Critical Habitat*, and that the likelihood of some impacts from the Project is linked to the likelihood of fish presence (Table 4). We assume that if resulting water temperatures are in the preferred range for a particular species (see section *III. Status of the Species and Critical Habitat*) that temperature impacts are not likely to adversely affect the species.

Table 4. Life History timing of salmonids in the Sacramento River near RBDD as cited in (Reclamation and TCCA 2002).

Name	**Adult Immigration**	**Spawning**	**Incubation**	**Larval/Juvenile Rearing**	**Juvenile Emigration**
Fall-run	July-Dec	Oct-Dec	Oct-Mar	Dec-Jun	Dec-Jul
Late-fall run	Oct-Apr	Jan-Apr	Jan-Jun	Apr-Nov	Apr-Dec
spring-run	Apr-Jul	Aug-Oct	Aug-Dec	Oct-Apr	Oct-May
winter-run	Dec-Jul	Apr-Aug	Apr-Oct	Jul-Mar	Jul-Mar
steelhead	Aug-Mar	Dec-Apr	Dec-Jun	Year-round (1 to 2 years)	Jan-Oct

We assume that habitat availability and suitability are related to habitat carrying capacity (*i.e.*, the number of individuals of a certain life stage that the habitat can support given the state of food and other resources in that area). Our assessment of habitat availability and suitability is intended to determine if proposed Project actions are likely to degrade the quantity or quality of natural resources necessary to support populations of salmonids in the action area. The approach is intended to determine if any changes to habitat are likely to affect individuals to the extent that listed salmon and steelhead populations in the action area would be affected in ways that would be expected to appreciably reduce the likelihood of their survival and recovery in the wild. We recognize that listed populations may be well below carrying capacity to begin with, which makes habitat-related effects to populations more difficult to discern. The relationship between changes in habitat quality and quantity 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 Nehlsen *et al.* (1991), Baker *et al.* (1995), McElhany *et al.* (2000), and others.

Salmonid habitat availability and suitability both typically are linked to flows. We have assumed in particular that changes in flow will continue to affect water temperature, velocity, and depth as well as river channel formation processes, and consequently the quantity and quality of habitat available to salmon and steelhead.

b. *Diversion and Entrainment*

NOAA Fisheries assumes that Delta survival is greater for juvenile salmon and steelhead that remain in the mainstem Sacramento and San Joaquin Rivers than those fish that are diverted through the DCC gates and HORB into the Central and South Delta (Kjelson *et al.* 1982, Newman and Rice 1997, Brandes and McLain 2001, as cited in the OCAP-BA Chapter 6). Recent work by DFG has shown a relationship between early DCC gate closures (*i.e.*, December and January) and reduced loss of winter-run Chinook salmon at the Delta Pumping Plants (Low 2004, unpublished).

NOAA Fisheries assumes that for spring-run Chinook salmon, uniquely marked (CWT) late fall-run Chinook released from Coleman National Fish Hatchery in the upper Sacramento River can be used as surrogates for the purpose of estimating incidental take at the Delta pumps. This assumption is based on similar timing and size at release of the surrogates to naturally-produced yearling spring-run Chinook salmon in the upper tributaries (*e.g*., Deer, Mill, and Antelope Creeks). In order to coordinate surrogate releases to the natural timing of the spring-run Chinook salmon outmigration period, real-time data from RSTs in key index streams are monitored and reported to the DAT.

For steelhead we assume that the loss rates at the Delta Pumping Plants are similar to those for Chinook salmon, because no studies have been done on steelhead mortality and predation in CCF. Currently, only salvage figures are estimated from the Delta Fish Facilities, but for the OCAP consultation loss rates were calculated. Anecdotal information and limited data indicates that due to their larger size during outmigration, steelhead mortality through the Delta facilities may be less than for Chinook salmon (Tracy Fish Studies 2004).

We assume that export reductions at the Delta Pumping Plants, through the use of EWA or b(2) water, do not have a significant effect on the survival of winter-run and spring-run Chinook salmon, or steelhead. Past use of EWA and b(2) water has resulted in curtailing exports for a few days by a few thousand cfs, which we believe is unlikely to benefit a large number of individuals or translate to meaningful population benefits (Kimmerer 2002). Very few listed salmonids are actually saved by export reductions even when indirect effects (*e.g.*, those related to predation, competition, or water temperature) are considered. If exports were curtailed for longer periods of time and to a greater extent, one would expect to see population benefits for winter-run Chinook salmon as well as other species (Brandes 2004). If the difference in take at the pumps between operations with and without EWA are minor, then we would expect that the population changes would be too low to detect.

3. Adaptive Management Process

For the purposes of this Opinion, NOAA Fisheries assumes that the process for making adaptive management decisions as described in the OCAP BA Chapter 2 will minimize some adverse effects associated with operation of the project. However even though a certain degree of flexibility in making operational decisions allows this process to occur, based on past experience, NOAA Fisheries anticipates that the adaptive management process can not fully mitigate for all project impacts (*e.g.*, limitations on the use of environmental water upstream only allow protective actions of short duration in certain areas).

B. Trinity River Effects

NOAA Fisheries issued a biological opinion (Trinity BO) on the TRMFR on October 12, 2000, that assessed the effects of implementing the TRMFR EIS (*i.e.*, ROD flows) for SONCC coho salmon, winter-run Chinook salmon, spring-run Chinook salmon, and steelhead (NOAA Fisheries 2000b). This biological opinion concluded that the TRMFR (FWS 2000) was not likely to jeopardize the continued existence of the above-listed salmonids, or destroy or adversely modify designated critical habitat. Sacramento River CVP operations affected by the Trinity BO occur only in those dry and critical years when Reclamation has reinitiated consultation on the CVP-OCAP biological opinion to avoid significant temperature-related losses of Sacramento River winter-run Chinook salmon (defined as greater than 10 percent as predicted by Reclamation's Salmon Mortality Model). Under these conditions Reclamation is required to: 1) determine the feasibility of using the bypass outlets on Trinity Dam as needed, and 2) evaluate drawdowns of Trinity Reservoir below the 600 TAF minimum end-of-water year carryover target.

1. Formal Consultation

Effects to the Trinity River for SONCC coho salmon and effects to the Central Valley for winter-run and spring-run Chinook salmon, and steelhead are the same as those described in the Trinity BO (NOAA Fisheries 2000b), and are summarized here. Since the 2000 Trinity BO was written, the largest impact to the Trinity River has been the increased ROD flows as shown in the OCAP BA (Fig. 9-3 to 9-10). For effects of Trinity River ROD flows on Central Valley species see sections under individual rivers.

a. *Adult Migration, Spawning, Incubation*

Increased flows on the Trinity River are a part of the implementation of the TRMFR program (FWS 2000), and are anticipated to provide adequate stream conditions for the upstream migration of coho salmon (FWS 1998). These flows are aimed at restoring the natural channel forming processes of the river, which in the long-term should provide benefits to adult coho salmon through the improved quality and quantity of spawning habitat created and maintained through bed scour and gravel bar formation. NOAA Fisheries expects in-river (*i.e.*, natural) spawning success of SONCC coho salmon to increase because adequate spawning habitat presently is very limited in the Trinity River (TR SEIS 2004).

September water temperatures often are expected to be above preferred ranges for SONCC coho salmon near the mouth of the Trinity River, but because delays in adult migration are anticipated to be short-term and adults can move upstream to more favorable conditions, this effect is not expected to cause physiological stress to the extent of injury. Temperatures would be below 60 ˚F at Douglas City in September of about 90 percent of years and suitable for holding adult coho salmon. During a few dry years temperatures could exceed 60 ˚F in September, potentially delaying upstream migration and leaving adults in the warmer Lower Klamath and Trinity River reaches. Flows during spawning and incubation would be maintained at 300 cfs, which has been shown to provide suitable conditions for spawning and incubation of coho salmon (FWS 1998).

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 pursuant to the Trinity BO. See the Sacramento River section for effects on temperature control due to loss of Trinity River exports and also *d. Adaptive Management*, below.

b. *Fry and Juveniles*

The Trinity River supports young coho salmon in the mainstem year round. Most rearing occurs upstream of Douglas City in the twenty miles below Lewiston Dam. A critical period for juvenile coho salmon rearing in the Trinity River may be June through September of dry years when water temperatures are at the high end of what is considered optimal for coho rearing. However, conditions under the future operational scenarios would be improved during this period, primarily due to higher ROD releases provided in April through July. Water temperatures are reduced by about 2 ˚F, on average, under future operations in May, June, and July, with and without EWA. Maintaining water temperatures near 60 ˚F is anticipated to maximize the growth rate of juvenile coho salmon, because food conversion efficiency should be optimized. This would be expected to increase survival because larger juveniles should be better able to defend feeding territories and less susceptible to predation. Also, higher flows in April through June should trigger out-migration at the appropriate time and thus increase the likelihood of survival through this life stage.

c. *Habitat Availability and Suitability*

The spring high flows under the future condition are provided to mimic the natural hydrograph during the snowmelt period. These flows should increase survival of out-migrating coho salmon smolts, and should benefit coho salmon through the long-term habitat values provided by returning more natural geomorphic processes to the Trinity River (NOAA Fisheries 2000). The higher flows are designed to discourage riparian vegetation establishment down to the edge of the lower flow channel margins and to scour the bed to maintain spawning and rearing habitat (FWS 200, TR SEIS 2004). Off-channel habitats out of the main river flow may be created by the higher flows, and are important for sustaining juvenile coho salmon through the winter months when water is cooler. Stranding and isolation of coho salmon fry behind the riparian berm can be substantial when the flows are lowered following the prescribed ROD flow increases (Zedonis 1996; Chamberlain 2003). However, the short-term stranding effects will be minimized by implementing the entire TRMFR program (*e.g.*, physical removal of riparian berms) and the long-term beneficial effects of higher spring-time releases. Flows under current operations *(i.e.*, 369-453 TAF) should be adequate to sustain migration, spawning and rearing habitat for coho salmon since they are not less than the current level and meet the recommended summer and fall temperature requirements based on HSC developed for each life stage of salmonids (FWS 1998).

Implementation of the Trinity ROD flows in the future condition (*i.e.*, 369-815 TAF) is anticipated to benefit coho salmon by providing higher spring-time flow conditions which should improve the long-term quality of habitat below Lewiston Dam. Improving the quality and quantity of SONCC coho salmon critical habitat by restoring suitable conditions is anticipated to increase the spawning success of adults and the growth and survival of juveniles. This is anticipated to increase their probability of survival and recovery of the SONCC coho salmon ESU.

d. *Adaptive Management*

In dry and critically dry water years (*i.e.*,10 percent of years) Reclamation will discuss end of September (EOS) carryover storage with NOAA Fisheries and FWS on a case-by-case basis. As a part of the Trinity River Restoration Program (*i.e.*, implementation of the preferred alternative) an Adaptive Environmental Assessment and Management Team and a Trinity River Adaptive Management Working Group were organized to help design and direct monitoring and restoration activities. Within these groups are stakeholder groups which review annual flow schedules and provides recommendations for flow modifications, if necessary, to the Trinity Management Council and Science Advisory Board. For more information on the process used, refer to Appendix C (FWS 2000). Decision options on water temperature effects during critically dry years include low level bypasses from Trinity Dam that access cold water for coho salmon. Bypass releases for the Trinity River may also provide water temperature benefits to winter-run Chinook salmon if some of the cold water is diverted to the Sacramento River. During years in which these releases are made, Reclamation and NOAA Fisheries will minimize adverse effects to coho salmon from stranding and isolation below Trinity Dam through the Trinity Management Council.

2. Early Consultation

No adverse effects to SONCC coho salmon or critical habitat are anticipated on the Trinity River as a result of implementing the proposed early consultation actions (*i.e.*, 8500 Banks, Project Integration, *etc.*) because the impacts of early consultation actions are confined mainly to the Central Valley region.

C. Clear Creek Effects

The following assessment of Project impacts to listed salmonids in Clear Creek is based on comparison of Whiskeytown flow release projections and average monthly water temperatures for wet and dry water years to the preferred conditions and habitat requirements of spring-run Chinook salmon and steelhead during migration, spawning, and incubation. Holding temperatures for spring-run Chinook salmon also were analyzed.

1. Formal Consultation

a. *Adult Migration, Spawning, Incubation*

Water Temperatures. Water temperatures are expected to be within, or near the preferred range throughout the adult steelhead migration period (December through March [Matt Brown, FWS, pers. comm. 2004]), and spawning and egg incubation period (December through May). Monthly water temperatures are predicted to be within the preferred range for adult spring-run Chinook salmon migration during April and May. Temperatures during June of both wet and dry years may exceed preferred ranges identified by Bell (1991), but will remain below the upper range recommended by Boles (1988). During July of both wet and dry years, temperatures will slightly exceed the upper range identified by Boles (1988), and are expected to delay adult migration. During August, water temperatures at the mouth of Clear Creek are expected to block adult migration of a few spring-run Chinook salmon late in the migration season of critically dry years. Evening water temperatures are expected to be slightly cooler and may be suitable for adult migration. Consequently, the overall effect of water temperatures on a few adult spring-run Chinook salmon migration is that fish entering lower Clear Creek at the tail end of the migration period during the months of July and August may experience adverse effects such as temporary migration delays, and an increased susceptibility to disease, but are still expected to reach upstream holding and spawning habitat because of the relatively short migration distance and low frequency of water temperatures that block migration altogether. Reductions in spawning success are not anticipated.

Water temperatures for spring-run Chinook salmon modeled above and below the Igo gage, during wet and dry years, are within the preferred range from April through September. Observed water temperatures were slightly higher than modeled temperatures in 2002, but only exceeded preferred holding temperatures for one day.

Spawning and egg incubation primarily occurs in the upper eight miles of Clear Creek below Whiskeytown Dam, where modeled water temperatures for spring-run Chinook salmon spawning, and egg incubation are within the preferred temperature ranges for all existing project conditions. However, observed water temperatures in September of 1999, 2000, and 2001 were higher than modeled temperatures, and some spring-run Chinook salmon redds were exposed to temperatures greater than 56 ^{o}F during initial incubation (FWS 2004b). FWS staff believe that the negative impact of this exposure is minimal because only a small percentage of eggs were affected, and because Seymour (1956) found that Chinook salmon egg mortality rates were low for eggs incubated at an initial temperature of 60 ^{o}F. Since 2002, NOAA Fisheries has required Reclamation to meet a daily average water temperature of 56 ^{o}F at Igo from September 15 to October 30, resulting in preferred water temperatures during the spawning season for the majority of spawning spring-run Chinook salmon in Clear Creek.

Instream Flows. For adult upstream migration, spring-run Chinook salmon require stream flows that are sufficient to trigger migration cues and locate natal streams (DFG 1998). Furthermore, spring-run Chinook salmon must migrate during high flow periods to successfully ascend high gradient channel segments that may be impassable or difficult to pass at low flows (Lindley *et al.* 2004). There do not appear to any physical barriers that limit the upstream migration of adult spring-run Chinook salmon in Clear Creek (FWS 2004b), although there are likely to be optimal attraction flows that trigger and facilitate upstream migration. FWS (2004b) found that flows of 150 cfs appear to provide adequate passage conditions for adult spring-run Chinook salmon. During 1999, when summer instream flows were maintained near 150 cfs, observations of Chinook salmon below Saeltzer Dam increased gradually throughout the summer, unlike previous years when adult Chinook salmon did not enter Clear Creek until flows were increased above 150 cfs. In 2002, consecutive monthly Chinook salmon counts from May through June increased at least 23 percent while flows were 150 cfs and dropped to a low monthly increase of 5 percent in August at the end of the migration period when flows were 95 cfs. Projected Whiskeytown flow releases during the upstream migration of spring-run Chinook salmon range from a monthly average of 90 to 200 cfs during wet years, and 80 to 180 cfs during dry years. These flows are expected to provide adequate passage conditions for adult Chinook salmon. In 5 to 10 percent of the modeled years, Whiskeytown releases may be reduced to 50 cfs during April, May, and June. These conditions are expected to delay adult upstream migration and may prevent some fish from accessing upstream holding and spawning habitat, thus decreasing the likelihood of successful spawning.

Projected monthly average flows during adult steelhead migration periods range from 170 to 175 cfs in dry years and 200 to 250 cfs during wet years. There is no information available on preferred passage flows for steelhead in Clear Creek; however, based on observations of successful Chinook salmon passage at similar flows, steelhead are expected to be able to migrate successfully. In 5 to 10 percent of the modeled years, Whiskeytown releases may be reduced to between 30 and 50 cfs. These low flow periods are projected to only occur infrequently (*i.e.,* 7 out of 71 years) and are not likely to last throughout the entire migration period. Additionally, numerous tributaries between Whiskeytown Dam and the Saeltzer Gorge will augment Whiskeytown releases and may increase actual flows to levels that will allow successful upstream passage of steelhead. Therefore, steelhead passage in Clear Creek is not anticipated to be impeded to the extent that precludes successful spawning.

In general, the relatively stable flows below Whiskeytown Dam are anticipated to be beneficial to spring-run Chinook salmon and steelhead redds. High flow events are most likely to affect spring-run Chinook salmon in December and January, and steelhead during December through March. Reclamation does not propose any releases into Clear Creek that will cause bed mobilization. However, tributary inflow or a Glory Hole[4] spill can augment Whiskeytown

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[4] The funnel-shaped opening of a massive vertical pipe that receives reservoir overflow and releases it under the dam.

releases and result in flows that are capable of scouring redds. Instantaneous flows capable of scouring steelhead redds (*i.e.,* > 3,000 cfs; (McBain *et al.* 1999, McBain and Trush 2001) are expected to occur approximately every two years at Igo. However, this frequency primarily is attributable to tributary flows and not Glory Hole spills, meaning that the majority of steelhead redds are unaffected by these flows because the highest redd densities are closer to Whiskeytown Dam, and upstream of most tributaries.

Another potential effect of flows on redds is dewatering. Redd dewatering occurs when stream flows are reduced during or after the spawning period. From September to January, under wet year forecasts, flows are expected to remain stable, at or near 200 cfs. Under a dry year, flows will increase from September to October, and will remain stable, at or near 175 cfs into January. These stable conditions are expected to be beneficial to spawning spring-run Chinook salmon and adequate to prevent redd dewatering. For steelhead, wet year flows are projected to increase during the first three months of spawning (*i.e.*, from 200 cfs to 325 cfs), and then decrease to 250 cfs in March, and 200 cfs in April and May. Dry year flows are projected to fluctuate monthly between 165 and 170 cfs. Based on stage discharge relationships developed on Clear Creek at Igo, Reclamation predicts that a flow reduction of 100 cfs would begin to dewater redds at flows below 300 cfs, and a flow reduction of 150 cfs would dewater redds in the 300 to 800 cfs range. Therefore, projected monthly release changes are not expected to dewater steelhead redds.

Recent surveys in Clear Creek (FWS 2004b) indicate that some adult winter-run Chinook salmon may stray into Clear Creek and spawn below the McCormick Saeltzer Dam site in June and July. Modeled water temperatures in the lower part of Clear Creek are predicted to be to above the lethal limit (*i.e.*, 64 to 67 °F) causing 100 percent mortality during egg incubation and fry emergence. The number of strays may increase as the winter-run Chinook population increases; however, since the present number of winter-run Chinook salmon that stray into Clear Creek is relatively small (*e.g.*, one redd was reported in 2004), compared to the current population size (*e.g.*, approximately 9,757 adults in 2003), this effect is expected to remain insignificant to the winter-run Chinook salmon ESU.

b. *Fry and Juveniles*

Water Temperatures. In Clear Creek, spring-run Chinook salmon and steelhead fry and juvenile rearing occurs from Whiskeytown Dam downstream to the confluence with the Sacramento River. In other streams that support spring-run Chinook salmon, such as Mill, Deer, and Butte Creek, a component of the juvenile population outmigrates as yearlings (DFG 1998), indicating that some Clear Creek fish may rear year round. Modeled monthly water temperatures in upper Clear Creek range from 44 °F to 54 °F, but actual temperatures may reach 60 °F during some years. These temperatures generally are within the preferred range for growth and development year-round and are not expected to result in adverse effects to individuals. In the lower reaches, water temperatures are within the preferred range during much of the migration and rearing period, but may exceed preferred ranges during June and July (*i.e.*, 15 to 20 percent probability). Most individuals are not anticipated to be affected since the majority of the juvenile spring-run Chinook population migrates through the lower reach prior to June. Individuals that are affected may experience increased physiological stress as they pass through lower Clear Creek, but this effect is not expected to cause injury because it will be temporary and preferred temperatures will be only moderately exceeded.

Steelhead fry emerge from redds from December to May and are captured year-round in rotary screw traps downstream. Peak capture occurs from April to July, and the majority (*i.e.*, >75 percent) are less than 70 mm (FWS 2003b). Snorkel surveys have observed juvenile steelhead rearing year-round, with the greatest number of fish rearing in the upper reaches below Whiskeytown Dam during the late summer months (FWS unpublished data). Predicted average monthly water temperatures are within the preferred range for growth and development for the majority of the rearing and emigration period. However, water temperatures are likely to be higher during the summer months and may cause some unknown level of disease and mortality. Despite temperatures exceeding the preferred levels for juvenile rearing and migration during the summer months, rotary screw trap captures show that peak juvenile steelhead migrations occur during these conditions. McEwan (2001) noted that the ability of steelhead to tolerate adverse temperatures varies depending on physiological conditions such as life stage, stock characteristics, and ecological conditions such as acclimation time, food availability, and cold water availability. Myrick and Cech (2001) also point out that California steelhead may have greater thermal tolerances than races from more northern latitudes. As a result, although summer water temperatures in Clear Creek will exceed preferred levels described in the literature and may cause some disease and mortality to individuals, NOAA Fisheries expects the juvenile steelhead in Clear Creek can tolerate otherwise marginal water temperatures during the summer and proceed with their migration.

Instream Flows. Rapid decreases in river stage following high flow events may cause stranding and result in mortality of juvenile spring-run Chinook salmon and steelhead. Stranding is most likely to result from uncontrolled spills through the Glory Hole, releases for flood control, dam safety inspections, or fish and riparian habitat improvement projects. Stranding rates appear to be highest during early winter storms which affect smaller fish.

c. *Habitat Availability and Suitability*

The removal of Saeltzer Dam has changed the distribution of spring-run Chinook salmon and steelhead by allowing these fish to access and utilize the upper 8.6 miles of habitat below Whiskeytown Dam. Based on the above analyses of water temperatures, spawning gravel availability, and likelihood of stranding or dewatering, habitat availability and suitability in Clear Creek is generally very good.

d. *Adaptive Management*

The Clear Creek Decision Analysis Model (CCDAM) is being developed for assessing alternative restoration actions related to instream flow management in Clear Creek below Whiskeytown Dam. CCDAM is intended to allow the comparison of alternative adaptive management experiments. The purpose of the fish submodel in CCDAM is to portray the effects of flow actions on Chinook salmon and steelhead populations, given the effects of flow and temperature on physical habitat and on the biological processes affecting fish survival rates.

CCDAM is currently in the intermediate design phase and is not ready for application.

The Clear Creek Technical Team is an interdisciplinary team of representatives from Reclamation, FWS, NOAA Fisheries, DFG, the Bureau of Land Management (BLM), and Western Shasta Resource Conservation District. The team meets regularly to discuss the development, implementation, and monitoring of fisheries restoration and management on Clear Creek. Flow, temperature and habitat needs for anadromous fish are considered by the team, and recommendations are made to Reclamation to meet fishery objectives.

2. Early Consultation

For this analysis, Clear Creek flows and water temperatures are based on Reclamation's water temperature model derived from CALSIM II Studies 4 through 5. There is very little difference between existing and future operation scenarios on Clear Creek. Because of the similarity of results between existing and future modeling studies, the effects of early consultation operational scenarios will be similar to formal consultation operations. Water temperatures would be about 1 ^{o}F cooler in August and September and about 1 ^{o}F warmer in October and November, well within the uncertainty of the model's ability to accurately predict changes. These changes maintain conditions that are within the preferred range of spring-run Chinook salmon and steelhead. The primary differences are limited to those 15 percent of critically dry years when average monthly flows during spring-run Chinook salmon spawning may be up to 10 cfs lower than under formal consultation conditions. This small difference in flows is not expected to cause a noticeable difference in effects beyond those already described under formal consultation.

D. Spring Creek Debris Dam

Runoff containing acid mine drainage from several inactive copper mines and exposed ore bodies at Iron Mountain Mine is stored in Spring Creek Reservoir. Since 1990, concentrations of toxic metals in acidic drainage from Iron Mountain Mine have progressively decreased due to several remedial actions including the construction and operation of a lime neutralization plant. Operation of the Spring Creek Debris Dam and Shasta Dam have allowed some control of the toxic wastes with dilution criteria which is considered an improvement over conditions present when winter-run Chinook salmon were first listed.

Reclamation proposes to implement actions that will protect the Sacramento River system from heavy metal pollution (*i.e.*, acid mine runoff) from Spring Creek Dam and adjacent watersheds. When storage within Spring Creek Reservoir is less than 5 TAF, Reclamation is able to make controlled releases that result in allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. When Spring Creek Reservoir storage exceeds 5 TAF and water must be released, the MOU provides for “emergency” relaxation of these criteria, which leads to a 50 percent increase in the objective concentrations of copper and zinc. In recent years Reclamation, DFG, and the Regional Water Quality Control Board (RWQCB) have agreed to not use the emergency criteria until a spill is imminent.

In order to minimize the build-up of toxic metals in the Spring Creek arm of Keswick Reservoir the releases from the debris dam are coordinated with releases from Spring Creek Powerplant to keep the metals in circulation with the main body of the lake. During significant rain events and because Spring Creek Debris Dam releases are maintained to achieve a dilution ratio with Keswick releases, uncontrolled spills of contaminated water can and have occurred. Low concentrations of copper and zinc resulting from those spills are usually limited to areas immediately downstream of Keswick Dam. With the completion of Slickrock Creek Retention Reservoir in 2004, approximately 95 percent of the toxic metals that historically emptied into the Sacramento River have been eliminated (see OCAP BA Appendix J). This reduction in toxic metals reduces the risk to developing salmonid eggs and fry below Keswick Reservoir to a level that would not be considered harmful.

E. Sacramento River Effects

1. Formal Consultation

a. *Adult Migration, Spawning, and Egg/Fry Mortality*

The effects of the proposed action on migration, spawning, and incubation conditions in the upper Sacramento River were evaluated by three different measures in the OCAP BA dated March 22, 2004: (1) estimated carryover storage conditions in Shasta Reservoir; (2) resulting estimated temperature conditions in the upper Sacramento River; and (3) resulting estimated mortality levels of the early life stages of Chinook salmon and steelhead.

The highest densities for winter-run Chinook redd counts occur in the area from Keswick Dam to Cow Creek, although since fish ladders were improved at ACID in 2001, there has been a substantial increase in the number spawning above ACID (DFG 2004). There is sufficient cold water available in Shasta Reservoir to achieve the 56 °F criterion in most years. In 1993, NOAA Fisheries recommended Bend Bridge as an appropriate compliance point, and in all but one year since has agreed to movement of the compliance point upstream towards Balls Ferry. This real time management of water temperatures has protected the winter-run Chinook salmon redds, which in most years are located above Balls Ferry. SWRCB Water Rights Orders 90-5 and 91-01 established a temperature objective of 56 °F or less to protect all salmon runs in the upper Sacramento River, and the CALFED ERP 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).

Spring-run Chinook salmon adults migrate above RBDD towards Keswick Dam from April to July as they seek cooler water within the suitable temperature range for spawning (<56 ºF). Spawning occurs primarily in September and October, and emergence of fry is expected during December and January. Due to the effects of Shasta Dam and past Project operations, very few spring-run Chinook salmon spawn in the mainstem Sacramento River.

Steelhead generally migrate upstream from August through April, and spawn between December and May. Preferred upstream migration temperatures are between 46 °F and 52 °F. Recent estimates suggest two thirds (approximately 2,000 adults) of the natural Central Valley steelhead population spawn upstream of Red Bluff (69 FR 33102). A majority of these spawners probably return to Battle Creek due to the presence of Coleman National Fish Hatchery. Specific information regarding steelhead spawning within the mainstem Sacramento River is limited due to lack of monitoring.

Carryover Storage. The WRO established a minimum EOS carryover storage criteria for Shasta Reservoir of 1.9 MAF, which in combination with storage reserves in Trinity Reservoir, minimum instream flows during the winter, and D-1485 Delta standards produced a following year May Shasta Reservoir storage in the 3.0 to 3.5 MAF range, with a reasonable amount of cold water available in the second year. Average EOS carryover storage in Shasta Reservoir is reduced by 130 TAF under future conditions compared to today's (CALSIM Studies 3 vs 5a). Under a 50 percent probability of exceedence, future operations reduce EOS carryover storage by about 230 TAF from operations today (OCAP BA Fig.9-24). Reductions in September carryover storage are due to releases for SWP in-basin requirements, compliance with Trinity River requirements, and extra pumping capacity for JPOD. The result will be a reduced ability to control water temperatures in the upper Sacramento River and an increase in frequency of very low storage conditions (as indicated by EOS storage below 1.9 MAF). For example, low storage conditions occur in 11 out of 72 years (15 percent of the modeled period) under baseline conditions. Under proposed formal consultation actions, low storage conditions increase to 14 out of 72 years (19 percent of the modeled period), a 26 percent increase in frequency over baseline conditions. Further, one year is added to low storage conditions during two of the three periods of significant drought in the 72 year modeled period. Decreased water availability also leads to decreases in deliveries. During critically dry periods, water deliveries to agricultural users south of the Delta decrease significantly: under baseline conditions the Project might deliver 10 percent of the allocation to these users; under expected future conditions, these levels drop to 7 to 8 percent.

Water Temperatures. Higher water temperatures and an increase in frequency of very low storage conditions` during dry and critically dry years in the mainstem spawning area are expected to reduce spawning success in certain areas through egg and larval mortality. Based on the proposed temperature compliance point of Balls Ferry, approximately 20 miles (42 percent) of the available mainstem spawning habitat of Chinook salmon is expected to be rendered less suitable for egg and larval survival during these years for those fish that spawn in these lower areas. On average, predicted temperatures over the 72 year modeled period at Balls Ferry will exceed 56 °F, and exceed baseline predicted temperatures (Study 3) in April (5 of 72 years), May (7 years), July (8 years), August (15 years), September (26 years), and October (12 years over 60 °F). In general, the number of exceedances increases by 1 year over baseline conditions, although August, September, and October exceedances occur in 6, 7, and 2 more years, respectively. Temperatures downstream of this point will also exceed baseline conditions, affecting the spawning success of any adults spawning below Balls Ferry.

Since 1993, NOAA Fisheries has recommended moving the compliance point upstream to conserve cold water in Shasta Reservoir for August and September when juveniles are most vulnerable to temperature effects. The impact of moving the compliance point upstream to Balls

Ferry is assumed by Reclamation to be insignificant, because in the last three years (*i.e.*, 2001 to 2003) the majority of winter-run Chinook salmon (*i.e.*, 99 percent) have spawned above Balls Ferry based on aerial redd surveys. A review of the historical spawning distribution over the last ten years (*i.e.*, 1993 to 2003) shows that on average 3.6 percent of the run spawned below Balls Ferry since RBDD gate operations were modified (DFG 2004e). NOAA Fisheries expects that as the population increases the spawning distribution may vary and a small proportion of the run may be exposed to unsuitable water temperatures below Balls Ferry. This effect is expected to be less than significant, unless large numbers of adults spawn below Balls Ferry. In the last five years this has occurred only once during a wet year (*i.e.*, in 2000, when 16 percent of the run spawned below Balls Ferry). Even in years when a portion of the run spawns downstream of the compliance point not all eggs would be killed, but a small amount of increased mortality would be expected ranging from 8 to 15 percent based on a relationship between water temperature and mortality of Chinook salmon eggs (OCAP BA Table 6-2).

For steelhead, predicted average monthly temperatures are above the preferred range (*i.e.*, 46 to 52 °F) in September, October and November for upstream migration, but within the range of preferred spawning temperatures. Temperatures are predicted to be higher than the preferred for migration in 60 percent of the years modeled. These high temperatures are expected to delay migration of early returning adults until after November when temperatures cool, but are not expected to reduce survival rates or spawning success.

Mortality Rates. Reclamation's salmon mortality model estimates that the proposed operations will increase temperature-related losses of the early life stages (*i.e.*, egg and fry) of winter-run Chinook salmon on average 1 to 2 percent over the baseline, or from 8 percent under current conditions to 9 to 10 percent under future conditions (Formal or Early) at Balls Ferry (OCAP BA Fig 9-32). Review of the individual water years also indicates that the estimated early life-stage mortality of winter-run Chinook salmon would increase 3 percent in critically dry years (*i.e.*, from 41 to 44 percent) at Balls Ferry. Using the existing Bend Bridge compliance point average mortality of would increase to 50 percent during critically dry years (OCAP BA Fig 9-33). Critically dry years represent 15 percent of the years modeled, and trigger development of a year-specific, temperature management plan when limited cold water in Shasta Reservoir results in forecasted inability to maintain 56 °F water temperatures at Balls Ferry in the April through September time frame. Reclamation and NOAA Fisheries would develop this plan based upon the observed winter-run Chinook spawning distribution in the upper Sacramento River and the maximum use of the limited cold water reserves in Shasta Reservoir. Experience with temperature management in the upper Sacramento River and spawning surveys for winter-run Chinook salmon redds allows for development of a temperature control plan that is likely to keep temperature-related losses from egg and larvae mortality to levels less than those projected by Reclamation's model. Therefore, in most years an average 1-2 percent of the winter-run Chinook eggs and fry are expected to die as a result of the Project, and in critical years this might increase by 3-4 percent over baseline conditions. Since the winter-run Chinook salmon population has been steadily increasing, despite an average 8 percent mortality under today's conditions, an incremental increase of 1-2 percent loss of eggs and fry on average is not expected to be significant to the population.

Average spring-run Chinook salmon egg and fry mortality for all water year types increases from 21 percent under today's conditions to 25 percent under both Study 5 and 5a targeting the proposed Balls Ferry compliance point. In dry years, average mortality increases from 30 percent under today's conditions to 50 percent in the future targeting Bend Bridge, and in critically dry years may be as high as 80 percent at Balls Ferry. Since most of the spring-run Chinook spawning in the mainstem occurs in this area, significant egg and fry mortality under future conditions is likely to limit the reproductive success of the Sacramento River portion of the spring-run Chinook salmon population. However, these higher mortalities are assumed to be insignificant since the majority of spring-run Chinook salmon passing RBDD currently spawn in the tributaries. Based on average escapement between 1990 and 2001, 908 adults, or 8 percent of the population spawned in the mainstem Sacramento River (Reclamation 2004a). Based on this estimate, 2.5 percent of the juvenile population would be expected to die as a result of the proposed Project.

Reclamation’s salmon mortality model does not estimate mortality for steelhead. Using late-fall Chinook salmon as a surrogate, since they spawn during the same time period, egg and fry mortality remains the same (approximately 2 percent) under both today and future model runs.

b. *Habitat Availability and Suitability*

Winter-run Chinook salmon spawning habitat is made less suitable by approximately 19 miles (*i.e.*, 42 percent of available spawning habitat currently available to Bend Bridge) by defaulting to the more upstream temperature compliance point at Balls Ferry compared to Bend Bridge under both operations today and in the future. Even though most of the current population is not anticipated to be affected, since generally winter-run Chinook salmon spawn upstream of Balls Ferry, planning for future temperature control operations at the higher compliance point could limit potential spawning distribution. NOAA Fisheries anticipates that the spawning distribution routinely will be more contracted (*i.e.*, reduced by 19 miles), therefore population abundance could be capped as these fish seek out areas of more suitable, cooler water for spawning and move farther upstream than they otherwise would do in some years.

Predicted releases from Keswick Dam of 6,000 to 12,000 cfs during the summer, combined with tributary accretions are expected to provide adequate depths and velocities for upstream passage and for winter-run Chinook salmon spawning based on recent IFIM studies in the upper Sacramento River (FWS 2003a). Based on IFIM studies, flows at the lowest range (*i.e.*, 3,250 cfs from November through March) provide enough spawning habitat spatially for a population of 14,000 winter-run Chinook salmon (Reclamation 2004a) between Keswick Dam and Battle Creek (downstream of Balls Ferry). Flows at mid-range (*i.e.*, 8250 cfs) would provide enough habitat to meet the recovery goals (*i.e.*, 20,000 adults for 13 years).

Relatively stable releases from Keswick Dam during the period of September through November are maintained for temperature control and for salmon spawning, which avoids scouring and dewatering of redds. Reclamation proposes to release minimum flows of 3250 cfs from Keswick Dam to the upper Sacramento River from November through March. Actual daily releases may fluctuate from these monthly averages, particularly during flood control operations. However, the pattern of Keswick releases is projected to decrease from 500-1,000 cfs between September and October. This reduction in flows can be rapid after the fall flood-up occurs for rice decomposition and refuges and can dewater redds of early spawning Chinook salmon. We cannot quantify the effect this has on spring-run Chinook salmon because these redds can not be distinguished from those of fall-run Chinook salmon. However, some spring-run Chinook salmon redds presumably will be dewatered, causing the death of eggs and larvae. Large numbers of late fall-run Chinook salmon redds have been observed dewatered as this trend continues into November, December and January (D. Killam, DFG, pers. comm. 2003). The population effect would be minimal assuming only a very small number of adults spawn in the mainstem Sacramento River.

Keswick Dam minimum releases of 3,250 to 3,800 cfs combined with tributary accretions are expected to provide adequate depths and velocities for upstream passage and for steelhead spawning based on recent IFIM studies in the upper Sacramento River (FWS 2003a) and similar fall-run Chinook salmon habitat criteria developed by DFG for this area (DWR 1993).

The ramping criteria for Keswick Dam releases to the Sacramento River established in the WRO remain in effect through March 31 of every year. These ramping criteria are expected to minimize or eliminate impacts to steelhead and spring-run Chinook salmon fry and juveniles from stranding and dewatering. Ramping down of flows occurs primarily at night when fish typically are more active and less likely to become isolated in pools or side channels. In addition, releases are reduced at very slow rates over several nights allowing adequate opportunities for fish to pass from shallow near shore areas and pools into the mainstem of the river. Stranding of winter-run Chinook salmon fry is not expected to be significant since large flows from Shasta Dam are usually stabilized by May.

Steelhead juveniles and smolts may emigrate from the upper Sacramento River over a prolonged period (October through early July) (McEwan and Jackson, 1996). Spring-run Chinook salmon yearlings may also emigrate from the upper Sacramento beginning in October and extend through February, while sub-yearlings may begin in December and continue through May. Predicted monthly average temperatures in the upper Sacramento River are within the preferred temperature range for steelhead and spring-run Chinook salmon smolts from November through June. Also, predicted flows within the upper Sacramento River are expected to provide suitable depths and velocities for emigrating juvenile steelhead and spring-run Chinook salmon due to the high summer time flow pattern. Flows are not predicted to drop below the minimum instream flow requirements during the low flow period (November through February).

Finally, a substantial resident rainbow trout population predominates in the upper Sacramento River above Red Bluff due to stable cool summer flows released from Keswick Dam for winter-run Chinook salmon temperature control. The greater productivity caused by these releases may allow an increased growth rate among resident trout, which may skew the steelhead population towards non-anadromous forms (McEwan 2001). Recent studies on large controlled rivers suggest that resident rainbow trout have a selective advantage in upstream areas close to dams because they grow faster and out-compete young steelhead (Cramer 2000). Therefore, the suitability of habitat conditions below Keswick Dam may favor a resident trout population over a steelhead population.

c. *Adaptive Management*

Decisions concerning temperature operations of the TCD are made by Reclamation in concert with the SRTTG. Each year starting in April, the SRTTG assesses the cold water pool available in Shasta Reservoir (see OCAP BA Appendix B) to determine temperature compliance points for the winter-run Chinook salmon spawning season (May-July). Biological data includes weekly aerial redd surveys to determine temporal distribution.

Operational decisions using (b)(2) water are made in the weekly B2IT meetings. Generally, on the Sacramento River these include increasing flows during the October through December period when Reclamation is decreasing flows to conserve storage. The use of (b)(2) water in this period is aimed at preventing fall-run/late fall-run Chinook salmon redds from being dewatered. Flows are usually stabilized above the 3,250 cfs minimum (*e.g.*, 4,000- 4,500 cfs), which may also benefit spring-run Chinook salmon that spawned in September and October. In addition, (b)(2) water and (b)(1) water (*i.e.*, re-operation) are utilized to stabilize flow fluctuations and balance reservoir releases during the fall and winter. These adaptive management actions occur on a daily time step and can not be accurately modeled by CALSIM. The FWS and Reclamation in coordination with NOAA Fisheries adaptively manage approximately 200 TAF of (b)(2) water to improve the upstream habitat conditions in the October through December time period. The use of these groups minimizes to some extent the impacts to salmonids but does not eliminate adverse effects to listed species (*e.g.*, the amount of (b)(2) water is usually very small by this time of the year due to export curtailments and water quality control earlier in the year, also EWA is not available from Shasta Reservoir)

2. <u>Early Consultation</u>

Under early consultation, the adverse effects discussed above are expected to have the same or greater impacts as formal consultation actions (Studies 3 vs 5). Small increases (1 percent) in spring-run Chinook mortality would occur in Wet and Below Normal years (5a vs 5).

F. Red Bluff Diversion Dam

1. <u>Formal Consultation</u>

a. *Adult Migration, Spawning, Incubation*

Current operation of RBDD includes a four-month period (May 15 through September 15) when the dam gates are placed in the river, creating a velocity barrier that prevents upstream migrating adult salmon and steelhead from passing under (or over) the dam. However, the entire population of winter-run and spring-run Chinook salmon that spawn in the Sacramento River must spawn above Red Bluff for reliable reproductive success because Red Bluff is the downstream limit of temperature control for Shasta Dam (Reclamation 1991). Permanent fish ladders currently are operational on the east and west ends of the dam, and a smaller (*i.e.*,100 cfs outflow) temporary ladder can be installed in the center gate of RBDD. These ladders operate during the gates-in period to allow some level of upstream passage of adult salmonids. However, the hydraulic performance of the existing ladders has been found to be less than optimum (Reclamation 1997b) and the fish ladders are inefficient in passing Chinook salmon (DFG 1998). The fish attraction flow (*i.e.*, outflow from the ladders) seldom meets the 10 percent of total river volume necessary to provide adequate passage through the ladders (Katopodis 1992). The average river flow past RBDD during the current gates-in period is 11,000 cfs, yet the total capacity of all three ladders combined is only 775 cfs (Reclamation and TCCA 2002).

The basic design of RBDD and resultant hydrology below the dam cause additional problems for fish attempting to pass the dam. Water is released from underneath the dam gates (generally eight or nine gates are opened when the center ladder is in place) creating attraction flows emanating from multiple points across the dam. As salmon or steelhead approach the dam they are attracted to these heavy flow areas, which would generally provide the best route past a natural obstacle, but are unable to break through the velocity barrier when they reach the source of the flows. Radio telemetry data (FWS, unpublished data) has shown tagged salmon approaching the dam and spending several days moving across the front of the dam, apparently testing the numerous flow sources in an attempt to pass the barrier. Dozens of adult Chinook salmon may swim in the strong hydraulics below multiple open gates, apparently unable to distinguish those flows that lead to passage (*i.e.*, at the ladders) from those that do not (M. Tucker, NOAA Fisheries, pers. obs. 2001).

All of these factors combined have resulted in blockage and delays of upstream migrating salmonids as documented in several fish passage studies at RBDD (Hallock *et al.* 1982; Hallock 1987; Vogel *et al.*, 1988). Hallock *et al.* (1982) determined that passage of 15 to 43 percent of adult Chinook salmon, depending on run, were blocked at RBDD. Similarly, Vogel *et al.* (1988) determined from radio telemetry studies that between 8 and 44 percent of adult Chinook salmon, depending on run, were blocked from passing upstream of RBDD. These studies were completed prior to initiation of current operations (gates open for 8 months of the year) and therefore likley do not accurately reflect current blockages. Radio telemetry investigations conducted from 1999 to 2001, using adult fall-run Chinook salmon, found that delays in passage, under existing conditions at RBDD, averaged approximately 21 days (FWS, unpublished data).

A simple time delay is not the only consequence of Chinook salmon being unable to pass RBDD. When adult Chinook salmon enter fresh water they cease eating and must rely solely on the finite supply of energy which they have stored in their bodies to last them through their entire migration, holding, and spawning activities. In their efforts to pass RBDD, particularly if these efforts continue for several days or even weeks, they consume a greater amount of these energy stores than if there been no obstacle in their path. This may leave the fish in a weakened state before spawning which may subject them to a greater chance of disease, especially if they have to hold over summer in warm water conditions prior to spawning (*e.g.*, spring-run Chinook salmon). Other biological consequences of blockage or passage delay at RBDD include changes in spawning distribution (Hallock 1987), hybridization with fall-run Chinook salmon (DFG 1998), increased adult pre-spawning mortality (Reclamation 1985), and decreased egg viability

(Vogel *et al.*, 1988), all of which may result in the reduction in annual recruitment of this species. These effects are more likely to affect spring-run Chinook salmon than winter-run Chinook salmon, since the spring-run migration is later than the winter-run and spring-run spawning overlaps more with fall-run, than does the winter-run spawning season. Some of these effects may occur with steelhead, but in general NOAA Fisheries expects that the reproductive strategy and condition of steelhead will protect them against these effects.

In addition to those fish which spawn in the Sacramento River, there are also spring-run Chinook salmon and steelhead natal to the tributaries upstream of RBDD that may lose access to their natal tributary by being delayed at the dam during the warmer months (April through June) when low flows and thermal barriers can develop at the mouths of these tributaries (*i.e.*, Cow and Cottonwood Creeks). A chronic loss of spawners from the small and remnant populations found in these tributaries could decrease the sustainability of these populations. Some spring-run Chinook salmon and steelhead, after encountering the delays at RBDD, may migrate back downstream and ascend Deer, Mill or Antelope Creeks to spawn, which could contribute to the recent high rates of return in these streams. Adult fall-run Chinook salmon tagged in the fish ladders and released below the RBDD have been reported dropping back downstream as far as 40 miles to the mouths of tributary streams, and in one case a tagged fish was recovered at the Feather River Fish Hatchery (D. Killam, pers. comm. 2004).

The removal of the RBDD gates from September 15 through May 15 of each year insures that many listed salmonids will not encounter a passage impediment at RBDD. Under current operations, an estimated 15 percent of winter-run Chinook salmon, 72 percent of spring-run Chinook salmon, and 17 percent of steelhead adults migrating through the upper Sacramento River may be blocked or delayed by RBDD (Table 5; DFG 1998; FWS/DFG, unpublished data, Reclamation and TCCA 2002).

Table 5. Summary of passage effects from RBDD based on historical run timing in the upper Sacramento River (Reclamation and TCCA 2002).

Life Stages affected by gates in four months (May-September)	Adult migration delayed or blocked	Juveniles and smolts subject to predation	Adult spawning population estimated above RBDD
spring-run Chinook salmon	72%	~ 1%	10%
winter-run Chinook salmon	15%	~ 9%	100%
steelhead	17%	~ 36%	57%

Based on the most current population estimates (DFG 2004c, 2004d, 69 FR 33102) and the analysis above, current operations of the RBDD gates will block or delay approximately; 7.2 percent of the total spring-Chinook salmon population (760 adults), 15 percent of the winter-run Chinook population (1,220 adults), and 9.7 percent of the steelhead population (340 adults).

Since implementation of the proposed Project will not change from current operations, the number of salmon and steelhead blocked or delayed is expected to remain the same under both current and future conditions. The consequence of delays in upstream migration at RBDD would be increased pre-spawning mortality, decreased egg viability, the repeated reduction of annual recruitment of spring-run Chinook salmon due to delayed entrance into natal streams and subsequent loss of genetic diversity, and changes in spawning distribution leading to increased hybridization with fall-run Chinook salmon. For winter-run Chinook salmon these effects are considered part of the baseline, since they were previously analyzed in the 1993 WRO, which concluded the operation of RBDD would provide for recovery of the species. For the 10 percent of the spring-run Chinook salmon population (Table 5), effects of the proposed operation are likely to impede access to recently restored habitat in Clear Creek and Battle Creek. Natural re-population of habitat above RBDD should be monitored to better determine whether operation of RBDD needs to be modified further for the benefit of spring-run Chinook salmon.

b. *Juveniles and Smolts*

When the dam gates are lowered, juvenile salmonids are forced to pass RBDD either by passing through the fish ladders or under the dam gates. Due to the large proportion of flows that pass under the gates it is likely that most juveniles also pass under the gates. These fish are subject to high water velocities and intense turbulence downstream of the dam where they become disoriented and thus more vulnerable to predation. At the same time, predatory fish have been found to congregate below the dam at unnaturally high densities, creating an increased predation risk for downstream migrating juvenile salmonids. Prior to 1986, when RBDD gates were left in place essentially year round, FWS (1981) concluded that juvenile mortality of up to 42 percent of downstream migrant steelhead and greater than 50 percent of Chinook salmon occurred at RBDD, likely as a result of predation by Sacramento pikeminnow (*Ptychocheilus grandis*) downstream of the dam.

Hallock (1987) reported that stomach content analysis confirmed that adult striped bass (*Morone saxatilis*) also were preying on juvenile salmon passing through RBDD. Tucker *et al.* (1998) reported that the percent composition by weight of juvenile salmonids in the stomach contents of Sacramento pikeminnow greatly outweighed other fish during the summer “gates-in” period. Striped bass were only detected during and immediately after the gates-in period, but juvenile salmonids outweighed other fish three to one in their stomach contents (Tucker *et al.* 1998).

The most recent predation study at RBDD, conducted by FWS from 1994 through 1998, following the initiation of the current gate configuration found that the current RBDD operations appear to have substantially reduced rates of predation to juvenile salmonids as compared to the situation prior to 1993 (Tucker *et al.* 1998; Tucker *et al.* 2003). The study also showed a significant increase in predator densities occurs when the gates are lowered compared to when they are removed.

The majority of juvenile salmonids pass RBDD when the gates are up, and therefore do not experience increased predation impacts due to the dam (Tucker *et al.* 2003). The passage timing for juvenile salmonids was obtained from data collected from rotary screw trapping investigations conducted immediately downstream of RBDD during 1994 through 2000 (Gaines and Martin 2001). For spring-run Chinook salmon, less than one percent of the annual production from the upper Sacramento River is vulnerable to increased predation due to closed gates at RBDD (Table 5). For winter-run Chinook salmon, approximately 39 percent of the annual juvenile production could experience increased predation due to closed gates, primarily during late July through mid-September, and approximately 36 percent of juvenile steelhead passing RBDD during the gates-in period are subject to these impacts (Reclamation and TCCA 2004).

Tucker *et al.* (2003) suggested that is unlikely that the level of predation impacts produced by Sacramento pikeminnow and striped bass at RBDD under current operational conditions is having a large effect on salmonid populations as a whole, due to a reduction in the predator population since the gates are open longer than pre-1993 conditions. Therefore, proposed general gate operations are not expected to increase predation rates or proportions of the populations to be affected over current conditions.

c. *Habitat Availability and Suitability*

Delays at RBDD decrease the access to habitat in upstream tributaries by holding adults at the dam while low flows or thermal barriers form at the mouth of upstream tributaries. The only remaining suitable spawning habitat for winter-run Chinook salmon in the Central Valley, besides the mainstem Sacramento River, is located above RBDD (*i.e.*, 42 miles in Battle Creek). Based on the estimated carrying capacity in Battle Creek, this creek could support 2,500 winter-run Chinook salmon adults or 23.7 percent of the current population (Reclamation and SWRCB 2003). In addition, the majority of steelhead in the Central Valley spawn above Red Bluff (69 FR 33102). The Battle Creek Salmon Restoration Project could increase the carrying capacity for an estimated 5,700 adult steelhead based on FWS studies (Reclamation and SWRCB 2003), which is twice the number that currently spawn above RBDD.

d. *Adaptive Management*

There is no adaptive management of the current gate operation, except under emergency conditions (*i.e.*, drought conditions or extremely dry springs) where there is some latitude for earlier gate closures. Black Butte Dam and Lake are operated jointly by the U.S. Army Corps of Engineers (Corps) 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. Based on reductions in the past (*i.e.*, 15 percent of gross pool), future diversions from Stony Creek into Tehama-Colusa Canal are expected to decrease as the storage capacity in Black Butte Reservoir is diminished due to sedimentation (Reclamation 2000). This may cause a greater reliance on water from RBDD. However, an additional 75 cfs pump is planned for installation at RBDD which should mitigate the need for emergency gate closures in early May. There remains uncertainty regarding possible increases in the numbers of adult winter-run and spring-run Chinook salmon that are blocked or delayed and increasing predation rates on juvenile spring-run Chinook salmon and steelhead.

2. Early Consultation

It is anticipated that the adverse effects described above under formal consultation would be similar under early consultation (*e.g.*, Banks 8500 pumping and Project Integration) because these actions do not change the timing or number of months RBDD gates are closed. The need for early May closures may increase under future conditions since Sacramento River flows are slightly decreased in May, which may increase the demand for water out of the Tehama-Colusa Canal.

G. American River

1. Formal Consultation

a. *Adult Migration, Spawning, and Incubation*

Impacts to the American River increase with the predicted increase in water demands. Actual deliveries, based on a long-term average, will increase from a total of 256 TAF at the 2001 LOD to 688 TAF at the 2020 LOD. In drought year sequences (*e.g.*, 1928 to 1934) deliveries will increase from 242 TAF to 530 TAF in the future CALSIM model studies. The ability to fill Folsom Reservoir in May is reduced from 50 percent of the time to 40 percent of the time between the conditions today and conditions in the future.

Central Valley steelhead is the only listed salmonid that occurs in the American River. Optimum use of American River steelhead spawning habitat area peaks at 2,400 cfs, although availability varies little between 1,000 and 4,000 cfs (FWS 1997). Flows during the spawning period would be below 2,400 cfs in about 30 to 60 percent of years, depending on the month. Average monthly flows could range up over 30,000 cfs in the wettest years with instantaneous flows likely over 100,000 cfs for flood control. Flows greater than 50,000 cfs show bedload mobility and could scour steelhead redds (Ayres Associates 2001), but will provide needed reconfiguration of the channel for long-term maintenance of spawning and rearing habitat. In critically dry years flows could average as low as 500 cfs. Spawning habitat area was not predicted for flows below 1,000 cfs but spawning habitat would certainly be less, and important side channel spawning habitat would be nearly absent. The steelhead population in the American River does not appear to be limited by spawning habitat availability, but by factors following fry emergence such as summer water temperatures and predation.

The annual installation of the hatchery weir below Nimbus Dam for fall-run Chinook salmon spawning presents a temporary migration barrier for adult steelhead from November to December (*i.e.*, when the weir is being operated). Less than one mile of spawning habitat exists above the hatchery weir. Recent spawning surveys have shown that a small number of adults (*i.e.*, 10 redds or 5 percent of the total redds) use this area between the weir and Nimbus Dam (Hannon *et al.* 2003). Adult steelhead can migrate into the area after the weir is removed; it may delay some adults from spawning in November and December, but the barrier is not expected to cause population level effects because few adults would be affected and the peak of the run largely would be avoided.

Average temperatures at the Watt Avenue temperature compliance point are generally within the preferred range for adult migration. During dry and below normal water years, temperatures in November, March, April, and May would be higher than preferred and could be as high as 71 °F in May of warm, dry years. The majority of steelhead spawning activity occurs during late December through March when temperatures generally are within the acceptable range for spawning (Hannon *et al*. 2003). Steelhead eggs are in the gravel from December until mid-May. Temperatures from March through May could be above the preferred range for egg incubation at Watt Avenue in about 50 percent of years during March, and in all years in April and May. DFG surveys have identified peaks in newly emerged steelhead in the American River through May, indicating that some eggs do survive at temperatures above the preferred range.

Most steelhead spawning occurs in the upper three miles of the American River. Under reduced flow conditions fish tend to spawn in overlapping areas, which results in redd superimposition, rather than extending spawning distribution downstream. Flows in the future would be lower than under present conditions throughout much of the year due to increased diversions upstream of Folsom Dam. Flows in the river could potentially be as low as 300 cfs in May, when steelhead eggs are still present in the gravel, under the driest condition in the future in both scenarios. Therefore, continued operation of the Project is likely to lead to increases in redd superimposition, which will further decrease spawning success.

Flood flows that are not reflected in the operations forecasts have the potential to scour steelhead redds (*i.e.*, greater than 50,000 cfs) resulting in the injury and mortality of eggs and sac-fry. Historically flood control releases between 20,000 and 115,000 cfs occurred in 44 percent of years from 1978 to 2002 (see NOAA Questions, OCAP BA Appendix I), indicating that redd scouring is likely to occur frequently. Flow reductions following flood control releases have the potential to dewater redds constructed during the higher flow period, and likely will cause mortality of eggs and larvae. Non-flood control operations typically are designed to avoid large changes in flows that may create stranding and isolation events through the use of ramp down criteria and (b)(2) water. However, since Folsom Reservoir is the closest water source to the Delta, releases from Folsom Dam often are used first to maintain Delta water quality standards (*i.e.*, SWRCB D-1641) when Delta conditions deteriorate quickly. Once the standards are met or increased flows from other reservoirs arrive in the Delta, Folsom releases are cut back to conserve storage, sometimes affecting fish or redds in the river. Stranding of steelhead redds after such real time operations has been observed in 3 of the last 4 years during redd surveys (Hannon *et al.* 2003, 2004). Significant losses of juvenile steelhead, and some non-natal rearing winter-run Chinook and spring-run Chinook salmon were reported in a study by DFG for Reclamation (Snider *et al.* 2001). Reclamation attempts to avoid flow fluctuations during non-flood control events such as meeting Delta outflow standards. In Snider *et al.* (2001) a recommendation was made to avoid fluctuations that raise flows above 4,000 cfs and then drop them back below 4,000 cfs. Estimates of the number of redds dewatered from non-flood control releases (*e.g.*, meeting Delta water quality standards) range from 5 to 8 percent of the redds surveyed since 2001 (Hannon *et al.* 2003). CVPIA section (b)(2) water, when available, has been used during this period to stabilize flows or avoid reductions that otherwise would be made. Overall, despite protective measures, stranding and isolation from both flood and non-flood events is expected to continue under future conditions, which may reduce the reproductive success of spawning adult steelhead and reduce the number of fry and eggs produced in the American River.

b. Juveniles and Smolts

The freshwater life stages of steelhead occupy the American River throughout the year. Most literature has indicated that rearing fry and juvenile steelhead prefer water temperatures between 45 °F and 60 °F (Reiser and Bjornn 1979; Bovee 1978; Bell 1986). However, Myrick (1998) found the preferred temperatures for Mokelumne River Hatchery steelhead placed into thermal gradients were between 62.6 °F and 68 °F. NOAA Fisheries generally uses a daily average temperature of 65 °F at Watt Avenue as a temperature objective for steelhead rearing in the American River and then adjusts the temperature objective depending forecasted ability in the spring to manage the cold water in Folsom Reservoir each year. Predicted water temperatures exceed a monthly average of 65 °F between May and October with the highest temperatures, up to 75 °F, occurring in July and August of years with a low cold water pool in Folsom Reservoir. Temperatures are predicted to be almost always higher than 65 °F at Nimbus Dam from July through September.

Predicted water temperatures would exceed 70 °F during July in 20 percent of years and in August in 50 percent of years at Watt Avenue. These high summer temperatures likely limit the natural steelhead population in the American River. Monitoring during 2001 and 2002 indicated that steelhead did not appear to locate water cooler than that found in the thalweg, and they persisted below Watt Avenue in water with a daily average temperature of 72 °F and a daily maximum over 74 °F (Snider and Titus 2000b). Water temperatures in the future CALSIM studies are predicted to be approximately one degree warmer from July to October and about 0.5 °F warmer in June and November. Water temperatures are about the same with and without EWA. Temperatures during the rest of the year will be relatively unchanged. Although mortalities due to temperatures above the lethal limit are difficult to detect and quantify, NOAA Fisheries expects that some juvenile steelhead will be killed due to thermal stress, increased predation by warmwater predators, increased susceptibility to diseases, and decreased growth rates during the summer months and into the fall. Due to the increased water temperatures from Project operations and competition from large numbers of hatchery steelhead spawning in the American River, the natural population will likely remain primarily supported by the hatchery.

Juvenile salmon emigration studies using rotary screw traps in the lower American River at Watt Avenue generally capture steelhead fry from March through June; steelhead yearlings and smolts emigrate from late December till May, with most captured in January (Snider and Titus 2000b). Specific flow needs for emigration in the American River have not been determined. Steelhead emigrate at a relatively large size and so are good swimmers and presumably do not need large pulses of water to emigrate effectively from the American River as long as temperatures are suitable through the lower river and into the Delta. Tagging and seining studies have shown that the abundance of juvenile steelhead in the American River drops off quickly at the beginning of summer, possibly due to thermal stress, increased physiological and energetic demands and predation (Snider and Titus 2000a). Those that are sampled show relatively good growth and condition factors indicating that despite the adverse conditions some juveniles can obtain smolt size relatively quickly. However, a large number of introduced non-native predators like striped bass, largemouth bass, and American shad prefer the American River for feeding an spawning. Predators likely take more juvenile steelhead when the water is warmer because predator feeding rates are expected to increase and juvenile steelhead avoidance behavior is likely decreased. Therefore, increased temperatures due to future operations of the Project are likely to increase predation rates on juvenile steelhead rearing in the lower American River.

c. Habitat Availability and Suitability

As described in the *environmental baseline* the remaining habitat below Nimbus Dam is not considered optimal habitat characteristics for steelhead due to its low elevation, larger gravel size, and higher temperature regimes compared to that of headwater streams (McEwan 2001). Spawning and rearing habitat are not limited, but are not considered ideal. Steelhead in the American River generally spawn in side channels and near the bank in areas where the gravel is smaller. In the last 3 years of redd surveys the steelhead population has remained small given the habitat available in the river, averaging 300-400 adults and is probably maintained by the presence of Nimbus Hatchery (Hannon 2003).

d. Adaptive Management

Reclamation proposes to continue adaptively managing temperatures using a combination of flow releases and shutter operations (blending) on Folsom Dam. If needed, the river outlet works (ROW) can be used to release cold water; however, these releases bypass the power generation plants. On the American River in order to compensate for the forgone loss in power, the EWA has been used to repay WAPA in two of the last four years.

Reclamation manages the cold water pool in Folsom reservoir in coordination with NOAA Fisheries staff with regular input from the AROG. The AROG has addressed a number of operational issues in periodic meetings and the discussions have served as an aid towards adaptively managing releases, including flow fluctuation and stability, and managing water temperatures in the lower American River to better meet the needs of salmon and steelhead. Continued use of such groups as the AROG and the B2IT will minimize some adverse impacts due to flow fluctuations and temperature control; however, a major impact of the Project is that Folsom cold water resources will be reduced making this task even more difficult. Past experience suggests that even with these groups in place, continued operations are likely to impact the steelhead population.

The signing of the Water Forum Agreement in 2000 provides beneficial flows for Chinook salmon and steelhead on the American River. This agreement involves 40 Sacramento regional water purveyors that have existing water rights to surface deliveries from the American River. The Water Forum Agreement modifies water use in dry and critical years to provide protection (*e.g.*, through reduced dependance on surface flows) for fishery resources while enabling water purveyors to meet customer needs. The provisions of the agreement are not included in the current project description. Reclamation included 47 TAF of water from the Water Forum in the future condition (*i.e.*, CALSIM model studies) to offset the increased LOD on the American

River, because it was part of the representation of future American River Division demand growth. Although the environmental review process has yet to be completed, a key element of the Water Forum Agreement is a minimum flow standard (approximately 2,000 cfs) that would be more protective of salmonids than the existing D-893 minimum flow of 500 cfs. Since 2000, with the addition of B2 water, the flows have never been as low as 500 cfs.

2. Early Consultation

Impacts to the American River resulting from early consultation elements are similar to formal consultations, including an increase with the predicted increase in water demands from the 2001 level to the 2020 LOD, including total water rights and M&I use. Carryover storage in September for Folsom Reservoir is reduced by the same amount as in the formal consultation on a long-term average basis between the present day and future CALSIM model studies.

The future CALSIM model studies (*i.e.*, studies 4 and 5, SDIP with or without EWA) include the Water Forum Agreement reductions discussed in the project description in future demands and provide an additional 47 TAF of mitigation water. Water Forum reductions are included in the future 2020 demands to maintain LAR flows and are dependent upon the adoption of a new American River flow standard by the SWRCB. However, since a new flow standard has not been adopted the CALSIM modeling incorrectly assumes that future operations will include 47 TAF of mitigation water. Therefore, the modeling may underestimate Project effects on flows and temperatures as effects of future operations without the Water Forum reductions are anticipated to be even greater. These effects are expected to include: reduced spawning and rearing habitat availability, increased redd superimposition and consequent egg and larval mortality, increased flow fluctuation and consequent redd dewatering and stranding and isolation of juvenile steelhead, and decreased habitat suitability from thermal stress and predation for over-summering juvenile steelhead.

H. Stanislaus River

1. Formal Consultation

a. Adult Migration, Spawning, and Incubation

Current operations of New Melones Reservoir have set criteria under the Interim Plan of Operations (NMIPO) that defines water supply on storage and project inflow. The NMIPO allocates annual water releases, after satisfying the provisions of water right settlement agreement with Oakdale and South San Joaquin Irrigation Districts, first for instream fishery enhancement (*i.e.*, 1987 DFG Agreement and CVPIA section 3406(b)(2) management), second for San Joaquin River water quality requirements (*i.e.*, required in SWRCB D-1641); third for San Joaquin Vernalis flow requirements (*i.e.*, also required in D-1641), and lastly for uses by CVP contractors. In addition, the NMIPO flow allocation has objectives to increase water supply for fishery management and water quality requirements. The 1987 DFG Agreement provides a process by which minimum annual flows are scheduled by DFG after a determination by Reclamation of the available volume calculated pursuant to the agreement. The agreement was developed with the intent of establishing a new minimum flow standard after completion of studies identified in the agreement.

In a report on the relationship between flow and fish habitat for the lower Stanislaus River, Aceituno (1993) provided the following steelhead management recommendations for flows: 500 cfs for adults, 150 cfs for juveniles, 200 cfs for spawning, and 50 cfs for fry. Based on this report, the criteria of the NMIPO met the recommended flows to manage steelhead. To verify steelhead response to the NMIPO, Kennedy and Cannon (2002) conducted several snorkel surveys in 2001 and 2002 and observed adult *O. mykiss* sporadically in the river. In another study, Mesick (2001) observed increased adult steelhead spawning in areas of gravel augmentation that were as far downstream as Lover's Leap (RM 52.2) and Honolulu Bar (RM 49.6) in the past three years as flows were maintained and operated in higher levels (Carl Mesick Consultants 2002). Despite these observations, steelhead population responses to the NMIPO have not yet been verified.

Based on flow measurements on the Stanislaus River at Ripon gauge, which is located in an area of similar channel morphology to that of spawning areas, reductions in flow of approximately 50 cfs in the flow range of 100 to 300 cfs, have the potential to expose shallow redds that are in less than five inches of water. Reductions in flow of 175 cfs in the flow range of 1000 to 2000 cfs will cause similar impacts. These drops in flow can occur after the VAMP period, after annual water demands have decreased, and after certain water quality objectives have been met. NOAA Fisheries is concerned when these drops in flows occur during spawning season, eggs and larvae in shallow redds will be subjected to higher temperatures and possible dessication. Water temperature affects survival, growth rates, distribution, development rates, and disease incidence of salmonid eggs and larvae (Myrick & Cech 2001). Exposing redds to high incubation temperatures may adversely affect egg development or result in non-viable eggs.

Using CALSIM model results, water temperatures in the Stanislaus River ranged from 42 ^{o}F to 58 ^{o}F and the compliance temperature of 65 ^{o}F is met from Goodwin Dam to Orange Blossom Road Bridge when adult steelhead are present and spawning occurs from December to February. Adult steelhead optimal temperature range is 46 ^{o}F to 52 ^{o}F and less than 65 ^{o}F for juvenile steelhead (McEwan and Jackson 1996; Myrick and Cech 2000). Generally, other than redd-dewatering events, flows and temperatures should provide suitable habitat for adult spawning.

b. Juveniles and Smolts

Fish survey reports (Kennedy and Cannon 2002), report juvenile steelhead trout are generally found as far downstream as Oakdale, with high densities between Goodwin dam (RM 57.5) and Two-Mile Bar (RM 56.6) and in the lower reaches at Knights Ferry, Lover's Leap, and Orange Blossom Road from May through September after the VAMP period. Throughout the spring and summer, water velocity appears to play a more important role for juvenile steelhead. Juveniles were observed in higher velocity areas without vegetation such as in the upper reaches near Goodwin Dam and Two-Mile Bar, and in lower reaches with faster velocities of water such as Knight's Ferry, Lover's Leap, and Orange Blossom Road, while fry were observed in slower velocity areas and in vegetative areas. During low summer flows, juveniles sought out higher velocity water towards the heads or tails of pools in a given habitat unit while fry were observed in flooded vegetation along the river channel seeking refuge, overhead cover and protection from predators. During winter and spring, high densities of steelhead were found in the upper reaches (Kennedy and Cannon 2002). The lowest flow reported was between 150 cfs to 250 cfs during November and December and provided sufficient habitat for survival. This suggests that the NMIPO provided adequate flow and velocity for steelhead juvenile and smolts in 2000 and 2001. Since no changes to Stanislaus River operations are proposed and the CALSIM modeling shows no difference in flows or temperatures as a result of future Project operations, the adequacy of the habitat conditions is expected to remain the same in the long-term.

c. *Habitat Availability and Suitability*

The presence of Central Valley dams for hydropower and water diversion is one of the major factors contributing to the decline of steelhead (NOAA Fisheries 1996). Historically, steelhead spawned and reared primarily in mid- to high-elevation streams where water temperature remained suitable all year (McEwan and Jackson 1996). Below Goodwin Dam only 58 miles are now accessible to steelhead, with approximately 46 miles used for migration and only 25 miles for spawning and rearing, compared to the pre-dam era (*i.e.*, 1912) when there were more than 113 miles of habitat available for steelhead (Yoshiyama *et al.* 1996; DFG 2003a). Since the presently available habitat is at a lower elevation, stream temperatures are more likely to be high due to the lack of adequate shading. The lack of shading along streams can increase water temperature by 11.7 to 18 ^{o}F, which can make habitat unsuitable for steelhead and is a chronic problem for steelhead populations (NOAA Fisheries 1996a).

The targeted temperature of 65 ^{o}F has been met at the present compliance point of Orange Blossom Road Bridge (RM 46.9) for the last three years by Reclamation through the NMIPO. New Melones is operated and regulated to provide water supply benefits within the defined Stanislaus River Basin, which include flood control, power generation, fishery management, and water quality improvement for the Lower San Joaquin River. NOAA Fisheries anticipates that when low flows are released below Goodwin Dam, steelhead habitat suitability will be reduced by the Project. Flows below 150 cfs are expected to be adverse to steelhead juveniles. Presently, there is no required base flow for the Stanislaus River. Low flows limit and isolate the available habitat for refugia and may result in elevated water temperatures and stranding fish in unsuitable habitat (NOAA Fisheries 1996a).

d. Adaptive Management

Several monitoring efforts are underway on the Stanislaus River that are either partially or wholly funded through Reclamation. These efforts focus mainly on gathering information on Chinook salmon abundance, but indirectly collect steelhead information. Monitoring has consisted of rotary screw traps, snorkel surveys, and redd counts conducted by DFG, the Fisheries Foundation of California, and S.P. Cramer and Associates (SPCA). In 2003, a resistance board weir was built by SPCA and DFG (CALFED-funded until 2005) to monitor adult salmon and steelhead as specified under the previous interim OCAP opinion. Resistance board weirs have been proven effective for providing direct, reliable counts of salmon and steelhead, which can be compared to escapement estimates to determine their accuracy.

The coordination of the Stanislaus River Fisheries Workgroup with the other adaptive Management groups (*e.g.*, DAT, B2IT and WOMT) has been beneficial for the management of steelhead in the Stanislaus River, since fishery issues are discussed and addressed before making operational decisions. This process addresses the needs of steelhead in the Stanislaus River throughout its life stages as the hydrology and availability of water changes. The weekly meetings and the efforts made by the coordination among Federal, state agencies and stakeholder group to plan interim operating flows over the last three years provides the high attention and concern that is needed since the NMIPO affects not only fishery management, but also other stakeholders who have water needs (*i.e.*, agriculture, M&I, private landowners, etc.). These work groups provide benefits to steelhead by stabilizing flows during the adult spawning period and increase flows for juvenile emigration during the spring and fall (see VAMP description). Steelhead habitat suitability has increased within the Stanislaus River due to these workgroups and steelhead are expected to benefit from the actions of these groups under future operations. As studies continue to be conducted, analyzed, and evaluated, better decisions can be made for steelhead and Chinook salmon with continued coordinated efforts of these groups.

2. Early Consultation

a. Adult Migration, Spawning, and Incubation

The presence and operation of the HORB during VAMP period indirectly affects the current operations of New Melones Dam since increased flows are released on the Stanislaus River to aide in juvenile passage past the HORB and away from the Delta pumping plants. The presence and operation of permanent barriers is expected to provide better water quality in the migratory corridor for steelhead. The San Joaquin River is known to have poor water quality during the summer months and right before fall when the water become hypoxic (*i.e.*, having low levels of dissolved oxygen [DO]) and carries elevated loads of pesticides and herbicides from agriculture runoff, and municipal and industrial wastewater. Having the barriers in place keeps the water flowing from the tributaries straight into the Delta, where conditions are maintained enough for adult salmon and steelhead to migrate through the San Joaquin River and into natal streams without straying. Without the barriers, flow is reduced in the lower San Joaquin River, where the water becomes stagnant and DO concentration declines, resulting in fish passage impedance and causing low returns of adult steelhead and salmon to San Joaquin River tributaries (RWQCB 2001, Lee and Lee 2003, and DFG 2003a). The proposed permanent barriers will improve passage of adult salmon and steelhead into San Joaquin River tributaries. The permanent barriers will improve the water quality and quantity during critical migration periods (*i.e.*, spring-time for juveniles and fall for adults).

The placement and operations of the permanent barriers in the South Delta likely will increase the probability of steelhead successfully outmigrating from the Stanislaus River. The barriers will concentrate the flows in the San Joaquin River mainstem during the VAMP period when outmigrating juveniles are heading for the ocean. Since 1968, when temporary barriers were first placed in the San Joaquin River and Delta area, an increase in the number of juvenile salmon has been observed in the Delta (DFG 2003a and FWS trawl and seining reports). This indicates that juveniles/smolts are not straying into areas of the Delta and being delayed with their migration to the ocean. Therefore, NOAA Fisheries expects that the operation of permanent barriers in the South Delta will likely increase the survival of steelhead smolts originated from the Stanislaus River and other San Joaquin tributaries.

Based on the project description for the long-term EWA, water transfers, and project integration, the likelihood of an adverse affect for steelhead on the Stanislaus River can not be determined at this time, since project operations on the Stanislaus River are generally independent of other CVP operations. The NMIPO governs Stanislaus River operations and is not directly affected by early consultation actions of the proposed Project.

I. Feather River

1. Formal Consultation

Projected Feather River flows and water temperatures are expected to influence the adult migration, spawning, and incubation of spring-run Chinook salmon and steelhead. Long-term average and dry monthly flow projections and modeled water temperatures were used to assess impacts to spring-run Chinook salmon and steelhead. Flow projections and average monthly water temperatures above and below the Thermalito Outlet (*i.e.*, Low-flow Channel and High-flow Channel), for wet and dry water years were compared to the preferred conditions and habitat requirements of Chinook salmon and steelhead during migration, spawning, incubation, rearing, and outmigration. Holding temperatures for spring-run Chinook salmon were also analyzed. Flow and water temperature simulations in the Low-flow Channel were used to evaluate effects to spring-run Chinook salmon holding, spawning, and egg incubation, and steelhead spawning and egg incubation. Chinook salmon mortality was estimated using Reclamation’s mortality model (Reclamation 2004a). Where average monthly temperatures or flows exceeded preferred conditions for the species, actual water temperatures and flows were considered if they were available and applicable. Habitat availability and suitability also were assessed using all available instream flow-habitat relationship information, including preliminary reports written for the relicensing of the Oroville Facilities (FERC No. 2100).

a. Adult Migration, Spawning, Incubation

CV spring-run Chinook salmon. Based on observations of spring-run Chinook salmon immigration in the Sacramento River, adults are likely to migrate upstream through the action area during the period between February and July where they hold in deep, coldwater pools until spawning begins in mid- to late August. Most pre-spawning spring-run Chinook salmon adults hold in the upper three miles of the Low-flow Channel below the Fish Barrier Dam (Reclamation 2004a). Temperatures near the upper end of the Low-flow Channel during the summer provide suitable holding conditions throughout the summer months and provide the coldest water available during September for the initiation of spawning. The High-flow Channel is considered a migratory corridor for adult spring-run Chinook salmon, and few, if any of these fish are thought to hold or spawn there. For spring-run Chinook salmon, spawning primarily occurs during September and October and eggs may incubate into December or January (DWR 1999a,b).

Egg mortality was estimated during the egg incubation period for spring-run Chinook salmon using Reclamation's Salmon Mortality Model (Reclamation 2004). The egg survival model uses Chinook salmon temperature-exposure mortality criteria for three life-stages (*i.e.*, pre-spawned eggs, fertilized eggs, and pre-emergent fry) along with spawning distribution and timing information, and output from the water temperature model. Egg mortality is less than 2.5 percent for all but critically dry years when mortality is about 4.0 percent. The egg survival model does not consider potential egg mortality from fall-run Chinook salmon redd superimposition, and is, therefore, more applicable as an indicator of water temperature suitability.

Average monthly water temperatures during adult spring-run Chinook salmon migration may range between 50 °F and 70 °F in the High-flow Channel, and between 49 °F and 68 °F in the Low-flow Channel. Monthly water temperatures in the High-flow Channel are predicted to be within the preferred range for adult spring-run Chinook salmon migration from February through May. During June of both wet and dry years, water temperatures in the High-flow Channel may exceed preferred ranges identified by Bell (1991) and Boles (1988), and during July, water temperatures will reach 69 °F to 70 °F, and are likely to block the tail end of adult migration or cause migration delays. In the Low-flow Channel, water temperatures will be in the preferred range for adult spring-run Chinook salmon migration from February through May. During June of dry years, average monthly temperatures will range from 63 °F to 65 °F, near the upper range identified by Boles (1988), but below the temperatures that completely block adult migration. July temperatures will be 68 °F, above the upper limit identified by Boles (1998), but below the temperature that would completely block adult migration. Fish may also experience an increased susceptibility to disease in June and July when water temperatures exceed 65 °F. The use of average monthly water temperatures for forecasting habitat suitability does not forecast diel temperature ranges that may either be higher or lower than those modeled. While actual daytime temperatures in July are likely to exceed the monthly average and block adult migration, evening temperatures may be lower and allow for upstream migration. Consequently, NOAA Fisheries anticipates that the overall effect of water temperatures on adult spring-run Chinook salmon migration is that the tail end of migration upstream during July may experience temporary delays, and an increased susceptibility to disease, but the fish are still expected to reach upstream holding and spawning habitat where cooler water is maintained throughout the adult holding period.

Simulated monthly average water temperatures for holding spring-run Chinook salmon in the Low-flow Channel, during wet and dry years, tend to exceed the preferred range in June, July, August, and September. In previous consultations on the effects of the SWP on the Feather River, NOAA Fisheries has required that to the extent possible, a daily average water temperature of 65 °F be maintained at Robinson Riffle from June 1 to September 30 to protect steelhead. This requirement has resulted in summer water temperatures that are within the preferred range of spring-run Chinook salmon in the upper five miles of the Feather River below the Fish Barrier Dam. Furthermore, actual water temperatures in the upper three miles of river may be as much as five degrees cooler than at the lower end of the Low Flow Channel near Robinson Riffle. Data collected by DWR during the summer of 1998 show that water temperatures in the upper Low-flow Channel rarely exceeded 60 °F near the hatchery during July and August while water temperatures at Robinson Riffle occasionally exceeded 65 °F for several hours or days at a time. DWR estimates that between 75 and 80 percent of the spring-run Chinook salmon in the Feather River hold in this three miles. Adult spring-run Chinook salmon holding in the lower reaches of the Low-flow Channel are likely to experience monthly water temperatures that exceed preferred temperatures for short durations, typically less than two days. These temperatures may increase the susceptibility of holding spring-run Chinook salmon to disease, and may cause limited mortality.

The majority of in-river spring-run Chinook salmon spawning is concentrated in the uppermost three miles of accessible habitat in the Feather River below the Feather River Fish Hatchery (DWR 2001), although spawning may extend to the downstream portion of the Low-flow Channel above the Thermalito Afterbay Outlet. Modeled water temperatures for spring-run Chinook salmon spawning exceed preferred levels during September, but are within preferred levels in October and November. Similar to the effect of actual water temperatures on holding spring-run Chinook salmon, water temperatures are expected to be lower than modeled in the upper three miles of river, and be within the preferred range for spawning throughout the spawning period. However, water temperatures at the downstream end of the Low-flow Channel are expected to exceed preferred range for spawning until October. Modeled water temperatures during egg incubation are exceeded during September, but are within the preferred temperature ranges from October through January. Since the majority of spring-run Chinook salmon spawning and rearing is above the downstream end of the Low-flow Channel this is not expected to significantly cause an impact.

River flow and water temperature also can be affected by reservoir carryover storage and by pump-back operations through the Thermalito Complex. Pumpback operations typically occur in the summer or fall during “off-peak” periods. The effects of pump-back operations are most noticeable during extreme drought periods when reservoir storage drops below 1.2 MAF. Lower reservoir elevation causes the cold water level to drop below the power plant intake shutters that provide temperature control during dam releases. However, operational simulations indicate that reservoir carryover storage is unlikely to drop below 1.2 MAF, even under the more conservative 90 percent exceedence forecast. As a result, pump-back operations are not expected to adversely affect anadromous fish in the Low-flow Channel.

For adult upstream migration, spring-run Chinook salmon require stream flows that are sufficient to trigger migration cues and locate natal streams (DFG 1998). Minimum flows in the Feather River were established in a 1983 agreement between DWR and DFG for the preservation of salmon spawning and rearing habitat (see section II. *Description of the Proposed Action*). This agreement established flow criteria for the Low-Flow Channel and the High-flow Channel. The minimum flow releases in the agreement are between 1,200 cfs and 1,700 cfs in the High-flow Channel between October and March, and 1,000 cfs between April and September. A minimum flow of 600 cfs is maintained in the Low-flow Channel.

CV steelhead. Adult steelhead migrate upstream into the Feather River from September through May. The majority of fish migrate from September through February, although recent studies by DWR have identified an adult run that returns during the spring (*i.e.*, April and May), presumably to spawn (DWR 2001). Most steelhead return to the Feather River Fish Hatchery and very limited information exists regarding their location, timing, and magnitude of spawning within the river. Observations to date suggest the Low-flow channel is the primary reach for steelhead spawning, with up to 50 percent of the spawning occurring in the uppermost mile of river in a side channel adjacent to the Feather River Fish Hatchery (DWR 2003). The remainder of the population spawns downstream, primarily in other side channels within the Low-flow Channel, although it is likely that some steelhead spawn in side channels in the High-flow Channel, as far downstream as Honcut Creek (DWR 2003). Spawning occurs from December through April and peaks in January and February (DWR 2003). Incubation is likely to continue into early May.

Average monthly water temperatures during the peak adult steelhead migration period of September through January range from 45 °F to 65 °F in the High-flow Channel and 46 °F to 61 °F in the Low-flow Channel. Preferred migration temperatures are exceeded in September and early October, but are within the preferred range during the remainder of the migration. Water temperatures during the spring migration period are slightly higher than the primary migration and range from 50 °F to 60 °F. Preferred migration temperatures are exceeded in May, but are not expected to alter fish behavior or stress adults.

During the steelhead spawning and egg incubation period, average monthly water temperatures in the Low-flow Channel range from 46 °F to 55 °F. Temperatures are within the preferred range for spawning from December through March, but exceed the preferred range in April (*i.e.*, 53 °F to 55 °F) and May (60 °F). Actual water temperatures in the upper Low-flow Channel, where most spawning is concentrated, may be lower, and closer to the preferred range because of the proximity of this habitat to the cold water releases of Oroville Dam. Average monthly water temperatures in May are 60 °F and exceed the preferred levels for steelhead spawning, but are not expected to be significant since very few adults spawn that late.

Projected average monthly flows in the High-flow Channel during the steelhead and spring-run Chinook salmon migration period range from approximately 1,500 cfs during dry years to 12,300 cfs during wet years. A constant flow of 600 cfs will be released into the Low-flow Channel. These flows are expected to provide adequate depths and velocities for upstream migration. Spawning flows were evaluated by DWR in a recent flow-habitat relationship study (DWR 2004a,b). The results of the study indicate that there is little change in weighted useable area (WUA) expressed as units of square feet per 1000 linear feet or relative suitability index (RSI) at different flows, and that optimum levels are achieved at lower flows than for Chinook salmon. However, the maximum WUA/RSI in the Low-flow Channel appears to be between 450 cfs and 700 CFS. In the High-flow Channel the maximum WUA/RSI is achieved between 800 cfs and 1,000 cfs and quickly drops after approximately 1,800 cfs.

Flows generally will remain stable during steelhead and spring-run Chinook salmon egg incubation, but may periodically be increased above standard forecasts during December and

January for flood control or to meet Safety of Dams Criteria. Oroville Dam releases in excess of 17,000 cfs must be released to the Low-flow Channel. Short duration, high flow events can scour steelhead redds and result in the injury and mortality of incubating eggs. While DWR and Reclamation do not provide estimates of flows that trigger bedload mobility and cause redd scour, they mention that the last bed-mobilizing flow occurred in 1997, and that subsequent flows up to 25,000 cfs have not mobilized the bed. This suggests that redd scour is not likely to occur at flows below 25,000 cfs. In the Low-flow Channel, where a majority of the spawning and egg incubation occurs, flows will remain at 600 cfs under all but critically dry years in December and January. In the High-flow Channel, where little, if any spawning occurs, flows are only expected to exceed 25,000 in December and January under the three to five percent exceedence forecast. These flow conditions will avoid scouring and dewatering of redds under standard operations.

Steelhead redd dewatering can occur when river flows are reduced during or after the spawning period and also can result in injury and mortality of incubating eggs. In the Low-flow Channel, where a majority of the spawning and egg incubation occurs, flows will remain at 600 cfs under all but the 10 percent exceedence forecast from January to May. These flow conditions will avoid scouring and dewatering of redds in the Low-flow Channel under normal operations in most years. In the High-flow Channel, the frequency of flow fluctuations is greater than in the Low-flow Channel and steelhead redds may be dewatered when periodic high releases return to forecasted levels. Flow fluctuations for flood control have dewatered Chinook salmon redds in the past, but surveys have not detected any dewatered steelhead redds. However, if steelhead redds are dewatered in the High-flow Channel, the effect is probably insignificant to the population since the majority of steelhead spawning takes place in the Low-flow Channel.

b. Fry and Juveniles

CV spring-run Chinook salmon. Spring-run Chinook salmon fry emerge from redds from December through January. Results from Feather River Chinook salmon emigration studies indicate virtually all spring-run Chinook juveniles in the Feather River exit as sub-yearlings. Emigration begins immediately following emergence in late November, peaks in January and February, and continues through June (DWR 1999a,b,c). Although most juvenile Chinook salmon are believed to have outmigrated through the High-flow Channel by early April, snorkel surveys have confirmed that as many as 500,000 juvenile salmon continue to rear in the Feather River throughout the summer, mostly in the Low-flow Channel, and are likely to outmigrate the following fall as yearlings (DWR 2003). Water temperatures necessary for maximum growth and development are from 53 °F to 57.5 °F, although temperatures up to 65 °F can be tolerated without adverse effects (Boles 1988).

Average monthly water temperatures during spring-run Chinook salmon juvenile rearing and outmigration range from 48 °F to 67 °F in the High-flow Channel and 45 °F to 65 °F in the Low-flow Channel. Water temperatures during the peak emigration period range from 45 °F to 50 °F. Temperatures are within the preferred range for growth and development during all months except May and June where temperatures may exceed preferred levels but generally remain below levels that cause adverse effects.

Flood control operations above 5,000 cfs may result in rapid and large flow fluctuations within the Lower Feather River. Depending on the magnitude and/or duration of these flow fluctuations, there is a potential for fry and juvenile Chinook salmon to become stranded. Ramping criteria for the Feather River were established by a 1983 agreement between DWR and DFG. This agreement requires flows below the Thermalito Afterbay that are under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood control. This ramping rate is expected to minimize impacts to juvenile spring-run Chinook salmon from stranding in the High-flow Channel. Past flow fluctuations for flood control or dam safety inspections have resulted in fry and juvenile Chinook salmon being stranded in the High-flow Channel and the Low-flow Channel. DWR engineers estimated that dam safety inspections are likely to occur on average every year and more frequently as the facility ages in the future. In February 2004, a safety inspection on the Thermolito Outlet caused stranding of juvenile salmon in the Low Flow Channel (DWR 2004 and DFG 2004). In 2001, DWR reported 23 redds dewatered and estimated 2,500 spring-run sized juvenile salmon were stranded between January and May in the High-flow Channel (DWR 2002b). DWR assumes that rearing juveniles are susceptible to stranding in the High-flow Channel when flows decrease by more than one-half over a seven day period when flows fluctuate between 8,000 cfs and 1,000 cfs. Since 1980, such conditions have occurred sixteen times in 21 years during the January through June rearing season. The significance of these stranding losses to the spring-run Chinook salmon population in the Feather River is unknown because it is difficult to truly distinguish the difference between fall-run and spring-run Chinook salmon due to the extensive overlap in spawning timing and distribution. However, if all 2,500 juveniles reported stranded in 2001 were spring-run Chinook salmon the effect of frequent recurring flow fluctuations would be significant to the Feather River population.

Based on rotary screw trap captures, there does not appear to be a relationship between flow and juvenile Chinook salmon outmigration rates (DWR 2002c). Fry passage at the rotary screw trap in the Low-flow Channel varies considerably over time while flows remain constant at 600 cfs. Similarly, at the Live Oak rotary screw trap in the High-flow Channel, where there is considerable flow fluctuation, outmigration rates do not correlate with flow increases.

CV steelhead. Steelhead fry and juveniles have been captured in Feather River Chinook salmon emigration studies since 1995. Young-of-the-year (YOY) were captured from March through June, while yearlings were captured from January through June. Steelhead were not captured during the period between October and December, but it was speculated that this may have occurred because the sampling gear may not be able to detect their presence during this time (DWR1999a, b, c). Based on these results and steelhead emigration patterns in the Sacramento River, steelhead juveniles and smolts are expected to emigrate from the Feather River from December through March. Fry and juvenile steelhead water temperature necessary for maximum growth and development are from 45 ^{o}F to 65 ^{o}F (McEwan and Jackson 1996; Myrick and Cech 2001).

Average monthly water temperatures during juvenile rearing periods exceed preferred levels (*i.e.*, greater than 65 ^{o}F) in June, July, and August. Water temperatures that exceed preferred ranges can cause thermal stress. Thermal stress induces varying degrees of physiological responses that may harm or kill juvenile steelhead by reducing their growth, and increasing their susceptibility to disease and predation. Recent temperature studies on the Feather River indicate that steelhead rear successfully at the downstream end of the Low-flow Channel where temperatures exceed 65 ^{o}F. Additionally, a laboratory study on Feather River steelhead found that naturally produced steelhead juveniles displayed a higher thermal tolerance than steelhead from the Feather River Hatchery. These studies suggest that steelhead may not be harmed or killed by forecasted summer water temperatures. During the remainder of the year, and throughout the juvenile outmigration period, water temperatures are either within the preferred range for growth and development or below levels that cause adverse effects.

There currently is little information available to assess the effect of flow on steelhead outmigration. Very few steelhead are captured in the rotary screw traps in the High-flow Channel and the Low-flow Channel, and steelhead are thought to be more efficient at avoiding capture because of their larger size and better swimming ability (DWR 2002). However, based on the information currently available, flow has not proven to be significant in stimulating outmigration.

Depending on the magnitude and/or duration of flow fluctuations for flood control or dam safety, there is a potential for fry and juvenile steelhead to become stranded. The 1983 ramping rate agreement between DWR and DFG is expected to minimize impacts to steelhead from and juveniles from stranding in the High-flow Channel. Past flow fluctuations for flood control or dam safety inspections have resulted in fry and juvenile steelhead being stranded in both the High-flow Channel and Low-flow Channel. DWR engineers estimated that dam safety inspections are likely to occur on average every year and more frequently as the facility ages in the future. In February 2004, a safety inspection on the Thermolito Outlet caused stranding of juvenile steelhead in the Low Flow Channel (DWR 2004 and DFG 2004). In 2001, DWR estimated 40 juvenile steelhead were stranded in one out of nine ponds between January and May in the High-flow Channel (DWR 2002a). DWR assumes that rearing juveniles are susceptible to stranding in the High-flow Channel when flows decrease by more than one-half over a seven day period when flows fluctuate between 8,000 cfs and 1,000 cfs. Since 1980, such conditions have occurred sixteen times in the January through June rearing season. The abundance of naturally produced juvenile steelhead is low (DWR 2003), so frequent flow reductions may have a significant impact on the number of juveniles produced in the Feather River.

c. Habitat Availability and Suitability

In addition to the temperature and flow-related effects of the Project on the life history stages discussed above, operations also affect overall habitat availability and suitability. Flows affect the amount of habitat available for adult spawning for all salmonids in the system, which in turn affects reproductive success since the spawning and rearing habitat is limited and redd superimposition is occurring. Changes in the amount of habitat for fry and juvenile rearing may affect growth and survival.

A 1994 flow-habitat simulation study conducted by DWR suggests that the maximum area of suitable Chinook salmon spawning habitat occurs at flows of approximately 1,000 cfs in the Low-flow Channel. DWR recently completed an updated flow-habitat relationship study (*i.e.*, using PHABSIM) at the recommendation of the Feather River Environmental Working Group (EWG), a collaborative team that has formed to address anadromous fishery issues related to the Federal Energy Regulatory Commission's (FERC) relicensing of the Oroville Facilities (DWR 2004a). The results of this study demonstrate that the maximum WUA/RSI for Chinook salmon spawning in the Low-flow Channel is achieved at a flow between 800 cfs and 825 cfs. Reclamation asserts that spawning spring-run Chinook salmon are unlikely to be directly impacted by the amount of space available for spawning since they are the first Chinook salmon run to begin spawning, and there appears to be an adequate amount of spawning habitat to support the current population.

Redd superimposition by fall-run Chinook salmon, which spawn later and in much greater numbers, could be causing substantial egg mortality (Sommer *et al.* 2001). This is significant due to the complete spatial overlap of fall and spring-run Chinook salmon spawning, and is likely to result in a high rate of redd superimposition. Since the majority of spring-run Chinook salmon in the Feather River spawn in the uppermost three miles of habitat and fall-run Chinook salmon use the same area it is likely that this habitat is being over-utilized. Sommer *et al.* (2001) observed that since the completion of Oroville Dam, there has been a shift in the distribution of Chinook salmon spawning from the High-flow Channel, and superimposition of redds in the Low-flow Channel is a major problem. However, Sommer *et al.* (2001) suggest that increasing flow in the Low-flow Channel to provide more spawning habitat may actually increase superimposition rates by attracting more fall-run Chinook salmon. Due to the combined effects of run hybridization, limited amount of spawning habitat (upper three miles of the LFC), and spatial and temporal overlap with fall-run Chinook salmon, Feather River spring-run Chinook salmon are not able to persist into the future as an independent population that is genetically distinct from fall-run Chinook salmon, unless they can be geographically segregated (Lindley 2004).

DWR holds a license for Oroville from FERC, which is currently undergoing review in the context of a relicensing proceeding. In the FERC relicensing proceeding, the effects of Oroville Dam and its operations on listed species will be considered, and NOAA Fisheries will have the opportunity to develop recommendations to avoid or mitigate adverse effects on listed species not only through the ESA but through the additional authorities granted to NOAA Fisheries under the Federal Power Act. NOAA has broad authority to prescribe fish passage measures under section 18 of the Federal Power Act and to recommend measures to improve or maintain habitat downstream of a dam pursuant to section 10(j) of the FPA. As part of the FERC relicensing process, DWR is completing studies and developing measures to address these issues.

Preliminary results of the PHABSIM studies on the Lower Feather River provide some insight on the effect of forecasted flows on Chinook salmon and steelhead rearing (DWR 2004b). For Chinook salmon and steelhead fry (*i.e.,* less than 50 mm), WUA/RSI increases proportionally with flow in both the High-flow Channel and the Low-flow Channel from 500 cfs to 7,000 cfs. For Chinook salmon and steelhead juveniles (*i.e.,* greater than 50 mm) WUA/RSI values vary depending upon how cover is valued for habitat suitability, but generally increases with more flow between 300 cfs and 3,000 cfs in the Low-flow Channel, and 400 cfs and 7,000 cfs in the High-flow Channel. Minor variations in the indices within the total flow range are a result of variability in channel margin areas (DWR 2004b). In all cases, forecasted project flows are at the lower range of modeled habitat availability and provide the least amount of rearing habitat for juveniles compared to modeled habitat available at higher flows. Therefore, predicted project flows will limit habitat availability. Habitat suitability indices generally indicate that habitat for both species reaches optimum suitability at flows of 1,000 cfs in the Low-flow Channel, and 3,000 cfs in the High-flow Channel.

The presence and current operation of the Oroville Facilities has eliminated the contribution of bed material from the upper watershed, and regulated flows from Oroville Dam have dampened the magnitude and frequency of low and high flow events downstream (DWR 2001). A reduction in overbank flooding, combined with the elimination of upstream bed material, halts natural sedimentation processes and contributes to channel degradation. The resulting substrate in the Lower Feather River is armored by cobbles and boulders, mainly due to the lack of gravel recruitment to riffles since the 1960s, when Oroville Dam was completed. Substrate evaluations using Wolman counts show that spawning gravel in the Low-flow Channel has become progressively armored over the past 16 years (Sommer *et al.* 2001). It is likely that the amount and quality of spawning gravel in the Low-flow Channel will continue to decline as flood flows move gravel downstream over time. NOAA Fisheries anticipates that as spawning gravel is reduced in supply, competition for spawning habitat will increase, resulting in increased levels of redd superimposition, and reduced levels of spawning success and egg survival.

As previously discussed, spring-run Chinook salmon and steelhead spawning habitat availability primarily is confined to the Low-flow Channel. Although the approximately seven miles of holding and spawning habitat appears adequate to support a large number of spring-run Chinook salmon, the suitability of the spawning habitat is diminished because this habitat is also utilized by a large population of fall-run Chinook salmon. The co-occurrence of these species in the same spawning habitat adversely affects spring-run Chinook salmon through redd superimposition and resultant egg mortality, and genetic homogenization through interbreeding (Sommer *et al.* 2001).

Most steelhead spawning and early rearing appears to occur in the Low-flow Channel in habitats associated with well-vegetated side channels (Cavallo *et al.* 2003). Recent steelhead redd surveys (DWR 2003) found that nearly half of all redds were constructed in the one mile immediately below the Fish Barrier Dam, and recent snorkel surveys by DWR show that most newly emerged steelhead fry are rearing in the uppermost portions of the Low-flow Channel (Cavallo *et al.* 2003). The remaining majority of spawning and rearing primarily occurs in one additional side-channel riffle complex toward the downstream end of the Low-flow Channel. IFIM results for adult steelhead indicated that the low magnitude and peak in spawning WUA/RSI was attributable to the relative scarcity of smaller substrate particle sizes utilized by spawning steelhead (DWR 2002). In 2003, fewer than 200 adults were estimated to have spawned in the Feather River. Both spawning and rearing habitats for steelhead are confined to a only few areas in the Lower Feather River. This lack of available spawning and rearing habitat is likely limiting natural steelhead production and juvenile rearing success.

d. Feather River Fishery Studies

Fish monitoring in the Feather River will continue to capture steelhead and spring-run Chinook salmon. DWR is likely to modify and perhaps expand on such activities to gather information needed by NOAA Fisheries and DFG with the FERC. Additional studies required through the FERC process were permitted in a separate biological opinion that assessed the effects of expanded monitoring (NOAA Fisheries 2004).

Steelhead and spring-run Chinook salmon capture occurs during rotary screw trap sampling, fyke net sampling, beach seine sampling, or snorkeling. Low numbers of steelhead typically are captured in the rotary screw traps between February and July. The total annual steelhead captured in the Feather River fish monitoring program is estimated to be 7,855 fish (*i.e.*, 6,835 YOY, 980 juveniles, and 40 adults), and the total annual potential spring-run Chinook salmon captured is estimated to be 6,500 fish (*i.e.*, 6,355 YOY, 146 juveniles (age unknown), and seven adults). Total annual mortality is estimated to be two percent, or 157 steelhead and 130 spring-run Chinook salmon. These estimates are based on the largest seasonal catch to date and the relative proportions of the different life stages in the catch combined with the estimate of capture for the sampling elements.

2. Early Consultation

Increased Banks export capacity to 8500 cfs and EWA actions in the future CALSIM model studies 4 and 5 increase the ability to draw down Oroville Reservoir to lower carryover storage levels than existing operations. CALSIM studies 4 and 5 shift releases from winter (*i.e.*, December to March) to summer months (*i.e.,* June to August) in wetter year types, resulting in higher summer flows and lower winter flows. Average monthly summer flow increases are expected to range from a few hundred to 1,500 cfs. Under dry year types average monthly winter flow are almost identical to existing operations, except in July, where flows are slightly higher (*i.e.,* as much as 500 cfs higher) and August and September, where flows are lower (*i.e.,* as much as 500 cfs lower).

Feather River releases in CALSIM studies 4 and 5 only are expected to affect the High-flow Channel because flows in the Low-flow Channel are kept at a constant 600 cfs all year. Effects of future flows are likely to benefit spring-run Chinook salmon and steelhead in wet years because flows will probably provide improved attraction conditions for upstream migration. Lower than existing flows in the winter are not expected to affect adult steelhead migration because adequate depths and velocities for upstream movement will still be met. Lower flows in August and September of dry year types will not affect spring-run Chinook salmon and steelhead, because these flows generally do not correspond with the use of the High-flow Channel by these species. Future flows are not likely to have any impact on spring-run Chinook salmon and steelhead adult holding, spawning, or egg incubation because these life history stages primarily occur in the Low-flow Channel where changes to the existing flow regime are not expected.

Reduced winter flows may have a greater adverse effect on fry and juvenile rearing and outmigration than existing operations because reduced winter flows correspond with peak migration periods. Although DWR (2002) has not observed any flow-related responses to juvenile outmigration rates, it is likely that lower monthly flows will result in slower water velocities, which may slow salmon and steelhead travel time and make them more susceptible to predation and unscreened diversions in the High-flow Channel, resulting in lower survival rates.

Average monthly water temperatures in the High-flow Channel will be reduced from June to August in wet years. Dry year types will be similar to existing conditions. Cooler water temperatures are expected to provide improved migration conditions for adult spring-run Chinook salmon and may improve summer rearing conditions for juvenile Chinook salmon and steelhead residing in the Low-flow Channel.

Average monthly water temperatures in the Low-flow Channel are not expected to change from existing conditions. Water temperature effects to spring-run Chinook salmon and steelhead will be similar to those analyzed for existing operations under CALSIM studies 1 through 3. Overall, early consultation effects are expected to be similar to the formal consultation, except that reduced storage in Oroville Reservoir will reduce the ability to manage cold water reserves in the late summer, early fall months. This will increase the mortality of over-summering juvenile steelhead and spring-run Chinook salmon.

J. Freeport Regional Water Project

1. Formal Consultation

The design capacity of the FRWP is 286 cfs (185 millions of gallons per day [MGD]). Up to 132 cfs (85 MGD) would be diverted under SCWA existing Reclamation water service contract and other anticipated water entitlements and up to 155 cfs (100 MGD) of water would be diverted after a 50 year period under EBMUD's amended CVP water service contract. The point of use of the EBMUD water would be Alameda and Contra Costa Counties.

EBMUD is able to take delivery of CVP contract water (*i.e.*, American River entitlement diverted from the Sacramento River) in any year in which EBMUD's March 1 forecast of the previous October 1 total system storage is less than 500 TAF. When this condition is met EBMUD is entitled to take up to 133 TAF. However, deliveries are subject to current CVP allocations and EBMUD's share of project capacity (100 MGD) and are further limited to no more than 165 TAF in any three-consecutive-year period that EBMUD's October 1 storage forecast remains below 500 TAF. EBMUD would take delivery of it's entitlement at a maximum rate of 100 MGD (*i.e.*,112 TAF per year) beginning March 1 of the CVP contract year or any time thereafter within the contract year. Deliveries would cease when EBMUD's CVP allocation for that water year is reached, when the 165 TAF limitation in any three-consecutive years limitation is reached, or when EBMUD no longer needs the water, whichever comes first.

SCWA has a CVP entitlement of 22 TAF through Reclamation and has subcontracted 7 TAF of this entitlement to the City of Folsom. SCWA expects to be able to provide additional anticipated surface water entitlements to serve Zone 40 demands, including an assignment of a portion of Sacramento Municipal Utility District's (SMUD) existing CVP water supply contract, potential appropriated water rights on the American and Sacramento Rivers, and potential transfers of water from areas within the Sacramento Valley. Zone 40 is a capital funding zone in central Sacramento County encompassing the Laguna, Vineyard, Elk Grove, and Mather Field communities. Total long-term average Zone 40 water demand is estimated to be 109.5 TAF/year, and long-term surface water use is expected to be 68 TAF/year, based on the 73 year historic hydrology. This demand would be met from SCWA's 132 cfs portion of the FRWP's design capacity of 286 cfs, aggressive conservation, and ground-water sources.

The OCAP BA models the Sacramento River flows at Freeport using the 2020 LOD at the 1928-1934 drought flow level. Under those conditions the Sacramento River flow is estimated to be about 13,900 cfs. Under "average" conditions the flow would be above 22,000 cfs (OCAP BA Table 8-5 dated March 23, 2004).

There are several dynamics involved in assessing EBMUD water withdrawals at the Freeport facility. First, EBMUD determines its critical need based on the hydrology of the Mokelumne Basin and its storage in that basin but draws its water from the Sacramento River, above the confluence with the Mokelumne River. Second, the quantity of water diverted varies with water-year type and based on Figure 9-56 (OCAP BA March 23, 2004) would range from 1 TAF in wet years to 63 TAF in critically dry years.

Values in Figure 9-57 (OCAP BA March 23, 2004) indicate that in 6 of 12 periods of diversion (*i.e.*, dry years based on EBMUD storage levels) in the 73 year historic period of the CALSIM model, EBMUD would have diverted its entire allocation in two consecutive years even though the third year may have been critically dry, dry, or below normal. In two sequences, EBMUD would have diverted in three consecutive years before meeting the limit of 165 TAF. In one sequence, EBMUD diverted in four consecutive years when the rolling average for three consecutive years did not appear to exceed the 165 TAF limit. This is important because extended diversions in dry years would have greater impacts on Delta inflow and pumping at the CVP/SWP Delta Facilities. If EBMUD pumped at its maximum capacity of 155 cfs it would divert at a rate of 310 af/day and would require about 194 days of pumping to move an average of 63 TAF. The maximum annual delivery at 100 mgd pumping rate is 112 TAF, or 21 TAF below full entitlement (133 TAF) in any single year. The OCAP BA (March 23, 2004) does not address the capacity of the pipeline to convey more water than the EBMUD pumping capacity at Freeport. The FRWP BA (Jones and Stokes 2004) indicates that the pipeline to Folsom South Canal will be a 66-inch diameter pipe with a 100 mgd capacity. The pipeline from Folsom South Canal to the Mokelumne Aqueduct will be 66-inch diameter with a capacity of 100 mgd or 155 cfs. EBMUD is unable to "borrow" SCWA capacity to pump at the Freeport facility because the pipeline connecting to the Mokelumne Aqueduct does not have the capacity to move that additional water. Therefore EBMUD cannot withdraw its full allocation in less time than otherwise projected. EBMUD's obligation to wheel water for CCWD is to be met within EBMUD's pumping capacity of 155 cfs and annual volume for diversion.

The SCWA has designed capacity at the Freeport facility to divert approximately 264 af/day or

132 cfs of the total 286 cfs design capacity. The full demand for Zone 40 from surface water supplies is estimated at 260 af/day or 68 TAF/year. SCWA appears to have designed to meet full demand at build-out even though its CVP entitlement is only 22 TAF. SCWA expects an assignment of a portion of the SMUD existing CVP water supply contract, potential appropriative water rights on the American and Sacramento Rivers, and potential transfers of water from areas within the Sacramento Valley to make up the difference.

a. *Adult Migration, Spawning and Incubation*

The Freeport facility will operate on a daily basis to deliver SCWA water except when reverse flow events might move treated wastewater from downstream into the vicinity of the intake. FRWA will coordinate with the City of Sacramento to regulate discharges and pumping relative to tidal flows to prevent the intake of treated wastewater into it's supply. This may result in short-term outages at the FRWP until downstream flows resume.

The Freeport facility will operate on a water-year basis to deliver EBMUD water, and not on an annual or pre-determined schedule. In the last 72 year period (Figure 9-57, OCAP BA, March 23, 2004) the facility would have operated in only 24 or one-third of the 72 years and only once for four consecutive years. As a consequence the facility will not operate at or near full capacity except in critically dry, dry, or below normal water years. During those years the fully screened facility would remove a maximum of 286 cfs or approximately 0.2 percent of the average critically dry year Sacramento River flow at Freeport (OCAP BA, Table 8-5, March 23, 2004). EBMUD would export 0.1 percent of the flow (155 cfs) out of the basin.

Since there is no spawning of listed salmonids in the area of the Freeport Project adults are not expected to be adversely impacted on the Sacramento River. Water transferred from the Sacramento River to the Mokelumne Aqueduct will not be released into the Mokelumne River. Hence there will be no mixing of water or false attraction of Sacramento River fish into the Mokelumne River as a consequence of the diversion. Flows in the Mokelumne River will not be directly affected by the diversion from the Sacramento River, either physically, chemically, or by temperature.

However, interrelated to the diversion of water at the Freeport Project, EBMUD is obligated to store a volume of water in its Mokelumne Basin reservoirs in proportion to the amount of water diverted from the Sacramento River (referred to as gainsharing). This water is to be made available to DFG and FWS through a joint settlement agreement (JSA) for release from Camanche Reservoir at their discretion into the lower Mokelumne River. Gainsharing water is to be available in any year in which carryover storage in EBMUD's storage in the Lower Mokelumne River Project on November 5th is projected to be at the maximum allowable level by the Corps flood control manual. When carryover storage on November 5th is projected to be less than the maximum allowable, the gainsharing water may be used only once during a drought sequence. NOAA Fisheries is not party to the JSA, but can request that FWS initiate consultation on its participation in the use of gainshare water when the release of that water may affect listed steelhead or EFH for fall-run Chinook salmon in the Mokelumne River. It is anticipated that the small amount of gainsharing water will slightly increase flows during some drought years in the Mokelumne River below Camanche Dam, thereby possibly providing greater habitat availability for steelhead and/or rainbow trout.

Despite the small and infrequent increases attributed to gainsharing water, CALSIM modeling and the FRWP BA modeling indicates Mokelumne River flows will not increase in the future conditions below Woodbridge Irrigation Dam, and may be lower in some years due to diversions above the dam. Lower flows entering the Delta from the Mokelumne River are expected to delay or impede passage of adult steelhead from August through November by reducing the attraction to fish ladders at Woodbridge Dam. Delays at Woodbridge Dam, due to predicted low flows in the future, are not expected to cause injury, but may increase the likelihood of straying into other rivers.

b. *Juveniles and Smolts*

FRWA has indicated to NOAA Fisheries that it will design and construct the fish screens on the Sacramento River (*i.e.*, part of a separate section 7 consultation) to protect delta smelt, which is a higher standard than required for protecting anadromous salmonids. Migrating salmonids are better swimmers than delta smelt and are not expected to be adversely affected by screening facilities that protect less able swimmers than salmonids. The intake is located in a tidally influenced area and will have reversing flows that will not meet the sweeping velocity criteria for screens designed to operate in unidirectional flows. NOAA Fisheries has provisions for exempting screens that operate in reversing flow circumstances from the sweeping flow velocities and requires FRWA to request a waiver of the sweeping velocity criteria prior to operating the intake facility. Reduced flows attributed to the FRWP are not expected to alter juvenile behavior or smolt emigration due to the small amount being diverted, relative to the total flow of the Sacramento River (*i.e.*, 0.2 percent at the maximum in a critical year) and because of the location in a tidally influenced area.

c. *Summary of Freeport Effects*

Reclamation will make its annual allocation of water to its contractors, including EBMUD and SCWA, on the basis of water year runoff and storage in the Sacramento Basin, including the American River forecasted supples. Regardless of the water year type or the allocation to contractors, the FRWP diversion is located downstream of most other diversions and downstream of critical spawning and rearing areas. CVP water released to meet FRWP contract amounts will remain in the Sacramento or American River longer thus providing some habitat value to listed salmonids through increased releases during drought years. Since the diversion point is in the tidally influenced region of the lower Sacramento River it is unlikely that any reduction in water level attributable to diversion at the facility can be discerned. Any elevation change due to diversion would be adjusted by wastewater returns to the Sacramento River about a mile downstream. Some of the wastewater return would include water diverted from the Sacramento River at Freeport and or the City of Sacramento upstream diversion point. Overall, the FRWP is not anticipated to have an adverse effect on individual salmonids or their populations. Short-term impacts to critical habitat (*i.e.*, currently only designated for winter-run Chinook salmon) will be addressed in a separate biological opinion on the construction and design of the fish screens.

2. Early Consultation

The effects of the FRWP can not be separated out in the CALSIM modeling done for the OCAP BA. The long-term modeling assumes that the FRWP is a part of the increase in 2020 LOD, already described under the American River. In order to meet these increased demands Reclamation is proposing to implement several new operations (*i.e.*, SDIP, project integration, and a long-term EWA). The effects of the early consultation operations will be mainly confined to the Delta, except for upstream water temperature impacts due to reduced to storage levels in project reservoirs. These effects have already been described above under the Sacramento River, American River and Feather River sections.

K. Sacramento/ San Joaquin Delta Effects

1. Formal Consultation

The Sacramento-San Joaquin Delta provides habitat for listed salmonids almost year round by: (1) serving as a corridor for upstream migrating adults returning to freshwater to spawn; (2) serving as a corridor for juveniles migrating downstream to the ocean; and (3) providing short-term rearing habitat for juveniles as they move downstream. Within the Delta itself, the Project is likely to adversely affect listed species and habitat through the increased entrainment of listed juvenile salmonids at the SWP, CVP, and Rock Slough pumping facilities. In addition, elevated pumping rates and water conveyance volumes will transport juvenile fish into the interior of the Delta, where survival rates are substantially reduced when compared to fish that remain in the mainstem of the Sacramento River (Brandes and McLain 2001).

a. *Fry, Juveniles, and Smolts*

(1) Tracy and Skinner Fish Collection Facilities. Salvage and loss estimates for winter-run Chinook salmon and spring-run Chinook salmon have been generated for both the formal and early consultations, and are discussed below in the appropriate sections. However, entrainment of juvenile salmonids and other adverse effects not accounted for by salvage and loss is known to occur at both the State and Federal facilities. At the John E. Skinner Fish Facility owned by the State, there currently is no standard method for reporting problems associated with the operation and maintenance of the facility. Delays in routine maintenance and replacement of critical control systems at the facility are not being reported to NOAA Fisheries, as they are experienced. Routine inspections of screens are not performed. In addition, efforts to minimize the pre-screen loss in Clifton Court are not being addressed. Predation in Clifton Court forebay accounts for 75 percent of salmonid loss. However, this loss rate was negotiated for management of the facility based on 10 studies from 1976-1993 which averaged 85 percent and ranged from 63 to 99 percent pre-screen losses for juvenile Chinook salmon (Gingras 1997 as reported in SDFF 2001). This would indicate that the loss rate at Clifton Court may be underestimated by as much as 10 percent. Since 1993 no new studies on predation have been conducted. At both fish collection facilities genetic sampling is not required, therefore only done as time allows. Salvaged fish are routinely held for up to 24 hours between hauling runs when fish densities are not great. This creates stressful conditions due to crowding, predation, and poor water quality in the holding tanks.

The Federal Tracy Fish Collecting Facility (TFCF) currently does not meet NOAA Fisheries screening criteria, nor does it screen fish effectively that are less than 38 mm since it was designed to screen larger size fish. Overall louver efficiency at the TFCF was found to be 46.8 percent for Chinook salmon ranging in length from 58-127 mm (Reclamation 1995). The pre-screen loss rate at TFCF is unknown, and an assumed loss rate is used to expand the salvage figures based on screens at GCID located in the upper Sacramento River. This could lead to under or overestimating the loss at the TFCF. The primary louver (screen) panels cannot be cleaned without leaving gaping openings in the screen face (*i.e.*, lifting each panel leaves a 7.8 foot wide x 20 foot high opening). Further, cleaning the secondary channel and louver panels takes the entire facility off-line. Also, during secondary louver screen cleaning operations, and secondary channel dewatering, the entire secondary system is shut down. As a result, all fish salvage is compromised for the duration of the outage. This loss in fish protection during cleaning operations allows unscreened water to pass through the facility approximately 25 percent of the time, resulting in underestimating the salvage and loss rates for Chinook salmon and steelhead at the CVP. Previous evaluations of the louver efficiency found that the overall louver efficiency (*i.e.*, primary and secondary combined) dropped to 0 percent while the primary louvers are lifted for cleaning (Reclamation 1995).

Significant delays in routine maintenance and replacement of critical control systems at the TFCF can and have occurred (*e.g.*, replacement of transition boxes on primary louvers in 2004). The effect on fish losses due to reduced screen efficiency, before the repairs were completed, was never analyzed or adjusted in the daily loss calculation. Finally, the TFCF experiences tidal shifts in flow and water elevation twice a day that do not meet sweeping velocity criteria in front of the louver panels. This allows fish to swim through the louvers to the pumps.

(2) E/I Ratio. Reclamation and DWR propose to operate the Delta export pumps and Delta Cross Channel gates in compliance with: SWRCB permits; existing biological opinions for winter-run Chinook salmon and delta smelt; the 1995 Bay-Delta Water Quality Control Plan (D-1641); and all CVPIA AFRP (b)(2) Delta actions. Recent Delta export operations under the 1995 Water Quality Control Plan and AFRP actions have caused a shift in pumping from the spring months to the fall and winter period. The export pumps will be operated significantly below the maximum E/I Ratio (65 percent) from April through September and slightly below these standards from November through March. At any time there is an opportunity to relax the E/I Ratio when fish salvage densities are low, Reclamation and DWR may exercise their flexibility to pump water for the EWA after agreement from NOAA Fisheries, FWS, and DFG. In general, the 35 percent E/I Ratio from February 1st through May 15 is expected to benefit listed salmonids by improving hydrodynamic conditions in Delta waterways and providing a more natural (*i.e.*, westward) flow pattern. The E/I ratio is included in the CALSIM model, and hence its effects on pumping rates and Chinook salmon salvage and loss are accounted for and discussed in the appropriate sections for both the formal and early consultations.

(3) X2 Standard[4]. In the Delta, small changes in X2 locations during February and June are projected by Reclamation's CALSIM model. Juvenile winter-run Chinook salmon 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. In general, it is likely that conditions improve for salmonids as X2 moves westward in the Delta simply because this situation is indicative of greater outflow. However, it is unlikely that the location of X2 within the Sacramento-San Joaquin Delta directly influences the survival of juvenile winter-run Chinook smolts. Therefore, the small changes to X2 location under the proposed action are not likely to adversely affect winter-run Chinook salmon, spring-run Chinook salmon, or steelhead.

(4) Intertie. As with the E/I ratio, the Intertie is included in the CALSIM model, and hence its effects on pumping rates and Chinook salmon salvage and loss are accounted for and discussed in the appropriate formal and early consultation sections below. The Intertie allows Tracy pumping to increase from 4200 cfs to the full design capacity of 4600 cfs with or without the SDIP being implemented (formal consultation CALSIM studies 4a and 5a). Pumping at Tracy would increase in the future condition from November through February when listed salmon and steelhead typically are present in the Delta. This increase in winter-time pumping results in a corresponding increase in entrainment of winter-run Chinook salmon, spring-run Chinook salmon, and steelhead during these months. In early consultation study 5, the use of EWA reduces Tracy pumping back to 4200 cfs from November through February. Therefore, the effect of the Intertie on listed salmonids is dependent on whether a long-term EWA becomes fully functional.

(5) Delta Pumping Rates. To satisfy the increased demand for water, additional volumes of water will have to be diverted from the Delta by the SWP and CVP facilities in the south Delta. This additional volume of water will be predominately obtained by periodically increasing the pumping rates at the facilities. The increases in the pumping rates are anticipated to increase the level of entrainment of listed salmonids at the fish collection facilities in the south Delta. The historical records for Chinook salmon and steelhead entrainment (expanded counts) are found in Tables A3 and A4.

State Water Project. Overall, a comparison of CALSIM study 4a with study 2 and 3, baseline conditions, indicates an increase in future pumping rates even without Banks 8500 and the SDIP. The greatest increases in pumping rates between study 4a and the baseline condition occur during the wet months, December through May, with the peak generally occurring in February or March.

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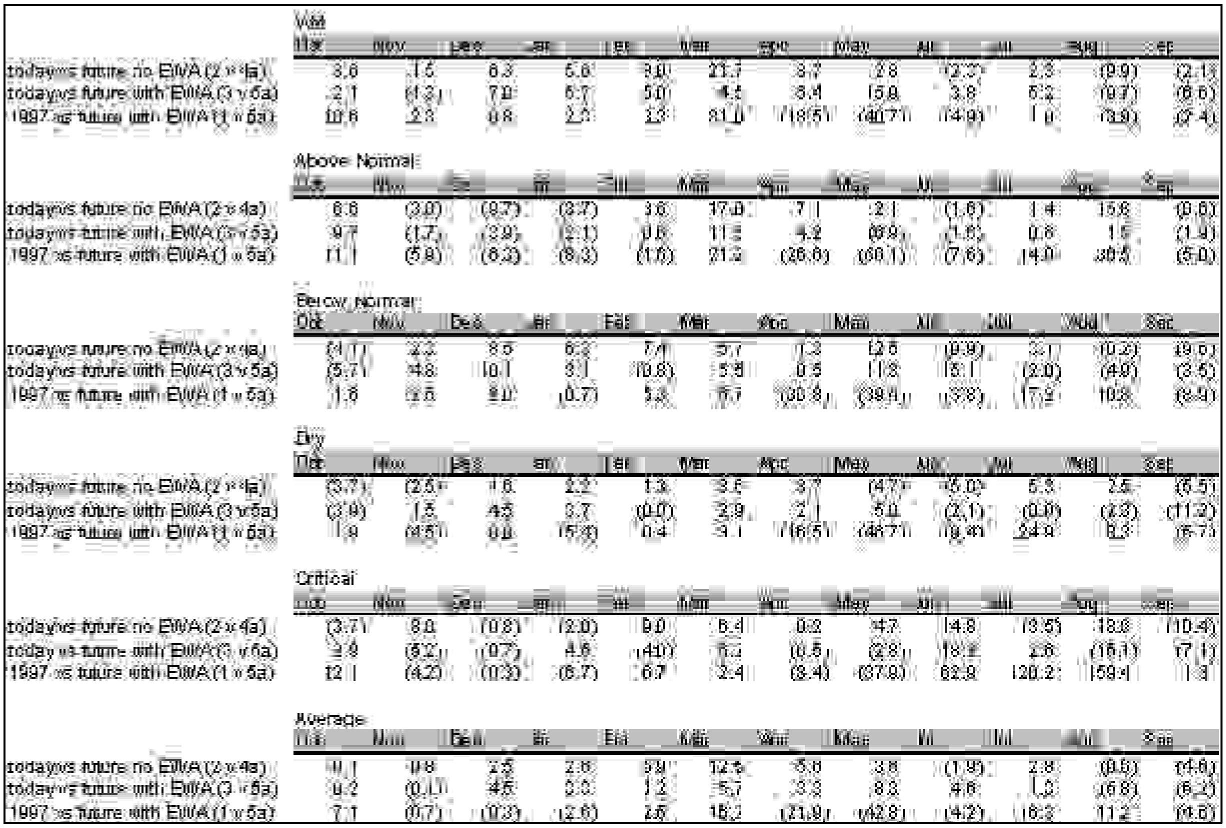
[4] The intent of the X2 Standard in SWRCB D-1641 was to improve habitat protection for fish in the Delta, resulting in adequate transport flows to move delta smelt away from the influence of the CVP/SWP water diversions and into low-salinity rearing habitat in Suisun Bay and the lower Sacramento River. The X2 position represents where the 2 ppt isohaline lies, as calculated from the monthly average Net Delta Outflow.

In general, the future Study 4a conditions show a consistent increase in the entrainment numbers for juvenile Central Valley Chinook salmon at the SWP facilities in all water year types during the months of February, March, and April (Table 6). These increases will adversely affect juveniles of the listed salmonids that occur in the Delta, including winter-run Chinook salmon, spring-run Chinook salmon, and steelhead. Earlier in the migration season (October through January) the changes in entrainment numbers are mixed. In wet and below normal hydrologic years, entrainment numbers generally increase during these early months, with wet years having higher numbers, which may have a greater impact *(i.e.*, higher proportion) on early juvenile winter-run and larger spring-run Chinook salmon yearlings that generally emigrate with the first storms.

Table 6: Percentage Changes in Pumping Rates at the SWP Export Facilities.
Percentage changes in the pumping rates between study 4a and 2, and study 5a and studies 1 and 3 at the SWP export facilities. Numbers in parenthesis indicate that the future condition is less than the current baseline condition.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
today vs future no EWA (2 v 4a)	3.6	1.6	6.3	5.6	3.0	21.7	3.7	2.8	(2.3)	2.3	(9.9)	(2.1)
today vs future with EWA (3 v 5a)	2.1	(1.3)	7.0	5.7	5.0	4.5	3.4	5.0	3.8	5.2	(9.7)	(6.6)
1997 vs future with EWA (1 v 5a)	10.6	2.3	0.8	2.0	3.3	81.0	(18.5)	(40.7)	(4.9)	1.0	(3.9)	(7.4)
Above Normal												
today vs future no EWA (2 v 4a)	6.6	(3.0)	(8.7)	(3.7)	3.6	17.0	7.1	2.1	(1.6)	1.4	15.6	(0.6)
today vs future with EWA (3 v 5a)	9.7	(1.7)	(3.9)	(2.1)	0.6	11.5	4.2	(0.9)	(1.6)	0.6	1.5	(1.9)
1997 vs future with EWA (1 v 5a)	11.1	(5.8)	(6.3)	(8.3)	(1.6)	21.2	(26.6)	(60.1)	(7.6)	14.0	30.5	(5.0)
Below Normal												
today vs future no EWA (2 v 4a)	(4.1)	2.3	8.5	6.2	7.4	5.7	1.3	2.5	(9.9)	3.1	(0.2)	(9.6)
today vs future with EWA (3 v 5a)	(5.7)	4.8	10.1	3.1	(0.8)	5.8	0.5	11.2	5.1	(2.0)	(4.9)	(3.5)
1997 vs future with EWA (1 v 5a)	1.6	2.5	9.0	(0.7)	5.3	6.7	(30.8)	(38.4)	(3.8)	(7.9)	10.3	(8.9)
Dry												
today vs future no EWA (2 v 4a)	(3.7)	(2.5)	1.6	2.2	1.3	3.6	3.7	(4.7)	(5.0)	5.3	2.5	(6.5)
today vs future with EWA (3 v 5a)	(3.9)	1.5	4.5	3.7	(0.0)	2.9	2.1	5.0	(2.1)	(0.0)	(2.3)	(11.2)
1997 vs future with EWA (1 v 5a)	1.9	(4.5)	0.0	(5.4)	0.4	3.1	(16.5)	(46.7)	(9.4)	24.9	8.3	(6.7)
Critical												
today vs future no EWA (2 v 4a)	(3.7)	8.0	(0.8)	(2.0)	9.0	5.4	0.2	4.7	14.8	(3.5)	18.8	(10.4)
today vs future with EWA (3 v 5a)	3.9	(5.2)	(0.7)	4.6	(4.0)	[illegible]	(0.5)	(2.8)	18.2	2.6	(15.1)	(7.1)
1997 vs future with EWA (1 v 5a)	12.1	(4.2)	(0.3)	(6.7)	6.7	2.4	(3.4)	(37.9)	62.9	120.2	159.4	1.3
Average												
today vs future no EWA (2 v 4a)	0.1	0.8	2.5	2.6	5.8	12.5	5.6	3.8	(1.9)	2.8	(0.5)	(4.6)
today vs future with EWA (3 v 5a)	0.2	(0.1)	4.5	0.0	1.2	5.7	3.3	8.3	4.6	1.0	(6.8)	(6.2)
1997 vs future with EWA (1 v 5a)	7.1	(0.7)	(0.3)	(2.6)	2.6	15.2	(21.9)	(42.8)	(4.2)	16.2	11.2	(4.6)

Conversely, reductions in pumping rates can reduce entrainment in these early months as indicated in the above normal and critical hydrological year types. The dry years have a mixed early season result, saving early emigrating fish in October and November (spring-run yearlings) but losing winter-run and smaller spring-run Chinook in December and January. During May, salvage numbers increase for all water year types except dry years, while the month of June shows reductions in entrainment in all water year types except critically dry years. The increase in May salvage is due primarily to the presence of more abundant fall-run Chinook salmon juveniles. Existing export reductions actions for VAMP and EWA are generally taken from April 15 to May 15. These later seasonal reductions in pumping rates will primarily benefit non-listed fall-run Chinook salmon in May and June.

Comparing the 1997 (CALSIM study 1) and today's conditions (CALSIM study 3) to future operations (CALSIM study 5a) shows the anticipated Project effects of ongoing operations without Banks 8500 pumping, or effects due only to increases in LOD and Trinity River flows. The comparisons between study 5a and studies 3 and 1 show a much higher degree of variability than was seen for the study 4a comparisons with study 2, with decreases in pumping up to about 5 percent occurring during some winter months, especially during drier water years. However, the increases in March pumping rates (*e.g.*, as much as 31 percent in wet years) that were observed in the study 4a comparisons with study 2 are evident. The beneficial effects of EWA (*i.e.*, pumping decreases) are seen in April and May for fall-run Chinook salmon. Mid-winter pumping increases (*e.g.*, in February and March) are expected to increase the entrainment or otherwise decrease the survival of emigrating listed salmonids during their transit of the Delta. An appreciable number of winter-run and spring-run smolts, as well as steelhead smolts, will be moving through the Delta at this time.

In general, the entrainment rates for study 5a (future Formal) increased consistently over the study 3 levels in March for all water year types (Table 6). December rates decreased for above normal and critically dry years, but increased for the other water year types. January rates decreased for only above normal water year types. February entrainment rates decreased for below normal, dry and critically dry water year types, while increasing in wet and above normal hydrological water year types. April entrainment rates decreased only in critically dry years, in all other water year types it increased. May rates of entrainment decreased only in above normal and critically dry years. As mentioned for the study 4a results, reductions in pumping rates earlier in the emigration season benefit listed salmonids more than reductions in the later portion of the season (May and June).

Study 5a comparisons with study 1 show substantially different entrainment patterns (Table 6). As with the other study, March entrainment rates increase over the “baseline” comparison (Study 1,2,3) for all water year types. April and May, unlike the Study 3 comparison, show an appreciable decrease in all water year types. In above normal, dry and critically dry years entrainment decreases during the month of November. The month of December decreases only in the above normal and critically dry years. All water year types except for the wet years have an entrainment decrease during January. The month of February reverses this condition, when only the above normal years have a decrease in entrainment rates as compared to the Study 1 conditions. The June situation has decreases in entrainment rates for all hydrological years except for the critically dry condition.

While the numbers of “potentially” entrained juvenile Chinook salmon may show a net decrease in some years, this value is often the result of large numbers of fish “saved” by pumping reductions in May and June. This can be misleading when taken in the context of the proposed pumping changes on listed salmonids. As discussed in the section concerning analysis assumptions, NOAA Fisheries anticipates that Chinook salmon "saved" in May and particularly June most likely will be Central Valley fall-run Chinook salmon and thus do not minimize or eliminate the project's adverse impacts upon listed salmonids. Those fish "saved" in April may belong to one of the listed salmonid populations and therefore pumping reductions during that period can minimize adverse effects upon listed salmonids.

Central Valley Project. Over the 72-year period modeled, the average pumping rates at the Tracy facility peaks in the month of January (4,158 cfs) under the study 4a conditions (Table A5). The month of May has the lowest average pumping rate at 1,736 cfs. The highest period of pumping occurs from September through February, followed by the sharp curtailment of pumping from April through June. Pumping rates increase again over the summer months (July - September). Pumping rates tend to be approximately 3 to 10 percent greater than baseline conditions from about November through January, and 5 to 10 percent less than baseline conditions from about February through April in all water year types except critically dry, when pumping increase for all months between December and April when compared to the Study 2 and 3 baseline values. The increases during the early portion of salmonid emigration primarily will affect YOY and yearling spring-run Chinook salmon and winter-run Chinook salmon juveniles that move downstream in December and January with precipitation events and the resultant spikes in flows on the Sacramento River. This early season increase is somewhat offset by the decreases later in the emigration period. Appreciable numbers of later out-migrating winter-run Chinook salmon smolts and spring-run Chinook salmon YOY will benefit from the reductions in pumping in March and April over the current levels.

The highest average pumping rate under the 5a scenario occurs in September (4,053 cfs), while the lowest average pumping rate occurs in May (1,441 cfs). Pumping rates decline modestly from the September peak through December. Pumping during the period between November and February fluctuates between 3,700 and 3,600 cfs. From February through May, pumping rates decrease from 3,650 cfs to the annual low in May of 1,441 cfs (see Table A5). Pumping rates increase from the May low point to the September peak.

In wet hydrological years, the study 5a conditions indicate that pumping will increase over the baseline conditions in Study 3 in most months. The comparisons with Study 1 indicate a completely different pumping profile between the two studies. Pumping rates decline up to 15 percent from December through February, and then increase by almost 8 percent in March over Study 1. The decreases in future pumping rates during the December to February time frame will reduce the entrainment of the YOY and yearling spring-run Chinook emigrating during this period as well as the early pulses of winter-run fry that will be moving downstream in December, January and February. Central Valley steelhead will also benefit from pumping reductions during this time frame. Increasing pumping rates in March will offset, to some degree, the positive effects of the previous period's pumping decreases.

Although monthly trends tend to be variable, in most other water year types, pumping increases in January and February, and decreases in March compared to baseline conditions. Notably, in critically dry years, significant increases (*i.e.*, by approximately 10 to 15 percent) in pumping extend into March and April. The increase in future pumping rates during February, March and April will directly reduce juvenile listed salmonids. The historical salvage data indicates that most Chinook salmon were collected at the salvage facilities in March, April and May during critically dry years (Table A3 and A4). Steelhead came through slightly earlier, usually between February and April. Therefore, while most of the months that salmonid emigration might occur have pumping reductions, three of the key months for salmonid emigration are the months in which the pumping rates are increased. Although the pumping reductions in Study 5a's comparison with Study 1 for the months of May (-32.6 percent) and June (-17.1 percent) are substantial, they will primarily serve to benefit fall/late fall-run Chinook salmon, and come after the peak of salmonid migration.

(6) Winter-run Chinook Salmon Salvage and Loss. *Salvage Estimates.* Reclamation calculated salvage losses for the combined pumping activities of the SWP and CVP actions for Sacramento River winter-run Chinook salmon (OCAP BA, Ch. 9). The salvage numbers are based on fish that were collected at the two facilities and sorted according to size/length criteria. Additional information could be discerned from fin clips, coded wire tags (CWT) and surrogate releases where appropriate. These numbers are estimates of winter-run salvage numbers, as size/length criteria has some degree of error associated with it, and may tend to over-estimate the total number of winter-run fish collected (refer to the 1995 WRO amendment, in which take was increased from 1 to 2 percent based on inaccuracies in the sampling and size/length criteria applied in the Delta) because some are expected to be later- hatched wild fish which fall below the guideline's size/length criteria. In addition, the current salvage operations at the CVP allows unscreened water to pass through the TFCF at least 25 percent of the time during screen cleaning operations. This also leads to an under-estimation of the salvage and loss numbers.

Reclamation's data spanned eleven years, from 1993 to 2003, in which there were five wet water years, three above normal water years, two dry water years, and one critically dry water year. Although Reclamation divided the years into two (*i.e.*, wet and dry) categories, NOAA Fisheries re-analyzed the data based on water year type (Tables A6 and A7).

Within the five wet water years, each comparison (Study 4a vs Study 2) and (Study 5a vs Study 3) resulted in additional winter-run Chinook salmon being salvaged. The percentage of additional fish salvaged ranged from 4.4 percent to 7.0 percent of the annual average salvage numbers. The (Study 5a vs Study 1) yielded three wet years with increased salvage and two wet years with reduced salvage. The two years with reduced salvage had the preponderance of emigration occurring early in the season (January), when pumping rates were reduced (-2.9 percent). The three years with elevated salvage numbers occurred in years when emigration took place mainly in March, when pumping rates were elevated by 21.6 percent. The percentage of change in the salvage numbers for this particular comparison ranged from -3.6 percent to 10.6 percent of the annual winter-run Chinook salmon salvage numbers. The comparison between Study 5a and Study 1 illustrates the importance of emigration timing on the number of additional fish that will be taken at the pumping facilities. The month of March has a substantially higher pumping rate than the baseline conditions in this comparison, and the majority of the emigration months actually have negative pumping rates as compared to the baseline conditions. Therefore the net change in salvage numbers depends upon the product of the pumping rate change and the number of fish that are present to be entrained at the pumps.

The three above normal, one normal, and two dry water years saw mixed results from the three study comparisons, with no strong trends in evidence except that the (Study 5a vs Study 1) comparison always showed a decrease in salvage because EWA reduces pumping without the corresponding increases in pumping attributed to the SDIP (8500 at Banks). Changes in salvage rates ranged from a 5.6 percent decrease to a 4.3 percent increase, with many changes of approximately one percent occurring. The one critically dry year (1994) had increases in all three comparisons, which ranged from 3.7 to 7.2 percent.

Loss Estimates. Reclamation calculated loss statistics for the eleven year period from 1993 to 2003. The loss statistics expand the salvage numbers according to parameters such as sampling time interval and frequency. The expansions altered the relative importance of individual months to the determination of the net annual total. In general, the trend of net annual totals of fish correlated well between the salvage and loss models; however, in some years (*i.e.*, 2000) there were reversals of the net annual totals for a given study comparison. In 2000, the net annual total of winter-run losses indicated a net savings in fish for the (Study 5a vs Study 1) comparison with a net decrease in fish of 3.5 percent. In comparison, the salvage data showed a net increase of 1.2 percent for the same grouping. This case illustrates how changes in the monthly totals can have significant effects on the annual total due to the differences in the monthly pumping rates. Overall, higher losses than predicted of juvenile winter-run Chinook salmon are expected during peak months of emigration through the Delta due to short-term variations that can not be modeled on a monthly time-step.

(7) Spring-run Chinook Salmon Salvage and Loss. *Salvage Estimates*. The spring-run Chinook salmon data was more variable than the winter-run Chinook salmon data due to the large differences in the number of out-migrants during the months of the peak emigration (March, April and May). Differences could range over an order of magnitude (*i.e.*,1999) and the months in which the peak of emigration occurs have the largest differences in pumping rates. Salvage in these months strongly influenced the annual salvage rates (Table A8and A9).

During the five wet water years, the comparison between (Study 4a vs Study 2) and (Study 5a vs Study 3), indicated that there would be additional spring-run Chinook salmon salvaged at the SWP and CVP facilities. The additional fish entrained ranged from 0.8 percent of the annual spring-run salvage numbers to 6 percent. The last comparison between Study 5a vs Study 1 generally showed substantial reductions (13 to 18 percent in 4 out of 5 years) in salvage due to sharply reduced pumping in April and May, when the peak of the spring-run Chinook salmon emigration occurred. Only one wet year (1997) had a slight increase (0.8 percent) in salvage numbers.

Patterns during the three above normal water years, two dry years, and one critically dry year were fairly similar to those in wet years for the respective model run comparisons. For the comparison between (Study 5a vs Study 1), the highest salvage reductions (up to 39 percent) occurred in May, when the both the peak of salvage and substantial pumping reductions often coincided.

Loss Estimates. The pattern for spring-run Chinook salmon reflects the general trends already observed in the salvage discussion. The two large departures from what was seen in the salvage section occurred in the critically dry year of 1994 and the wet year of 1997. The Study 5a comparison with Study 1 for 1993 depicted the loss numbers decreasing 7.5 percent below the historical numbers due to an offset in the historical May number of fish lost (1,140 versus 569 fish). Likewise, in the 1997 comparison (Study 5a vs Study 1), the elevated historical loss numbers in April and May offset the loss numbers in March so that the net total for the year was negative. This translates to a 3.5 percent decline in the loss numbers for 1997 under this comparison. Overall, assuming the fish lost in May are really Spring-run and not fall-run Chinook salmon, there would be a beneficial reduction in salvage; however, the model results are more likely to overestimate the benefit, based on past analysis (DWR 1999 and 2003) and CWT results (DWR 2004), that show relatively few spring-run Chinook salmon are actually present to be saved.

(8) Steelhead Salvage and Loss. *Salvage Estimates.* Average changes in steelhead loss were calculated from changes in salvage assuming a similar predation rate to Chinook salmon at the CVP/SWP facilities (see *Assumptions*). This assumption may overestimate the actual loss rates since steelhead are generally larger than Chinook salmon at the time of emigration and smaller fish tend to experience greater loss over time in CCF (Gingras 1997). Average loss of juvenile steelhead ranged from 3 percent in March of a critical year to 14 percent in March of a above normal year (Study 3 vs 5) at Banks. Loss at the CVP was significantly lower due to less predation effects (*i.e.,* no forebay), ranging from 1.3 percent in March of a critical year to 3.8 percent in January of an above normal year (Study 3 vs 5). The highest proportional differences in loss occurred December through March at Banks in wet years, due to increased pumping rates.

The loss calculations include adult steelhead that represent approximately 3.5 percent of the historical salvage at both the CVP and SWP combined. Most of the adult salvage occurs in March through May at a time when loss is expected to be the highest.

(9) Indirect Loss of Juvenile Salmonids in the Interior Delta. Survival indices calculated for paired releases on the lower Sacramento River indicated that smolts released into Georgiana Slough were between 1.5 times to 22 times more likely to suffer mortality than fish released further downstream at Ryde on the Sacramento River based on recoveries at Chipps Island in the trawl surveys (Brandes and McLain 2001; FWS 2001, 2003). This is equivalent to between 33 percent and 95 percent mortality in the central Delta compared to the Sacramento River. For comparison, Vogel (2004) found that approximately 23 percent of radio-tagged smolt-sized Chinook salmon were considered to have been lost to predation in Sacramento River releases, versus 37 to 82 percent for Georgiana Slough releases. The longer distance through the Delta for fish entering the Georgiana Slough channel would account for some of the additional mortality due to the extended exposure to adverse factors; however, the distance to Chipps Island is only 37 percent greater through Georgiana Slough than by staying in the mainstem of the Sacramento River. Brandes and McLain (2001) concluded that smolts entering the Sacramento Delta suffered higher mortalities when entrained into the central Delta via the DCC or Georgiana

Slough in both the winter and spring months. Likewise, smolts migrating through the Old River channel in the south Delta suffered higher mortalities than those which remained in the mainstem of the San Joaquin River (Dos Reis release). However, both the Mossdale and Dos Reis releases had higher mortality rates (lower survival indices) than the similar releases conducted on the Sacramento, suggesting that survival through the south Delta and the San Joaquin mainstem is lower than that for the Sacramento system.

Direct entrainment by the south Delta pumping facilities was cited in Brandes and McLain (2001) as a source of mortality, although the results from different studies varied greatly in their level of significance. Kjelson (1981) reported that the records for salmon entrainment and spring export rates from 1959 to1979, showed a correlation between export rates and juvenile Chinook salmon salvage. However, the impact of export activities by the south Delta facilities on the survival of emigrating salmonids through the Delta cannot be estimated just from the expanded salvage numbers obtained by the fish collection facilities. Even though the expanded salvage numbers of CWT smolts released in the Sacramento River or within the Mokelumne River and recovered at the south Delta export facilities were very low (*i.e*., average of 0.36 percent), the indirect loss associated with the export actions will be much greater. In order to support the number of salvaged salmon that are counted at the export facilities, a much larger number of fish must enter the central Delta and survive their passage through these waters to reach the fish screens at the Delta facilities. In estimating the number of winter-run and spring-run Chinook salmon that must enter the Delta from the Sacramento River to support the numbers of salmon in the expanded count, the efficiency of the screens, pre-screen mortality, and the relative survival of fish transiting the central Delta must be factored into the determination. In deriving a simple model for the estimation of the number of salmon that must enter the central Delta, the current rates for screen efficiency and pre-screen loss at the SWP and CVP will be used (Table A12). In estimating indirect loss in the central Delta, the range of survival estimates from the Brandes and McLain (2001) review will be used (*i.e*., 33 percent to 95 percent mortality).

The simple model (Table A10) indicates that a substantially greater number of salmon must enter from the northern Delta in order to survive to be recovered at the fish screening facilities in the south Delta. Using an example of 10,000 salvaged fish (*i.e.*, expanded count from 10 minute sample), the number of fish that must enter the Delta from the north is equal to approximately 24,000 fish for the CVP and approximately 81,000 fish for the SWP under high survival conditions. The key point of this discussion is that increases in indirect losses incurred by the export activities could be substantial, as measured by the number of salmon needed to pass through the central Delta from the Sacramento River in order to satisfy the expanded loss estimates predicted by the CALSIM results. Indirect losses are many times greater then that of the salvage estimates themselves. Using the simple model presented here indicates that at the CVP, each fish in the expanded salvage count represents from 2 to 31 fish entering from the Sacramento River. Similarly, each fish in the expanded salvage count at the SWP represents from 81 to 107 additional fish.

When incidental take levels are approached (*i.e*., 1-2 percent of the juvenile Chinook production entering the Delta), perhaps as much as 40 percent of those juvenile production could be lost while crossing the Delta. This would occur when cross-Delta survival is very low (*e.g.*, 95 percent mortality) and the export salvage reaches the incidental take limit. This would be a worst case condition, but is technically possible. In the best case scenario, 4 percent of the juvenile salmon populations is lost crossing the Delta (*e.g.*, 33 percent mortality).

Although the actual percentages of the winter-run Chinook salmon, spring-run Chinook salmon, and steelhead populations diverted into the Central Delta on an annual basis have not been measured directly, PTM studies suggest that these percentages are large, and therefore in concert with the back calculations of the preceding paragraph. The PTM data suggest that the timely operation of the DCC control gates is important to juvenile salmonid survival. In the first year of the modeling study, 1979, the DCC was open for the first eleven days of January. The Sacramento River had a flow of nearly 20,000 cfs and the CVP and SWP were pumping at, or near, their full capacity. The PTM data indicated that a substantial percentage of particles injected at Vorden and Freeport were quickly entrained down the DCC and showed up at the SWP and CVP pumps over the next 15 days. By the end of the 30-day test period nearly half of the Vorden particles and 40 percent of the Freeport particles were captured in the south Delta at the state and federal pumps. In subsequent months, when the DCC was closed, entrainment rates of Sacramento River derived particles rarely exceeded seven percent. In June however, when the DCC was re-opened, entrainment rates for Sacramento River based particles again surged upwards, reaching approximately 40 percent of the injected particles. The drastic difference in the entrainment rates at the CVP and SWP when the gates are open versus closed also illustrates the potential loss of early season out-migrants in the Sacramento River system. The results from the January data indicate that even a short window, such as the eleven days in January, 1979, in which the DCC was open, can substantially affect the later entrainment rates at the pumps. The effects of the DCC on listed salmonids are discussed in greater detail below in section e. *Delta Cross Channel*.

The PTM data also suggest that the particles, or the hypothetical fish, which move down the San Joaquin River, have a very low probability of transiting the Delta and passing Chipps Island at the western edge of the Delta in all but the highest flow levels. In most years, close to all of the particles released at Mossdale end up entrained by either the CVP or SWP pumps within the 30 day test period. In the below normal water year (1979) and critically dry water year (1988) modeling runs, more than 80% of the particles were captured within15 days of release. Those particles that did escape the CVP and SWP pumps were subject to increased entrainment by agricultural diversions.

(10) Delta Cross Channel. (*Juveniles*) The primary avenue for juvenile salmonids emigrating down the Sacramento River to enter the interior Delta, and hence becoming vulnerable to entrainment by the export facilities, is by diversion into the DCC and Georgiana Slough. Therefore, the operation of the DCC gates may significantly affect the survival of juvenile salmonids emigrating from the Sacramento River basin towards the ocean.

The DCC can divert a significant proportion of the Sacramento River's water into the interior of the Delta. The DCC is a controlled diversion channel with two operable radial gates. When fully open, the DCC can allow up to 6,000 cfs of water to pass down the channel into the North and South Fork of the Mokelumne River channels in the central Delta. During the periods of winter-run Chinook salmon emigration (*i.e.*, September to June) through the lower Sacramento River, approximately 10 to 30 percent of the Sacramento River flow can be diverted into the interior of the Delta through the DCC when both gates are open (OCAP BA Figure 10-5); with the gates closed, approximately 20 to 35 percent of the flow is diverted down the Georgiana Slough channel (OCAP BA Figure 10-6). However, in most years the peak of winter-run Chinook salmon emigration past the DCC occurs from late November to December, based on FWS trawl and seining data (Low 2004); when 10 to 20 percent of the Sacramento River flow can be diverted through the DCC and 35 to 40 percent is diverted down Georgiana Slough. There is little change between the current and future conditions, with less than a 5 percent reduction in flows, occurring during the summer months when listed salmonids are not present.

DFG (Low 2004) found significant linear relationships between the proportion of Sacramento River flow diverted into the interior of the Delta in December and January and the proportion of the juvenile winter-run Chinook salmon lost at the CVP/SWP export facilities. Analysis of two week intervals found highly significant relationships between these proportions in late December (December 15 to 31) and early January (January 1 to15) periods before the DCC gates are closed.

A series of studies conducted by Reclamation and USGS (Horn and Blake 2004) supports the previous report's conclusion of the importance of the DCC as an avenue for entraining juvenile salmonids into the central Delta. These studies used acoustic tracking of released juvenile Chinook salmon to follow their movements in the vicinity of the DCC under different flows and tidal conditions. The study results indicate that the behavior of the Chinook salmon juveniles exposed them to entrainment through both the DCC and Georgiana Slough. Horizontal positioning along the east bank of the river during both the flood and ebb tidal conditions enhanced the probability of entrainment into the two channels. Furthermore, upstream movement of fish with the flood tide demonstrated that fish could pass the channel mouths on an ebb tide and still be entrained on the subsequent flood tide cycle. In addition, diel movement of fish vertically in the water column exposed more fish at night to entrainment into the DCC than during the day, due to their higher position in the water column and the depth of the lip to the DCC channel mouth (-2.4 meters). The study concluded that juvenile Chinook salmon entrainment at a channel branch will not always be proportional to the amount of flow entering said branch, and can vary considerably throughout the tidal cycle. Secondary circulation patterns can skew juveniles into the entrainment zones surrounding a given branch, thus resulting in a disproportionately high entrainment rates.

As presented above, changes in Delta hydrodynamic conditions associated with CVP and SWP export pumping inhibit the function of Delta waterways as migration corridors. Export pumping rates will create unnatural flow conditions in the central and south Delta. Net flows during December and January generally will be eastward (*i.e.*, reverse flows) instead of westward in the lower San Joaquin River. North of the CVP and SWP Delta pumping plants, net flows in Old and Middle rivers will be southward instead of northward. As a result of these changes in hydrodynamic conditions, some salmon and steelhead smolts are expected to be diverted from their primary rearing and migration corridors. Many individuals will arrive at the CVP and SWP fish salvage facilities while others are expected to be subjected to increased predation along the way. Mortality is expected to result from entrainment in over 2,050 unscreened water diversions, predation by introduced species, food supply limitations, elevated water temperature and poor water quality (DFG 1998). However, from February though May, exports will be reduced to comply with SWRCB D-1641 Delta Standards (*i.e.*, 35 percent E/I ratio). This reduction in exports is expected to improve the Delta hydrodynamic conditions and increase survival rates over those experienced in December and January.

With mandatory closure of the DCC gates from February 1 through May 20 (pursuant to SWRCB D-1641), approximately 50 percent of juvenile winter-run Chinook salmon and 70 to 80 percent of the steelhead and spring-run Chinook salmon juveniles migrating downstream in the Sacramento River are expected to remain in the Sacramento River. These fish will be less subject to decreased survival rates through the Delta related to the effects of CVP and SWP Delta export pumping. The remaining 20 to 30 percent are expected to be transported into the Delta in direct proportion with the diversion of Sacramento River flow into Georgiana Slough.

Several years of FWS fisheries data indicate that the survival of salmon smolts in Georgiana Slough and the central Delta is significantly reduced when compared to the survival rate for fish that remain in the Sacramento River (FWS 1991-2001). Data from investigations conducted since 1993 with late fall-run Chinook salmon during December and January are probably the most applicable to emigrating steelhead and spring-run Chinook salmon yearlings. These survival studies were conducted by releasing one group of marked (*i.e.*, CWT and adipose fin-clipped) hatchery-produced salmon juveniles into Georgiana Slough, while a second group was released into the lower Sacramento River. Results have repeatedly shown that survival of juvenile salmon released directly into the Sacramento River while the DCC gates are closed is, on average, eight times greater than survival of those released into the central Delta via Georgiana Slough (DFG 1998).

The results of these studies demonstrate that the likelihood of survival of juvenile salmon, and probably steelhead, is reduced by deleterious factors encountered in the central Delta. Baker *et al.* (1995), showed that the direct effects of high water temperatures are sufficient to explain a large part (*i.e.*, 50 percent) of the smolt mortality actually observed in the Delta. The CVP and SWP export operations are expected to contribute to these deleterious factors through altered flow patterns in central and south Delta channels. In dry years, flow patterns are altered to a greater degree than in the wet years and are expected to result in a higher level of impact to emigrating steelhead and winter-run and spring-run Chinook salmon smolts. If the Delta Cross Channel gates are opened for water quality improvements or other purposes, a significantly greater proportion of Sacramento River flow and juvenile fish will be diverted into the central Delta.

Delta Cross Channel (*Adults*). From November through May, adult winter-run and spring-run Chinook salmon and steelhead migrate through the Delta for access to upstream spawning areas in the Sacramento and San Joaquin basins. Changes in Delta hydrodynamics from CVP and SWP export pumping in the south Delta may affect the ability of adult salmon and steelhead to successfully home in on their natal streams. Recent radio tagging studies on adult fall-run Chinook salmon indicate that these fish frequently mill about in the Delta, often initially choosing the wrong channel for migration (DFG, in IEP Workshop 2002). CVP and SWP export pumping alters Delta hydrodynamics by reducing total Delta outflows by as much as 14,000 cfs and reversing net flows in several central and south Delta channels. Adults destined for the Sacramento Basin may experience some minor delays during passage through the Delta by straying temporarily off-course in north and central Delta waterways. Closure of the DCC gates from November through May 20 may block or delay adults that enter the back side of the DCC. However, it is anticipated that closure of the DCC gates during this period will reduce diversion of Sacramento River water into the Central Delta, thereby improving attraction flows for adults in the mainstem Sacramento River. Intermittent openings to meet water quality standards or tidal operations are not expected to cause significant delays to adults because of their temporary nature and the ability of adults to drop back and swim around the DCC gates.

(11) False attraction and Delayed Migration. Within the south Delta, several studies have indicated that adult fall-run Chinook salmon may be negatively impacted by the operations of the export facilities during their upstream spawning migration (Hallock *et al.* 1970, Mesick 2001). The reduced fall flows within the San Joaquin system, coupled with the elevated pumping actions by the SWP and CVP during the fall to “make up” for reductions in pumping the previous spring, curtails the amount of San Joaquin River basin water that eventually reaches the San Francisco Bay estuary. It is necessary for the scent of the San Joaquin basin watershed to enter the Bay in order for adult salmonids to find their way back to their natal river. Reductions, or even the elimination, of this scent trail has been postulated by Mesick (2001) to increase the propensity for fall-run Chinook salmon to stray from their natal San Joaquin River basin and into the adjacent Mokelumne River or Sacramento River basins. This problem may exist for Central Valley steelhead that utilize the San Joaquin River basin or the Calaveras River for their olfactory cues during their upstream spawning migrations back to their natal stream. The increased time spent by adults searching for the correct olfactory cues in the Delta could lead to a decrease in the fish's overall health, as well as a reduction in the viability of its gametes. Increased exposure to elevated water temperatures, chemical compounds and bacterial or viral infections present in the Delta increases the likelihood that adult Chinook salmon and their eggs may experience negative effects on the behavior, health, or reproductive success of the fish (Meehan and Bjornn 1991, Rand *et. al.* 1995).

In addition, the existence of the chronic DO sag in the San Joaquin River between the Port of Stockton and Turner Cut can delay the upstream migration of adult salmonids. The ambient DO levels in this portion of the San Joaquin can drop below 4 mg/L during the fall and early winter periods. Hallock *et al.* (1970) found that most adult fall-run Chinook would not migrate through water with less than 5 mg/L DO. Laboratory data for juvenile Chinook salmon (Whitmore *et al.* 1960) supports this finding as the juvenile Chinook salmon avoided water with less than 4.5 mg/L under controlled laboratory conditions. Flow levels in the mainstem San Joaquin below the head of Old River are inherently dependent on the status of the HORB, reservoir releases, and the operation of the CVP pumps. When flow rates are high, the DO sag does not set up. Conversely, when flows drop below approximately 1,500 cfs, the conditions in the deep water ship channel become conducive to creating the low DO situation.

(12) Contra Costa Canal Rock Slough Intake. The Rock Slough Intake is an unscreened diversion owned by Reclamation and one of three operated in the Delta by CCWD. Historically, diversion rates ranged from 50 to 250 cfs; current diversion rates average 171 cfs per month. In the future condition with or without EWA, average diversions increase to 218 cfs per month, or 27 percent. Total diversions for CCWD are predicted to increase from the 2001 LOD to the 2020 LOD by 34 TAF as a long-term average in the future studies (OCAP BA Table 12-15). From December through May when listed salmonids are present in the Delta, average monthly diversions from the Delta increase by 47 cfs and 40 cfs during drought years. This is likely to adversely affect listed winter-run Chinook salmon, spring-run Chinook salmon, and steelhead by increasing mortality and injury due to entrainment at the Rock Slough Intake and also by causing increased predation rates. However, pursuant to the FWS 1993 biological opinion for the Los Vaqueros Project, the screened Old River Facility is now the primary diversion point for CCWD during January through August. All three intakes are operated as an integrated system to minimize impacts to listed fish species. Both the NOAA Fisheries (1993a) and FWS opinions for the Los Vaqueros Project require CCWD to cease all diversions from the Delta for 30 days during the spring, if stored water is available for use in Los Vaqueros above emergency storage levels. Therefore, the analysis discussed below is based on assumed diversions at the unscreened Rock Slough Intake only, and therefore represents worse case effects.

In the 1993 WRO, NOAA Fisheries required monitoring for winter-run Chinook salmon. Based on DFG sampling during the period from1994 through 1996, mortality from entrainment in the Rock Slough Intake occurs from January to June. Annual numbers captured in a sieve-net downstream of the pump plant for the years 1994-1996 were 2 to 6 winter-run Chinook salmon, 25 to 54 spring-run Chinook salmon, and 10 to14 steelhead (Morinaka 2003). Additional losses (8 to 30 percent) due to predation in the canal and fish being killed passing through the intake also were determined to occur. Extrapolated numbers of juvenile Chinook salmon (all races) entrained at Rock Slough between 1994 and 1996 ranged from 262 to 646 per year (OCAP BA June 2004). However, since that time most of CCWD water diversions have shifted to newer, screened facilities at Old River and to a lesser extent Mallard Slough. In addition, current pumping rates at Rock Slough have been reduced in the winter months compared to the historical (1994 to 1996 conditions).

Survival estimates based on marked fall run Chinook salmon recaptured below the pumping plant ranged from 0 to 51 percent and averaged about 18 percent. Assuming a 20 percent survival rate, the estimated numbers of juvenile Chinook salmon entrained between 1994 and 1996 would be 1,695; 3,210; and 1,310 respectively (OCAP BA Chapter 10). If the rate of entrainment remains the same, the salmonid mortality would be comprised of approximately 8 percent winter-run Chinook salmon, 69 percent spring-run Chinook salmon, and 23 percent steelhead. Extrapolating these numbers using the highest year for loss (*i.e.*,1995) would mean that up to 257 winter-run Chinook salmon, 2,215 spring-run Chinook salmon and 738 steelhead would be likely entrained by this element of the Project under the future condition.

Recently an expanded monitoring program was implemented to compare present day entrainment with that from 1994-1996. A total of 13 Chinook salmon (all runs combined) were collected between March 17 and May 3, 2004, at the Rock Slough Headworks and Pumping Plant #1 (Tenera 2004). Out of the 13 collected, 6 were fall-run sized fish and 7 were within the spring-run Chinook salmon size criteria, indicating that listed salmonids are still being entrained at the facility despite reduced pumping rates. In addition, the recent monitoring showed higher numbers of introduced predators (*e.g.*, largemouth bass) than the 1994 to 1996 DFG studies.

The significance of the Rock Slough mortality can best be judged by comparison to the combined incidental take for the CVP and SWP Delta pumping plants in 2004. Using the extrapolated numbers above, the winter-run Chinook salmon entrainment at Rock Slough would be 3.3 percent of the actual Project loss (*i.e.*, 7,779 juveniles), or 0.01 percent of the JPE entering the Delta. The spring-run Chinook salmon loss would be 5.3 percent of the historical average loss at the CVP and SWP (1993-2003) and the steelhead loss would be 21 percent of the incidental take limit in 2004. However, if the extrapolated loss above for Rock Slough Intake was combined with the CVP/SWP loss (as required in the past interim OCAP BOs) the loss for the Project under today's conditions would still be under the incidental take limits for listed salmonids (*i.e.*, using 2004 estimated loss and take limits).

The Project is expected to result in increased entrainment of listed salmonids into the Contra Costa Canal as the LOD increases by 2020, but this loss will represent a small fraction of the take at the SWP and CVP pumping plants. It is unknown how changes in Delta hydrodynamics as a result of increased pumping rates at the SWP will effect the Rock Slough Intake. Since exports are positively correlated with fish salvage rates (Reclamation 2004), higher pumping rates (*i.e.*, Banks at 8500) in the future condition will increase the number of listed salmonids present in the South Delta. It is logical to assume that since greater numbers of listed salmonids will be present any unscreened diversion will be more likely to entrain listed salmonids. Due to Rock Slough’s close proximity to the San Joaquin River this diversion would have a tendency to entrain proportionally more steelhead and fall-run Chinook salmon from that system than the Sacramento River.

(13) North Bay Aqueduct at Barker Slough Intake. DWR operates the North Bay Aqueduct intake in the range from 30 to 140 cfs. Project deliveries range from 27 TAF in dry years to 42 TAF in above normal years. If DWR were to deliver the full contracted amount, deliveries could be as high as 70 TAF. Diversions are predicted to increase into North Bay Aqueduct from the fully screened Barker Slough Intake due to increased 2020 LOD. Average monthly diversions increase from 54 cfs in the today studies to 74 cfs in the future studies. The increase in diversion rate is not expected to affect any listed salmonids due to properly functioning screens that meet NOAA Fisheries screen criteria.

g. *Summary of Effects*

In summary, the proposed OCAP project will create several adverse conditions for listed salmonids in the Sacramento-San Joaquin Delta that will result in take. This take will be in the form of mortality from both direct and indirect causes. Non-lethal take also will occur as fish are delayed in their migrations at the Fish Collection Facilities, DCC gates, or are exposed to environmental conditions (*e.g.*, low DO in the Stockton ship channel) that decrease their physiological status.

The increase in pumping rates under the two study conditions (4a and 5a) will increase the number of fish drawn to the pumps in the south Delta over the current baseline conditions. In order to support the additional numbers of fish projected to be lost at the export facilities under the increased export demands, an appreciable number of fish must cross the Central Delta and be exposed to lower survival rates. Under the assumptions of the modeling, increases in salvage and loss are offset by the benefits of such actions as EWA reductions when take is high. However, once the listed fish have already been loss, further reductions will not benefit the species since they are no longer available. For example, in a wet year, the SWP can increase pumping by almost 22 percent under the 4a study conditions in March, a peak month for both winter-run and spring-run Chinook salmon emigration as well as the peak in steelhead salvage at the export facilities. Any increase in water volume moving towards the pumps will carry additional fish with it, hence the proportional increase in salvage numbers when pumping rates increase. Fish that are drawn to the export facilities will incur lethal take not only from predation prior to being screened (75 percent at the SWP), but also from screen inefficiencies (cleaning, holes, gaps etc.) which underestimate the loss and allow fish to pass on to the pumps themselves.

Beyond the increased entrainment of listed fish at the export facilities, the indirect mortality and morbidity that will result from listed fish drawn into the waters of the Delta interior may be substantial. As demonstrated in the simple model for survival in the central Delta, each fish physically recovered at the export facilities represents several dozen additional fish that are lost in the interior of the Delta. The evidence from the PTM, survival and abundance studies, radio telemetry studies, and the acoustic tracking studies all support the conjecture that an appreciable number of salmon juveniles are lost to the DCC and/or Georgiana Slough and once in the Delta interior will be drawn southwards towards the export facilities. Since there will be little change in the proportion of Sacramento flow diverted at the DCC, the number of fish that are entrained through the DCC and emigrate across the Central Delta should be about the same as under current operations. Therefore, there should not be a large increase in mortality associated with indirect effects. The predation data from the radiotelemetry studies (Vogel 2004) supports the survival indices calculated from the abundance and survival studies. The FWS studies had mortality ranging from 33 percent to 95 percent while Vogel’s studies found a predation rate of 82 percent in Georgiana Slough. Vogel also found that predation in the Sacramento River was approximately 23 percent of the released fish. Those fish that are not lost to predation are susceptible to loss due to irrigation diversions (see PTM section above) in the south and central Delta. In addition, some fish will be lost to adverse water quality, pollution, pathogens, and delayed migration which will lead to a declining physiological status and eventually death.

These studies all suggest that the increased mortality associated with the indirect effects of moving water and fish across the interior of the Delta can range from 4 to 40 percent of the juvenile population entering the Delta, using winter-run Chinook salmon juveniles as an example.

For other listed species such as steelhead, mortality is expected to be greater for those fish emigrating through the Delta from the San Joaquin River since a greater portion of that river's flow is exported at the Delta pumping facilities.

2. Early Consultation

The Delta effects of the various elements discussed above under the formal consultation generally apply to the early consultation except as indicated below. The most obvious change compared to the formal consultation is the increase in water diversion due to higher pumping capacity (8,500 cfs at Banks) under the South Delta Improvement Program. Increases in the pumping rates are expected to further increase the level of entrainment of listed juvenile salmonids at the fish collection facilities in the south Delta, as well as draw additional juvenile outmigrants into the central and south Delta where mortality is likely to be higher than in the main rivers. As indicated under the formal consultation, early consultation effects on the E/I ratio and Intertie have been accounted for in the CALSIM model runs, and hence are integrated into the discussions for pumping rates and fish salvage and loss below.

a. *Fry, Juveniles, and Adults*

(1) Delta Pumping Rates. *State Water Project.* Study 4 models the future OCAP conditions with the addition of the 8,500 cfs pumping rate at the State's Harvey O. Banks pumping facility in the south Delta, as proposed for the SDIP. Over the 72 year period, the average pumping rate under the study 4 conditions peaks in January (6,694 cfs). The month of May has the lowest average pumping rate (3,154 cfs). Pumping rates are highest during the wet season (November through March), decline in spring, and then increase during the dry summer season (Table A11).

The average pumping rates in study 4 are higher in all months of potential salmonid migrations (September through June) than the baseline conditions. Most of the study 4 pumping rates are at least five percent or greater than the baseline values. March has the highest increase over the baseline conditions, with an increase of 14.2 percent. As with the study 4a comparisons, the month of March had the highest level of increases for study 4 in all hydrological year classes. This will negatively affect all three listed salmonids, as March is the month with the most significant outmigration of the listed salmonid populations (Table A12).

In wet years, the rate of pumping increases compared to baseline conditions are above five percent in all of the months between September and July. During the critical juvenile salmonid outmigration period from December through April, most months show double digit pumping increases (*e.g.*, 16 percent in December, 19.5 percent in March, and 15.1 percent in April). The elevated pumping through the entire emigration period is expected to adversely affect winter-run Chinook salmon, spring-run Chinook salmon, and steelhead by increasing entrainment at the export facilities and indirect loss in the central Delta (Table A12).

In above normal years, pumping rates increase appreciably in October and November over the baseline levels, which would primarily affect the older and larger spring-run yearlings that are emigrating at this time. Pumping rates also increase by more than 20 percent in March over the baseline levels, and by 10.5 percent in April. This will lead to a corresponding increase in entrainment of all three listed salmonid populations, which are actively moving through the Delta at this time (Table A12). Similarly, in below normal years, pumping rates increase in all months between November and May, and in dry years, pumping is higher than the baseline condition in all months between October and May. In critically dry years, pumping rates increase over the baseline by 10.5 percent in October and 6 percent in December. Pumping rates are elevated over the baseline conditions in the remainder of the out-migrant period, hitting peaks in the February-March period and in May. Pumping increases average around 11 percent over the baseline levels during these periods.

Study 5 models the future OCAP conditions with the addition of the 8,500 cfs pumping rate at the State's Harvey O. Banks pumping facility in the south Delta, as proposed for the SDIP in addition to the utilization of EWA assets. Over the 72 year period, the average pumping rate under the study 5 conditions peaks in January (6,351 cfs). The month of May has the lowest average pumping rate (1,527 cfs). Pumping rates are highest during the wet season (October through March), decline in spring, and then increase during the dry summer season (Table A11).

The average pumping rates for study 5 increase over the baseline values of study 3 in all months between October and April, with the greatest increases occurring in December (12.9 percent) and March (9.1 percent). Except for February, which only increases 2.5 percent over the baseline, all of the other months are increasing by 5 percent or more. The average pumping rates for the study 5 versus study 1 comparison indicates that pumping will increase in all of the months except the three month period of April through June. The month of March shows an increase of almost 20 percent in the SWP pumping rates over all water year categories (Table A12).

Examining the results by water year shows that pumping increases are anticipated to occur in almost all months from October through March in all water year types except critically dry. These increases can be substantial especially in wet years and especially in March (e.g., wet year increases of 20.8 percent in December and 36.4 percent in March; above normal year increase of 26.3 percent in March), and effects on listed salmonids are expected to be similar to those described above for study 4 comparisons. Specifically, increased pumping in the fall and early winter months is expected to increase diversion into the interior Delta and entrainment at the CVP and SWP pumping facilities primarily of winter-run Chinook salmon fry and YOY and yearling spring-run Chinook salmon which emigrate during these months. Outmigrant juveniles from all three listed Central Valley salmonid ESUs will be impacted in the same way by pumping increases in the winter and early spring, especially in March. The often large decreases in pumping rates in April and May (*i.e.,* by as much as 50 percent compared to baseline conditions) will primarily benefit fall-run Chinook salmon smolts, but may also help the later spring-run emigrants that may move through the Delta in April (Table A12).

In critically dry years, the study 5 pumping rates decrease in November and December (and in January in the study 5 versus study 1 comparison), increase in February and March, and then decrease again in April and May. A proportion of the early emigrating YOY and yearling spring-run Chinook salmon will be "saved" by the pumping decreases in November and December, but the increases during the winter period from January through March will increase entrainment of winter-run and spring-run Chinook salmon fry as well as Central Valley steelhead smolts. Pumping decreases from April through July will benefit the later emigrating spring-run and fall-run smolts (Table A12).

In summary, the operating conditions as represented by the study 4 and study 5 models will result in increased pumping rates at the SWP facilities in most of the months when Central Valley juvenile salmonids are emigrating through the Delta to the ocean. As seen previously in the formal consultation analysis, the month of March always sees pumping increases, and frequently has the greatest increase in pumping rates over the entire year. This is a critical month for listed salmonid outmigrations. The pumping reductions in spring during the later portions of the emigration period primarily benefit non-listed fall-run Chinook salmon, but also will protect some of the later emigrating spring-run Chinook salmon. All five of the hydrological water year types will see periods of substantial pumping increases during the salmonid migratory periods for emigrants. NOAA Fisheries anticipates that the mortality of outmigrants will increase due to increased entrainment at the pumping facilities, and large numbers of individuals being drawn into the south Delta where mortality rates are higher than in the main rivers for a variety of reasons (*e.g.*, increased predation and diversion into largely unscreened agricultural irrigation systems).

Central Valley Project. The pumping profile of study 4 is very similar to that of the study 4a, and the CVP contributions to the future pumping capacity of the Delta exports is virtually the same as that modeled for study 5a. The average pumping rate changes for the five different water year types are slightly less in the study 4 and 5 conditions compared to study 4a and 5a, respectively, presumably due to the increased pumping actions at the state facility. In general, the future pumping actions at the CVP will have the same level of effects under the study 4 and 5 parameters as has already been discussed for the study 4a and 5a conditions, respectively, in the formal consultation (Table A13 and A14).

(2) Winter-run Chinook Salmon Salvage and Loss. *Salvage Estimates.* As in the formal consultation, NOAA Fisheries re-analyzed Reclamation’s salvage data based on water year type (Tables A15 and A16). Within the five wet years that occurred during the eleven year period, the study 4 comparison with study 2 and study 5 comparison with study 3 indicated that an average of approximately 7 percent more winter-run sized fish would be salvaged. Like the study 4 results, all months under the study 5 conditions showed increases in salvage over the study 3 baseline values. The salvage numbers for the study 5 comparison with study 1 had an annual average increase of 4.8 percent over the study 1 baseline salvage values. The salvage changes ranged from a 2.9 percent decrease to a 12.8 percent increase in comparison to the study 1 values.

In the three above normal years, salvage for the study 4 comparison with study 2 increased an average of 2.4 percent. The two study 5 comparisons showed mixed results. In the comparison with study 3, salvage rates increased an average of 4.3 percent, whereas the study 5 comparison with study 1 indicated that salvage numbers would decrease an average of 2.4 percent from the baseline salvage values.

The two dry years and one critically dry year had increases in salvage numbers for all three study comparisons. Annual average increases ranged up to approximately 7 percent above the baseline salvage numbers.

Reclamation calculated loss statistics for the eleven year period from 1993 to 2003. The salvage statistics expand the direct fish count numbers according to parameters such as sampling time interval and frequency. Loss statistics are extrapolated from the salvage numbers by factors such as pre-screen losses (predation) and trucking mortality. The expansions altered the relative importance of individual months to the determination of the net annual total. In general, the trend of net annual totals of fish correlated well between the salvage and loss models.

(3) Spring-run Chinook Salmon Salvage and Loss. *Salvage Estimates.* For all water year types, the study 4 comparison with study 2 and study 5 comparison with study 3 showed average annual salvage increases ranging from approximately 3 to 7 percent, except for the dry year average for the study 5 comparison with study 3 in which the salvage numbers remained virtually unchanged (Tables A17 and A18). In contrast, the study 5 versus study 1 comparison indicated decreases (*i.e.*, as much as 27.5 percent in compared to the baseline salvage numbers for all water years) due to the substantial pumping decreases in April and May.

Loss Estimates. The pattern for spring-run Chinook salmon reflects the general trends already observed in the salvage discussion. The two large departures from what was seen in the salvage section occurred in the wet years of 1995 and 1997. The study 5 comparison with study 1 for 1995, and the study 5 comparison with study 1 in 1997, showed decreases in spring-run Chinook salmon loss (*i.e.*, by 15.2 and 4 percent, respectively). These results are likely related to high losses in April and May in the historical record combined with the substantial decrease in pumping that occurs during the same period under the study 5 conditions due to VAMP pumping reductions. Since most of the modeled benefits (reduced entrainment) to spring-run Chinook salmon occur in April and May, when the overlap in size-length criteria with the co-migrating fall-run Chinook salmon juveniles makes it nearly impossible to distinguish between the races, the clear distinction of the benefit to spring-run Chinook salmon is difficult to discern.

(4) Indirect Loss of Juvenile Salmonids in the Interior Delta. The modeling conditions of the PTM model remain the same for the early consultation for injection points, water years, barrier operation schedules (as appropriate) and observation points as described previously in the formal consultation. The conditions that change include the inclusion of the SDIP 8,500 cfs operating criteria, and the operation of the system with the current temporary barriers or with the projected permanent barriers.

Future pumping conditions with the export rate of 8,500 cfs at the SWP indicated two general results. First, the SWP entrained a greater percentage of particles than seen in the baseline condition (2004 conditions), and second, fewer particles were captured at Chipps Island with the balance typically split between the export pumps and the “in Delta” categories. However, the general results of the particle tracking remain the same for both formal and early consultation. Particles released in the San Joaquin River at Mossdale had a higher probability (*i.e.*, greater than 90 percent) of being entrained at the CVP or SWP export facilities under the 8,500 cfs pumping conditions than under the baseline conditions, typically 10 percent greater at each time point. Likewise, particles released at Mossdale, had a higher probability of being entrained in agricultural diversions in the south Delta as a result of changes in circulation patterns under the 8500 parameters.

As with the formal consultation, NOAA Fisheries anticipates increased mortality of listed salmonids during their emigration period resulting from the operation of the water export facilities in the south Delta. January and June are higher-risk months for Sacramento River fish, as the DCC is open for a portion of each month. This provides a more direct path to the south Delta and the export facilities and in the PTM, resulted in the loss of 25 to 50 percent of the Sacramento River particles to the export facilities. During the intervening months, rates of entrainment of Sacramento River particles averaged between 5 and 10 percent at the export facilities and another 10 to 15 percent "lost" to the various in Delta categories. Predictably, lower water flows exacerbated the loss of particles, as the flushing flows to the western Delta regions were reduced.

b. *Adult Migration, Spawning, and Incubation*

c. *Summary of Effects*

NOAA Fisheries believes that the conditions that were responsible for indirect losses in the formal consultation will be applicable to the early consultation and thus the analysis for that portion will apply to the early consultation. The evidence presented by the CALSIM II modeling runs for the future conditions with the SDIP implementation of the 8500 cfs pumping rate indicates that a significant increase in pumping rates over current conditions will occur at both the SWP and CVP export facilities.

The increase in pumping rates under the two study conditions (4 and 5) will increase the number of fish drawn to the pumps in the south Delta over the current baseline conditions. In order to support the additional numbers of fish projected to be salvaged at the export facilities under the increased export demands, a substantial number of fish must enter from the north Delta. Under the assumptions of the modeling, certain months during the migration period for salmonids have significant increases in pumping over the baseline conditions. For example, in a wet year, the SWP can increase pumping by over 36 percent under the 4 study conditions in March, a peak month for both winter-run and spring-run Chinook salmon emigration as well as the peak in steelhead salvage at the export facilities. Any increase in water volume moving towards the pumps is expected to carry additional fish with it, hence the proportional increase in salvage numbers when pumping rates increase. Many listed fish that are drawn to the export facilities will die not only from predation prior to being screened (*i.e.*, 75 percent at the SWP), but also from screen inefficiencies (*e.g.*, cleaning, holes, gaps etc.) which will allow fish to pass through to the pumps themselves (*i.e.*, CVP cleaning operations). In addition, stress, injury, and death of salvaged fish is expected to occur from the handling, trucking, and predation after release back into the Delta.

Beyond the increased entrainment of listed fish at the export facilities, the indirect mortality and morbidity that will result from listed fish being drawn into the waters of the Delta interior is anticipated to be substantial. As demonstrated in the simple model for survival in the central Delta, each fish physically recovered at the export facilities represent several dozen additional fish that are lost in the interior of the Delta. The evidence from the PTM, survival and abundance studies, radio telemetry, and the acoustic tracking studies all indicate that an appreciable number of salmon juveniles will be lost to the DCC and/or Georgiana Slough and once in the central Delta will be drawn southwards towards the export facilities. The predation data from the radiotelemetry studies (Vogel 2004) supports the survival indices calculated from the abundance and survival studies. The FWS studies indicated mortality ranged from 33 to 95 percent while Vogel's studies found predation was 82 percent in Georgiana Slough. Vogel also found that predation in the Sacramento River was approximately 23 percent of the released fish. Those fish that are not lost to predation are susceptible to loss due to irrigation diversions (see PTM section above) in the south and central Delta. In addition, some fish may be lost to adverse water quality, pollution, pathogens, and delayed migration which will lead to a declining physiological status and eventually death.

These studies all suggest that the increased mortality associated with the indirect effects of moving water and fish across the interior of the Delta can range from 4 to 40 percent of the juvenile population entering the Delta, using winter-run Chinook salmon juveniles as an example. For other listed species such as steelhead, mortality is expected to be greater for those fish emigrating through the Delta from the San Joaquin River, since a greater portion of that river's flow is exported at the Delta pumping facilities. Operation of the proposed Project under the early consultation is expected to increase mortality up to the upper range of thresholds established in previous biological opinions as being significant (*i.e.*, past incidental take levels), or in the case for steelhead surpass the threshold and have an effect on the population as well.

The current practice of waiting for salmon numbers at the fish salvage facilities to increase before triggering protective actions is not anticipated to reduce or eliminate the increased loss due to mortality and morbidity incurred crossing the interior Delta from increased pumping activities. By the time sufficient numbers of listed salmonids are recovered at the export facilities, a substantial proportion of the population may already have been lost in the Delta. In addition, the practice of reducing pumping in mid-April through mid-May is expected to preferentially protect non-listed fall-run Chinook salmon, which have their peak out-migration during this time period, rather than listed salmonids.

L. Suisun Marsh

DWR operates several facilities within Suisun Marsh that may affect listed anadromous salmonids. The Suisun Marsh Salinity Control Gates (SMSCG) are operated seasonally to improve water quality in the marsh. At Roaring River, Morrow Island, and Lower Joice Island Unit, DWR operates water distribution systems that serve both public and privately managed wetlands in the marsh. Other DWR-constructed facilities in the marsh include the Goodyear Slough Outfall and a drain gate at Cygnus Unit.

1. Suisun Marsh Salinity Control Gates

a. *Adult Migration, Spawning, and Incubation*

Montezuma Slough in Suisun Marsh is primarily a migratory corridor for adult salmon and steelhead as they pass upstream from the ocean to their natal streams for spawning. Steelhead, spring-run Chinook salmon, and winter-run Chinook salmon migrate from San Francisco Bay through Montezuma Slough to the Delta from October through May. The SMSCG span Montezuma Slough in the southeastern corner of Suisun Marsh. CCC steelhead are less likely to encounter the SMSCG during their upstream migration, because their spawning streams are located to the west of the SMSCG. Suisun Creek, Green Valley Creek and an unnamed tributary near Red Top Road are considered CCC steelhead streams, which drain into the northwestern portion of Suisun Marsh.

The SMSCG generally operate from September through May of each year, as needed to meet SWRCB water quality requirements during the control season from October to May. This period of operation coincides with the upstream migration of listed anadromous salmonids. To evaluate the potential effects of the SMSCG on adult salmonid passage, telemetry studies were initiated in 1993 on adult Chinook salmon. In six different years (1993, 1994, 1998, 2001, 2002, and 2003), migrating adult fall-run Chinook salmon were tagged and tracked by telemetry in the vicinity of the SMSCG. These studies showed that the operation of the SMSCG delays passage of some adult Chinook salmon. Other adult Chinook salmon choose never to pass through the SMSCG and instead swim downstream for approximately 30 miles to Suisun Bay and then access their natal Central Valley streams via Honker Bay. Based on the results of studies conducted during the early 1990's, DFG recommended modifications to the structure to improve passage (Tillman *et al.* 1996; Edwards *et al.* 1996).

The telemetry studies conducted in 1998, 1999, 2001, 2002, and 2003, were designed to evaluate adult salmonid passage rates under various SMSCG configurations and operational conditions. In 1998, modifications were made to the flashboards to include two horizontal openings. Monitoring results from 1998 and 1999 studies indicated that the modified flashboards did not improve salmon passage at the SMSCG (Vincik *et al.* 2003). Studies conducted in 2001, 2002, and 2003 evaluated the use of the existing boat lock as a fish passageway. Results in 2001 and 2003 indicate that fish passage rates improved when the boat lock was opened. Passage rates improved by 9 and 16 percent in 2001 and 2003, respectively, when compared to full SMSCG operation with the boat lock closed. In addition, the opening of the boat lock reduced mean passage time by 19 hours and 3 hours in 2001 and 2003, respectively. The 2002 results did not confirm these findings, and equipment problems at the structure during the 2001 season likely confounded comparison of fish passage rate results (R.F. Vincik, DFG, pers. comm. 2004).

DWR proposes to operate the SMSCG as needed from September through May to meet SWRCB and Suisun Marsh Preservation Agreement standards. Full bore operation of the SMSCG includes the flashboards installed, the gates are tidally operated, and the boat lock is opened only when necessary for boat traffic. Under this operational plan, it is anticipated that between 50 and 60 percent of the adult salmonids arriving at the SMSCG during its operation will successfully pass the structure. However, some fish that do successfully pass the structure will be delayed from 10 to 40 additional hours when compared to some fish that encounter the site without the structure operating (*i.e.*, flashboards out, gates fixed open, and the boat lock closed). While some of the remaining 40 to 50 percent of the adult salmonids won’t pass the structure when it is operating (it is unknown what percentage pass the structure undetected). While some fish are expected to be delayed by several days as they return downstream by backtracking through Montezuma Slough to Suisun Bay and find an alternative upstream route to their natal Central Valley streams through Honker Bay.

In above normal and wet water years, salinity within Suisun Marsh is generally low and the SMSCG will be operated less frequently or not at all. SWP operators can exercise discretion with the operation of the SMSCG as they deem appropriate for the conditions, forecasts, or to accommodate special activities. Thus, in some years, listed adult salmonids are unlikely to encounter delays at the SMSCG, because the structure is not in operation. In recent years the gates have not operated beyond December, and since the 1995 WQCP have only operated three years for the complete season. However, when the gates are operated, adult salmonids migrating upstream through Montezuma Slough will be delayed or blocked by the SMSCG. Delays in the upstream migration of adults will range from a few hours to several days.

The effect of these delays on adult listed salmonids is not well understood. Winter-run Chinook salmon typically are several weeks or months away from spawning and, thus, they may be less affected by a migration delay in the estuary. Steelhead migrate upstream as their gonads are sexually maturing and a delay in migration may negatively impact their reproductive viability. Spring-run Chinook salmon typically are migrating through the estuary several months before spawning, but an extended delay in the estuary may affect their ability to access their natal spawning streams. Adult salmonids generally utilize high stream flow conditions to assist in their upstream migration. Rapid upstream movement may be needed to take advantage of a short duration high stream flow event, particular in dry years when high flow events may be uncommon. If the destination of a pre-spawning adult is among the smaller tributaries of the Central Valley, it may be important for migration to be unimpeded since access to a spawning area could diminish with receding flows. In this manner, operation of the SMSCG may reduce the spawning and reproductive success of listed spring-run Chinook salmon and steelhead.

b. *Juveniles and Smolts*

The operational season of the SMSCG overlaps with the expected outmigration period of juvenile listed anadromous salmonids. As juvenile salmon and steelhead emigrate downstream, some fish will pass through Montezuma Slough and the SMSCG as they travel to the ocean. During full operation of the SMSCG between September and May, the gates open and close twice each tidal day. The gates are operated to achieve a net flow of approximately 1,800 cfs in the downstream direction when averaged over a tidal day. When the gates are open on an ebb tide, freshwater outflow and fish will pass from the Delta into Montezuma Slough without restriction. On the flood tide, the gates are closed and freshwater flow and the passage of fish will be restricted. Most juvenile listed salmonids in the western Delta entering San Francisco Bay are expected to be actively emigrating smolts. Smolts are likely taking advantage of the ebb tide to pass downstream (Vogel 2004), and, thus, the operation of the SMSCG is not expected to significantly impede their downstream movement in the estuary.

Predation of smolts by striped bass and pikeminnow could be enhanced by operation of the SMSCG. Both predatory fish are known to congregate in areas where prey species can be easily ambushed, because fish passage is blocked or restricted. However, only three Chinook salmon were found in the stomachs of striped bass and pikeminnow captured near the SMSCG during investigations between 1987 and 1993 (OCAP BA 2004). The relatively large size and strong swimming ability of Chinook salmon and steelhead smolts reduce the likelihood of predation. Therefore, increased predation rates on smolts at the SMSCG is not expected to be significant.

c. *Habitat Availability and Suitability*

Montezuma Slough primarily is a migration corridor for adult and juvenile listed salmonids. Some rearing and foraging may occur if juvenile listed salmonids arrive in the estuary as pre-smolts. As discussed above, operation of the SMSCG strongly influences water currents and tidal circulation in Montezuma Slough. Some predatory fish may congregate in the vicinity of the structure reducing habitat suitability. In general, operation of the SMSCG does not significantly change habitat availability or suitability for rearing and migration of juvenile listed anadromous salmonids. However, operation of the SMSCG does impair adult upstream passage conditions in Montezuma Slough.

d. *Adaptive Management*

DWR, Reclamation and DFG are coordinating an additional year of study at the SMSCG to evaluate adult fish passage. Equipment and operational problems during the 2001 studies likely confounded that year's results. Therefore, these agencies has proposed to perform a fourth year of study during the fall of 2004, in a separate permit. In coordination with the SMSCG Steering Group, this additional year of study and additional actions to improve passage conditions will facilitate adaptive management. By continuing this process of designing and executing actions to improve passage and monitoring the responses at SMSCG, it is likely delays and blockage of upstream migrating listed salmonids can be lessened in future years.

2. <u>Roaring River, Morrow Island, and Lower Joice Island Unit Distribution Systems</u>

a. *Adult Migration, Spawning, and Incubation*

At Roaring River and Lower Joice Island Unit, the intakes for these water distribution systems are equipped with fish screens. At Morrow Island, a fish screen is proposed for construction. Listed adult salmonids are primarily migrating through Suisun Marsh and are not expected to be affected by the operation of these facilities. Although the Morrow Island Distribution System (MIDS) does not currently have a fish screen, it is unlikely an adult salmonid would be entrained into the water distribution system. The size and excellent swimming ability of adult salmonids are sufficient to avoid entrainment at MIDS. Suisun Marsh does not provide suitable conditions for spawning or incubation of salmonids.

b. *Juveniles and Smolts*

At Roaring River and Lower Joice Island Unit, the intakes for these water distribution systems are equipped with fish screens which prevent entrainment of juvenile salmonids. At Morrow Island, a fish screen is proposed for construction under a separate opinion. A small number of juvenile salmonids may be entrained or killed at MIDS prior to the installation of a fish screen.

c. *Habitat Availability and Suitability*

Operation of these three water distribution systems is not expected to significantly affect habitat availability and suitability for listed salmonids in Suisun Marsh. The marsh is subject to tidal influence and operation of the water distribution systems does not reduce the volume of aquatic habitat in the marsh. Fish screens minimize aquatic organisms lost to entrainment and, thus, the foraging on prey organisms by juvenile salmonids is not likely to be affected.

d. *Adaptive Management*

Reclamation and DWR continue to coordinate with FWS and NOAA Fisheries in an effort to develop alternatives to a new fish screen at MIDS. DWR staff has proposed mitigation measures that are designed to provide greater benefits for listed species than a new fish screen. As new information is developed, NOAA Fisheries will continue to work with the other agencies to evaluate actions that benefit listed species in Suisun Marsh.

3. <u>Goodyear Slough Outfall and Cygnus Unit</u>

a. *Adult Migration, Spawning and Incubation*

Both facilities are outfall structures designed and operated to improve water circulation in the marsh. Goodyear Slough Outfall drains water from the southern end of Goodyear Slough into Suisun Bay. Cygnus Unit is a drain gate on a private parcel west of Suisun Slough near Wells Slough. Operation of both facilities as drains is not expected to adversely affect adult anadromous salmonids.

b. *Juveniles and Smolts*

By improving circulation and water quality, both the Goodyear Slough Outfall and the Cygnus Unit drain are not expected to adversely affect juvenile salmonids. Improved water quality likely benefits rearing and foraging juvenile salmonids in the marsh. Improved circulation may assist emigrating juvenile salmonids from the marsh to Suisun Bay.

M. Interrelated and Interdependent Effects

1. <u>Hatcheries</u>

Hatcheries have been constructed and operated as mitigation for the loss of natural fish production and habitat from the construction and operation of large dams, and preferable to the prohibitive costs of fish passage. Water agencies built hatcheries and set mitigation goals for fish production, and continue to provide the funding for hatchery management and operations.

Since the establishment of the Trinity River (1960), Livingston Stone[5] (1998), Coleman (1942), Feather River (1967), and Nimbus (1955) hatcheries, millions of fish have been released into the Central Valley and Trinity River basins, providing fish for commercial harvest and recreational fishing opportunity (DFG and NOAA Fisheries 2001).

While efforts were made to replace lost natural fish numbers through artificial propagation, comparable consideration was not given to project effects of altered river hydrology and water quality, timing, and quantity on maintaining or increasing fish habitat to accommodate subsequent fish numbers below dams (Reclamation 2004). Fish adapted to upper basin habitat were no longer able to spatially, or in some cases, reproductively, isolate from lower basin populations and have become genetically impacted or extirpated (DFG 1998). Fish populations below dams are vulnerable to low flows, high temperatures, and stranding events stemming from water management operations. Hatcheries have adopted management strategies to meet mitigation goals despite the environmental impacts of dams. Fall-run Chinook salmon, more suited to lower elevation habitat, are produced in hatchery programs in lieu of the spring-run Chinook salmon populations. Fish production has been increased and out-of-basin stocks were transferred to offset years of low escapement and poor hatchery returns (DFG and NOAA Fisheries 2001). Enhancement programs have been adopted to ensure a sufficient number of salmon for commercial catch beyond the required mitigation numbers, and fish from Central Valley hatcheries have been transported downstream by truck to San Pablo Bay to avoid challenges in the migration corridor, including high water temperatures, fish predation, fish competition, lack of refugia, and high flows into the Delta.

a. *General Hatchery Effects*

Hatcheries can no longer be managed as isolated from the natural system, as their operations directly affect the viability of natural fish populations (Williams *et al.* 2003). Management would necessarily entail distinguishing between natural and hatchery fish stocks. There has been a growing body of evidence suggesting serious consequences from artificial propagation to natural fish in the form of genetic and ecological risks (HSRG 2004). High numbers of hatchery releases compete with natural fish over limited habitat and food resources, may carry exotic strains of diseases, stray into non-natal waters, and hybridize with native local stocks of fish. Numerical dominance of hatchery fish leads to increased effects from domestication (selection for genetic traits advantageous in a hatchery setting and accompanied by a loss of fitness for natural rearing). Hatchery fish may increase the abundance of fish numbers, but there is evidence to demonstrate that they are not as productive or genetically fit in the natural environment as fish under natural selection (Chilcote 2003, *et al.* 1986; Berejikian *et al.* 1999; Fleming *et al.*1993). Although there may be gene flow between hatchery and natural fish, the release from natural selection in the hatchery environment may contribute substantially to the deterioration of the natural population through the introgression of the hatchery and natural genome (Philipp and Claussen 1994). To assist in the management of the public resource,

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[5] Livingston Stone National Fish Hatchery was built as a conservation for winter-run Chinook salmon and not as mitigation for the effect of dams.

Congress has signed into law a mandate that all Federal and federally-funded salmon and steelhead hatcheries implement a marking program on the fish they release to visually distinguish between hatchery and natural stock (H.R.5093, Section 139, H.Rept.107-564). The law also provides funding to implement mass-marking programs and assist in the management of the public resource.

b. *Hatchery Programs within the Project Action Area*

(1) *Trinity River Hatchery*

The Trinity River Hatchery (TRH) was established as mitigation for the loss of 109 miles of habitat above Lewiston Dam. Just after the dam was completed, up to 90 percent of the historic flow of the river was diverted to the Central Valley for agricultural use. As a result of reduced flows, the Trinity River channel narrowed and thick riparian vegetation began to encroach in the river bed, confining the mainstem channel while reducing spawning and rearing areas. The completion of Lewiston and Trinity Dams resulted in the depletion of spawning gravel recruitment in downstream habitat while reduced flows caused the deposition of fine sediments into spawning habitat (NOAA Fisheries 2001). Salmon and steelhead populations have plummeted despite the establishment of TRH below Lewiston Dam. Presently, the majority of juvenile coho salmon out-migrating from the Trinity River Basin consists of hatchery stock and approximately 90 percent of the adult escapement are hatchery returns (DFG 2002). There is little infusion of wild genes in the hatchery population, increasing the risk of domestication effects and genetic drift in naturally-spawning coho salmon (Israel and Williamson 2003). The paucity of natural spawners is likely due to the highly degraded environment caused by the previous management of the Trinity River prior to the signing of the ROD in 2000. The entrenched river channel has not been allowed to naturally meander during the post-dam low flow regime, preventing the formation of cool water pools, varied water velocities, and shallow edge water habitat preferred by juvenile salmonids (NOAA Fisheries 2000). Altered hydrology may impair salmonid imprinting and homing, leading to high rates of fish straying (DFG and NOAA Fisheries 2001). Fingerling, yearling and yearling-plus fall-run Chinook salmon volitionally released from the TRH stray at rates of 58, 57, and 45 percent respectively (DFG and NOAA Fisheries 2001). Currently, TRH marks 100 percent of its steelhead and coho salmon production, and 25 percent of the Chinook salmon production.

(2) *Livingston Stone National Fish Hatchery*

The draft Sacramento River winter-run Chinook salmon recovery plan identified artificial propagation among needed restoration actions to prevent the extinction of the winter-run population (NOAA Fisheries 1997). The hatchery conservation program initially began operations at the Coleman National Fish Hatchery (CNFH), and was later moved to the Livingston Stone National Fish Hatchery (LSNFH) facility on the Sacramento River in 1998. LSNFH has assisted in the recovery of the winter-run Chinook salmon ESU by increasing the number of naturally spawning winter-run Chinook salmon. The winter-run population has undergone several genetic bottlenecks after being blocked from their habitat in the upper basin by the construction of Shasta Dam, resulting in the introgression of the remaining winter-run stocks into one population (BRT 2003). The winter-run population is sustained by cold-water releases from Shasta Dam under Reclamation management. Reclamation installed a TCD on Shasta Dam in 1997 to allow selective management of cool water releases to be made through the power penstocks, avoiding power bypasses. However, due to reduced water supplementation from the Trinity River, increased Delta Standards, and other downstream demands, winter-run Chinook salmon critical habitat has been reduced below Keswick Dam. The LSNFH winter-run program is conducted under the authority of an ESA section 10(a)(1)(A) permit. LSNFH marks 100 percent of its winter-run Chinook salmon production.

(3) *Coleman National Fish Hatchery*

Coleman National Fish Hatchery (CNFH) experiences few limits on cold water availability and has a water treatment plant on its premises to control disease pathogens. CNFH releases its hatchery production in-river, and marks 100 percent of its steelhead and late-fall run Chinook production. However, for the past several years, none of the 12 million fall-run Chinook salmon releases intended for harvest have been fin-clipped. CNFH operations are being integrated into the CVPIA AFRP-sponsored restoration of 42 miles in upper Battle Creek. It is hoped that the increase of habitat would permit an expansion of spatial structure for winter-run and spring-run Chinook salmon, and steelhead. However, any increase in natural production may be offset by two of the CNFH water intakes utilized in hatchery and power house activities that are either not screened or do not meet NOAA Fisheries screening criteria, leaving juvenile fish vulnerable when operations depend upon their use. The CNFH programs are conducted under authority of an ESA section 7(a)(2) consultation.

(4) *Feather River Hatchery*

Steelhead are severely limited by a lack of habitat in the lower Feather River basin, and there is no passage to historical habitat above Oroville Dam (DWR 2003). Entrapment prevents gravel replenishment below the dam, decreasing spawning habitat over time. A 2003-04 steelhead redd survey found 75 redds in the upper reaches below the dam, and estimated 163 naturally-spawning steelhead in the river (DWR 2003). The contribution of hatchery steelhead to the naturally spawning population is not known, but as Feather River Hatchery (FRH) returns numbered 2,999 fin-clipped steelhead and no more than five non-clipped fish in 2003-04, it is likely that the majority of in-stream spawners were of hatchery-origin. The FRH produces 450,000 steelhead, six million fall-run Chinook salmon, and two to five million spring-run Chinook salmon. The Feather River spring- and fall-run Chinook salmon have genetically introgressed and express mixed run-timings, now delineated as “early- and late-running” (BRT 2003). As of 2002, 100 percent of the hatchery spring-run Chinook salmon are externally adipose fin-clipped and coded-wire tagged prior to release, as is approximately five percent of the hatchery fall-run Chinook salmon production. All steelhead and half of the spring-run Chinook salmon production are released in-river. The remaining spring-run and fall-run Chinook salmon production is trucked to San Pablo Bay for release. FRH has begun a process of developing distinct run timings for Feather River fall- and spring-run Chinook salmon through broodstock management. Physical isolation of the spring-run and fall-run Chinook salmon through the placement of an in-river weir or by passage around Oroville Dam is being analyzed within the FERC relicensing process for the Oroville Project. FERC is also expected to initiate an ESA section 7(a)(2) consultation with NOAA Fisheries on the effects of the hatchery programs and infrastructure on listed species.

(5) *Nimbus Fish Hatchery*

Historically, the American River supported runs of spring-, fall-, and late-fall Chinook salmon and summer, fall, and winter runs of steelhead in 125 miles of accessible riverine habitat (Water Forum 2001). All except fall-run Chinook salmon were thought to have been largely extirpated before 1955, although remnant populations of late-fall Chinook salmon and fall and winter steelhead remained. The Nimbus Fish Hatchery (NFH) steelhead program was founded primarily with Eel River stock, but also incorporated steelhead eggs transferred from CNFH on Battle Creek and from the Warm Springs Hatchery in the Russian River system (SSHAG 2003). NFH currently depends on adult returns entering the facility for broodstock collection. Recent analysis on Central Valley steelhead revealed that the NFH steelhead stock has introgressed with the American River steelhead population (Nielsen *et al.* 2003). The NFH steelhead are 100 percent fin-clipped but the out-of-basin/ESU stock may present some risk to in-ESU steelhead populations. Additionally, other than a completed two-year CALFED-funded study on the use of hatchery marking trailers, NFH does not mark its production of four million fall-run Chinook salmon production nor any of the enhancement program fish. Mitigation and enhancement fish are trucked to San Pablo Bay for release.

c. *Consequences of Central Valley and Trinity River Hatchery Operations*

When production goals are met, the Central Valley and Trinity River hatcheries can release up to 39 million Chinook salmon, 500,000 coho salmon, and 2.38 million steelhead juveniles (DFG and NOAA Fisheries 2001). Hatchery fish form the majority of adult returns to the Central Valley and Trinity River basins. The 2003 fall-run Chinook salmon spawning escapement to California was estimated to number 519,600 in the Sacramento River and 191,600 in the Klamath-Trinity River Basin (PFMC 2004). The management escapement goal for the Central Valley ranges between 122,000 to 180,000 fall-run adults, and which has been consistently exceeded since 1995. Fish that are not taken commercially may be harvested in the freshwater fishery; however, despite increasing creel take allowances, the carrying capacity of some rivers below dams (*e.g.*, American and Feather Rivers) have been surpassed for the limited amount of habitat, resulting in high prespawning mortality and the superimposition of redds.

Hatchery steelhead programs produce the majority of anadromous *O. mykiss* in the Central Valley. The Feather River steelhead spawning population was estimated to be 163 fish; returns to the FRH numbered 2,999 (DWR 2003). The American River steelhead population was estimated to range between 201 and 400 fish; hatchery returns numbered 2,825 (Hannon *et al.* 2004). Approximately 90 percent of coho salmon escapement in the Trinity River basin is comprised of hatchery-origin fish. The 2003 coho salmon returns to the TRH numbered 10,425, and another estimated 10,000 to 30,000 coho salmon were thought to have remained in the Trinity River. Despite high adult returns, natural productivity is low throughout the Trinity River basin. Hatcheries contribute to ESU abundance, but contributions of artificial propagation to natural fish productivity, spatial structure and genetic diversity are lacking and could contribute to the reduced fitness of natural populations and the continuing decline of listed ESUs. With the exclusive dependency on salmonid habitat below dams, mitigation goals should emphasize habitat restoration to permit greater natural production and less impact from hatchery production.

d. *Water Quality*

Water quality is the most important variable in fish culture. Hatchery fish are grown together at high densities in contained raceways that are open to predation, often ungraded so that smaller fish are subject to the more aggressive actions of larger fish, all leading to stress-inducing vulnerability to pathogen invasion. Native fish stocks have evolved a degree of tolerance to indigenous fish pathogens found in the Central Valley and Trinity River basins; it is difficult to intentionally infect a wild fish with a native strain of infectious hematopoietic necrosis virus IHNV (Foott 2000). However, outbreaks of diseases are not uncommon in hatcheries with pathogen-laden water. Hatcheries have created a laboratory environment for pathogens to evolve into more virulent strains against which there are no natural defenses in wild or hatchery fish. The practice of out-of-basin fish transfers has also allowed for the introduction of exotic viral strains (Hedrick and Yun 2003)

e. *Hatchery Review Process*

California hatchery programs have been initially reviewed by a joint agency committee (DFG and NOAA Fisheries 2001) and recommendations were put forth to minimize hatchery impacts to listed ESUs. Some recommendations are specific to practices which offset project effects and are considered “risky” for implementation by hatchery managers. It has become evident that fish recovery requires coordination between hatchery and basin management with on-going monitoring efforts to evaluate hatchery effects on the natural populations of the ESUs. This is especially relevant to natural populations within evolutionarily significant units (ESUs) that have been listed as “threatened” or “endangered” after the establishment of California hatcheries. As the Federal entity responsible for the establishment and continuation of the Trinity River and Nimbus Hatcheries, Reclamation is required to initiate ESA consultation on the effect of their hatcheries on listed ESUs and provide the support to effectively manage them for recovery of the public resource. Reclamation provides funding for the TRH, NFH, CNFH, and LSNFH hatcheries. The latter two facilities operate under ESA permitting of their programs although there are aspects of hatchery operations which require additional funding for their improvement. The recent NOAA Fisheries proposal regarding the listing determinations for 27 ESUs of West Coast salmonids (69 FR 33102) does not eliminate any of the listed California populations from ESA protection.

As mitigation for the construction and water operations of the CVPIA, the hatcheries are part of the project description and obligated to be included within the OCAP consultation. However, the Trinity River and Central Valley hatcheries and their effects cannot be adequately addressed in this biological opinion as their analyses will require an amount of effort that extends beyond the current consultation time line. For a more complete analysis of hatchery effects see the analysis of individual hatcheries provided in the *Status and Baseline* by the Biological Review Team (69 FR 33102)

2. Long-term Water Contracts

Indirect effects associated with long-term contracts will occur from project operations to deliver water as part of Reclamation's obligation as described in the project description. Long-term contracts are subject to CVP allocation restrictions based on reservoir storage levels and forecasts (see OCAP Chapter 2). Also dependant on these long-term contracts are several flow augmentation programs, which provide water to benefit salmon and steelhead. These programs include the use of 800 TAF of CVPIA (b)(2) water; approximately 77 TAF of water from CVPIA (b)(3) Water Acquisition Program; 380 TAF of water from the CALFED EWA; and 50 to 100 TAF of acquired water from the CALFED ERP. Many of these long-term contracts allow CVP water to be pumped through unscreened diversions in the Sacramento River (*e.g.*, City of Redding, Reclamation District-108, Sutter-Mutual and Natomas-Mutual Water Districts). These diversions are in the process of being screened and are subject to their own section 7 ESA consultation.

Indirect effects of long-term contract renewals include entrainment of listed salmonids, alteration of natural flows, and changes in water quality associated with the use of contract water (see water transfer effects). The effects of entrainment will be dealt with through separate section 7 ESA consultations on long-term contract renewals after the OCAP BO is completed and through biological opinions on the unscreened diversions mentioned above that are included in the CVPIA Anadromous Fish Screen Program. However, many of the unscreened diversions have no federal nexus other than through CVP contract renewals (*e.g.*, 123 unscreened diversions below Red Bluff). Seventeen diversions are between RBDD and Butte City and probably pose the highest risk to listed salmonids based on location and timing of diversions. These diversions may entrain juvenile salmon as they outmigrate from April through October.

An analysis by Reclamation of the effect of this entrainment due to CVP contracts (base + Project amounts) showed unscreened diversions represent 0.37 percent (*i.e.*, 7,095 juveniles) of the estimated juvenile winter-run Chinook salmon passage at RBDD from 1995- 1999 (OCAP BA Fig. 9-15). Monthly diversions from April to October ranged from 0.1 to 1.0 percent of the RBDD passage based on the amount of Project plus Base water diverted. However, this does not include the diversions that are in the process of being screened which represent much larger quantities of CVP contract water being diverted or the mortality in-river from RBDD to the Delta where the one diversion accounted for 65 percent of the entrainment. Even if the diversions that are in the process of being screened in the next ten years (not included in the estimate above) represented twice that of the remaining diversions the total entrainment of winter-run Chinook salmon would still be less than 2.0 percent of the population at RBDD. Since this level of entrainment is below the already established threshold for incidental take at the Delta Pumping plants it is not expected to reduce the likelihood of survival and recovery of winter-run Chinook salmon, but it is in addition to the Delta take.

The proportion of spring-run Chinook salmon that are entrained by these unscreened diversions is likely lower than that of winter-run Chinook salmon due to a later time of emergence. Numbers for steelhead were not estimated but entrainment is likely higher due to higher base water supply diversions from April through June when steelhead are usually emigrating from tributary streams. Also, since steelhead exhibit a longer emigration period and many of the unscreened diversions are located in upstream tributaries where steelhead are present (*e.g.*, Feather River, Merced River) the probability of encountering an unscreened diversion is greater. A recent study by DFG on a small diversion (43 cfs) in the Merced River supports this conclusion (DFG 2002). Entrainment of Chinook salmon and steelhead was estimated to be 3.5 percent compared to the 0.06 percent used by Reclamation in the above analysis. Therefore, the entrainment rate is highly dependent on the location of the diversion in relation to spawning and rearing habitat. Indirect effects of contract renewals through the use of water and return of water to the Sacramento River are unknown; however, since the contract amounts are not increasing there should be no increase in effects over the baseline conditions today. Overall, the indirect effect of CVP long-term contract renewals is expected to kill through entrainment in unscreened diversions no more than 1-2 percent of the winter-run and spring-run Chinook salmon and 3.5 percent of the steelhead populations in the project area.

3. FERC Relicensing Process/Feather River

DWR has completed an Initial Settlement Agreement with FERC in 2004 for the relicensing of the Oroville Dam Power Plant. The 30to 50 year term of license is due to be completed in 2007. This process is expected to initiate its own ESA section 7 consultation of the effects of the Oroville Dam Project No. 2100. Even though the ESA consultation has not yet begun, preliminary studies have been proposed to determine the how the Oroville Project will affect flows, temperature, gravel, recreation, and the hatchery mitigation program for the lower Feather River. These study proposals have been reviewed and coordinated with studies required for the OCAP consultation dealing with operations (*i.e.*, DWR salmon and steelhead monitoring, stranding and isolation studies, etc.). A separate biological opinion covering the incidental take for the FERC-related studies was completed in 2004 (NOAA Fisheries 2004).

Proposed studies under the FERC relicensing process have a much broader scope than the studies under the ESA consultation, including areas above and below the dam. In the lower Feather River, DWR has included the following studies which overlap with the ESA consultation; 1) flow and temperature modeling, 2) gravel augmentation, 3) large woody debris studies, 4) a fish weir to separate spring-run from fall-run Chinook salmon spawners, and 5) evaluation of fish passage to determine the feasibility of re-introducing anadromous fish above Lake Oroville (DWR 2004a).

The fish passage evaluation proposal was rejected by DWR in favor of improving existing habitat in the lower Feather River. However, an assessment of the benefits to anadromous fish of improving the habitat in the lower Feather River has not been proposed. To date, preliminary DWR modeling suggests that water temperature control can not be extended further downstream than the existing criteria without major changes to Project operations such as: use of the river outlets, or reconfiguring water conveyance through the Thermalito Afterbay. Alternative operations that improve the suitability of habitat will be assessed through the FERC studies.

Gravel augmentation or improvement of existing spawning areas has not been conducted in the Feather River since 1987 (Stillwater 2004). DWR under the FERC process has proposed to improve the quantity and quality of spawning habitat for spring-run Chinook salmon and steelhead by adding gravels in the lower Feather River. The program would then be reviewed every 5 years.

Overall, the proposed FERC studies and projects are expected to provide beneficial impacts to spring-run Chinook salmon and steelhead; therefore, no adverse impacts are anticipated from the FERC relicensing studies. The Oroville Project will be reviewed under a separate section 7 consultation at the time of license application.

N. Early Consultation Effects

The impact of proposed early consultation operations are discussed in this section and under the *Effects Section* for each river in the project area discussed above.

1. <u>8500 Banks and SDIP</u> (Refer to Delta effects section above)

2. <u>Long-term Environment Water Account</u>

The EWA was established to provide water for the protection and recovery of at-risk fish species beyond the water available through existing regulatory actions related to the operations of the SWP and CVP. It is based on the concept that flexible management of water can achieve fishery and ecosystem benefits more efficiently than a completely prescriptive regulatory approach. This approach requires the acquisition of alternative sources of project water supply that are used to augment stream flow and modify Delta exports, to provide fishery benefits at no uncompensated cost to project water users. The EWA is in it's fourth year of operation and is reviewed annually by an independent science review panel (CALFED 2003). A long-term EWA has not yet been developed, but a final EIS/EIR, an ASIP, and a ROD were signed in March 2004. This document covers implementation of the EWA until 2007. FWS and NOAA Fisheries have conducted ESA section 7 consultations on the EWA EIS/EIR.

An assessment of the EWA for the EIS/EIR was conducted for the years 2001 through 2003 (CALFED 2004). The EWA is used primarily to reduce entrainment losses of Chinook salmon and steelhead at the SWP and CVP Delta diversions and improve survival through the Delta. The resulting benefits of EWA for listed salmonids depends on the magnitude of the action and the proportion of the population present during the action. Reductions in entrainment loss of Chinook salmon have been estimated by determining how much less water is pumped during a curtailment and assuming the density of fish in the water being pumped is the same during the curtailment as it was when it began. Even though EWA actions target periods of high density for listed species the magnitude of the reduction is not enough to affect population level impacts, but does reduce incidental take levels.

For example, the highest estimated loss period for juvenile winter-run Chinook salmon occurred between February and March of 2001, when an estimated 20,000 fish were lost at the Delta pumps. A relatively large amount of EWA assets were expended to reduce this entrainment resulting in a reduction of 5,000 fish, or a 20 percent reduction from the assumed loss of 25,000 that would have occurred without EWA. To put this in perspective, the juvenile production entering the Delta was estimated to be about 2.6 million in 2001 based on a revised estimate of spawner escapement (NOAA Fisheries 2002c). The difference in the EWA reduction to the population amounted to 0.19 percent of the juvenile production. The difference to the incidental take limit at the Delta pumps amounted to a 9.56 percent reduction based on the revised take limit of 52,272 winter-run Chinook salmon juveniles. Therefore, the change to the population was very small, but Project operations were positively affected by not exceeding the incidental take limit.

For spring-run Chinook salmon, entrainment loss from the Sacramento River basin typically is low (*i.e.*, less than one percent since 1994) based on comparisons to fall-run adult escapements (DWR memos 1999 and 2003); however, loss rates for the Delta pumping plants have been greater than three percent in recent years based on recoveries of tagged surrogate release groups. The amount of exempted take for juvenile spring-run Chinook salmon is one percent of the surrogate releases (NOAA Fisheries 2002b). Several EWA actions were implemented in 2003 and 2004 to reduce losses of spring-run Chinook yearlings at the Delta pumping plants. Despite the use of EWA, Reclamation has had to re-initiate consultation in both years due to exceeding the spring-run Chinook incidental take. The loss rates of these surrogate release groups are dependent on many variables affecting mortality during the 200 mile migration to the Delta. If out-migration conditions are suitable and the hydrology is wet, mortality may be reduced, thus a higher proportion of individuals show up in the fish salvage facilities. Therefore, higher loss rates may indicate greater survival to the Delta and EWA may be ineffective at reducing take of juvenile spring-run Chinook salmon.

EWA actions have mainly targeted species other than steelhead (*e.g.*, delta smelt or Chinook salmon); therefore, steelhead typically have benefitted only secondarily from these protective actions. The EWA has been used for export curtailments during the VAMP and afterwards in the spring; these actions are intended to increase Chinook salmon smolt survival through the Delta. Although this action targets fall-run Chinook salmon on the San Joaquin River it also provides some protection for late emigrating juvenile steelhead and adults returning to the ocean. Pre-VAMP export reductions to protect delta smelt have been adaptively managed in some years (when delta smelt are in the vicinity of the CVP/SWP pumps) and may provide protection to greater numbers of steelhead and some YOY spring-run Chinook salmon. Upstream EWA actions have provided some habitat improvements for steelhead and spring-run Chinook salmon through the increase in flows when releases are transferred to the Delta (*e.g.*, Yuba and American River). In two cases, EWA power credits were used to replace foregone energy generation when the lower river outlets were used on the American River to lower water temperatures. These actions reduced the amount of pre-spawning mortality for fall-run Chinook salmon and secondarily may have provided suitable water temperatures for over-summering juvenile steelhead.

Overall, EWA does not provide significant benefits to listed salmonids at the population level; however, it does reduce the number of individuals killed at the CVP/SWP Delta facilities and may be more beneficial at reducing water versus fish conflicts. In the future conditions, both under formal and early consultation, EWA may be used more frequently as pumping increases will increase the loss rates for juvenile salmonids (and adult steelhead). In the upstream areas as populations continue to decline, EWA may provide greater benefits if it were used to stabilize releases below Project reservoirs during critical spawning periods or during periods of stranding and isolation.

3. Project Integration

Project Integration, or "borrowing water", only occurs in two out of 72 years (*i.e*., 1961 and 1962) when Oroville storage is less than 1.5 MAF and Shasta is over 2.4 MAF. Since the probability of this action occurring is very low (*i.e.,* only three percent of the years modeled) and project operations are subject to all applicable operating constraints in the biological opinions, this is not considered to have an appreciable effect on listed salmonids.

Also included in project integration is the management of San Luis low point. There are no direct effects to listed salmonids from San Luis low point since all operations occur downstream of the Delta fish collection facilities. However, there are some indirect effects that may occur through a greater use of EWA, or greater Delta pumping to fill San Luis Reservoir in August and September when the target drops below 300 TAF. The CALSIM model does not show how San Luis Reservoir is jointly operated between the CVP and SWP in order to maintain a total reservoir level. In the today studies (*i.e*., Banks at 6680 cfs), the 300 TAF target is exceeded during approximately 15 to 25 percent of the years. In the future condition Reclamation may source shift water with SOD contractors in order to meet the low point concern. Increased Delta pumping in August and September to alleviate the San Luis Low Point problem is not expected to affect listed salmonids due to their lack of presence in the Delta during that time period.

4. Water Transfers

Water transfers, as described in the OCAP BA (March 22, 2004) usually are actions undertaken by a water user north of the Delta to make water available for transfer to another water user, generally SOD. Transfers requiring export from the Delta are done at times when pumping capacity at the Federal and State pumping plants is available to move the water. To ensure that the projects operate to agreed upon procedures, reservoir releases and Delta exports must be coordinated. The Federal and State projects signed a COA in November 1986 to operate the CVP and SWP in a manner to meet Sacramento Valley and Delta needs based on the sharing principles outlined in the COA and facilitated by an accounting procedure. Operational constraints introduced by NOAA Fisheries and FWS biological opinions, by SWRCB D-1641, and by CVPIA have been addressed by Reclamation and DWR through mutual informal agreement (OCAP BA, March 22, 2004).

California Water Law and the CVPIA promote water transfers as important water resource management measures to address water shortages provided certain protections to source areas and users are incorporated into the transfer. Water transferees generally acquire water from sellers who have surplus reservoir water, sellers who can pump groundwater instead of using surface water, or sellers who will idle crops or substitute a crop that uses less water in order to reduce normal consumptive use of surface diversions. The CVP and SWP may provide Delta export pumping for transfers using surplus capacity that is available, up to the physical maximums of the pumps, consistent with prevailing operations constraints such as E/I ratio, conveyance or storage capacity, and the protective criteria established that may apply as conditions on such transfers. For example, pumping for transfers may have conditions for protection of Delta water levels, water quality, or fish.

On February 25, 1993, Reclamation released Interim Guidelines for Implementation of Water Transfers Under Title XXXIV of Public Law 102-575 (Reclamation Projects Authorization and Adjustment Act of 1992). On April 16, 1998 the Department of the Interior released the Final CVPIA Administrative Proposal on Water Transfers. These documents provide the administrative guidelines relative to the governing conditions for water transfers using the facilities covered by the OCAP BA. Under the Interim Guidelines it is Reclamation's responsibility to:

- Approve or disapprove water transfer proposals within 90 days from receipt of a complete written proposal. If the transfer proposal is disapproved, Reclamation shall inform the Transferor and Transferee in writing why the transfer does not comply with the terms, conditions and criteria of these Interim Guidelines and what alternatives, if any, could be included so that the transfer would reasonably comply with the terms, conditions and criteria of these Interim Guidelines.

- Ensure that no transfer will be approved if Reclamation, in consultation with the FWS, determines that such transfer would result in significant reduction in quantity or decrease in the quality of water supplies currently used for fish and wildlife purposes, unless Reclamation, in consultation with FWS, determines pursuant to findings setting forth the basis for such determination that such adverse effects would be more than offset by the benefits of the proposed transfer. In the event of such determination, Reclamation, in consultation with FWS, shall develop and implement alternative measures and mitigation activities as integral and concurrent elements of any such transfer to provide fish and wildlife benefits substantially equivalent to those lost as a consequence of such transfer.

The criteria for transfers authorized under Section 3405(a) of the Act of 1992 include: provisions (L) All transfers of Project water shall be consistent with Federal and State laws, including compliance with all environmental requirements of the NEPA, ESA, the Fish and Wildlife Coordination Act (FCWA) and if applicable CEQA, and CESA; and (M) Compliance with environmental analysis, including preparation of all documents and mitigation requirements under NEPA, ESA, FWCA (if applicable), CEQA or CESA, will be the responsibility of the Transferor.

The Final CVPIA Administrative Proposal addresses third-party impacts of water transfers and includes environmental impacts as a third-party. CVPIA contains provisions that limit the extent of third-party impacts including the provisions: (5) mitigation of adverse impacts to fish and wildlife resources, and (6) consistency with Federal and State laws. In considering these impacts

Interior has stated that third-party impacts should be addressed when evaluating both short- and long-term water transfers.

Three additional classes of water transfers were also addressed in the Final CVPIA Administrative Proposal: (1) historical water transfers approved under separate authorities, (2) Sacramento River Settlement contracts, and (3) Exchange Entity contracts. Interior responded to (1) stating that it believed the "programmatic review process" on historical water transfers will encompass the majority of the water transfer issues raised as a concern. For those water transfers that are outside of the "programmatic review process" criteria, separate evaluations will be made on a case-by-case basis. Interior responded to (2) stating that all Sacramento River Settlement contracts contain a provision that requires the Contracting Officer to approve any transfers of base supply or CVP water. For the purposes of this OCAP consultation, this Federal connection to Sacramento River Settlement contracts meets ESA requirements for consultation with NOAA Fisheries and FWS. Interior responded to (3) stating that the only water that the United States has authority to "exchange" with the Exchange Entities is CVP water. Therefore, the water transfer provisions of section 3405(a) of the CVPIA apply to water provided under the Exchange Entities contract.

Reclamation specifically states in the OCAP BA (March 23, 2004) that it and DWR have considered and attempted to increase the level of operational coordination and integration for many years. The benefit of such coordination allows one project to utilize the other's resources to improve water supply reliability and reduce cost. As such, Reclamation and DWR plan to integrate the strengths of the CVP and SWP (storage and conveyance, respectively) to maximize water supplies for the benefit of both CVP and SWP contractors that rely on water delivered from the Bay-Delta in a manner that will not impair in-Delta uses, and will be consistent with fishery, water quality, and other flow and operational requirements imposed under the Clean Water Act (CWA) and ESA.

To accomplish this benefit the OCAP BA (March 23, 2004) assumes the majority of transfers would occur during July through September and would increase Delta exports from 200-600 TAF in most years, once the 8,500 cfs Banks capacity is operational. Such future transfers would occur within the Banks 8,500 cfs capacity, and the Tracy 4,600 cfs capacity described in the OCAP BA (March 23, 2004) and in no case would transfers require higher rates of pumping than those. The range of 200-600 TAF describes the surplus export capacity estimated to be available in July-September (primarily in Banks) in about 80 percent of years when 8,500 cfs Banks is in place.

Under these conditions, transfer capability often will be capacity-limited. In the other 20 percent of years (which include critical and some dry years), both Banks and Tracy have more surplus capacity, so capacity most likely is not limiting to transfers. Rather, either supply or demand for transfers may be a limiting factor. In some dry and critical years, water transfers may range as high as 800 TAF-1MAF depending on the severity of the water supply situation, cross-Delta capacity and available supplies upstream.

During dry or critical years, low project exports and high demand for water supply could make it possible to transfer larger amounts of water. Low project exports in other months may also make it advantageous to expand the "normal transfer" season. Transfers outside the typical July through September season may be implemented when transferors provide water on a "fish-friendly" pattern. Real-time operations would be implemented as needed to avoid increased incidental take of listed species.

Although, by definition, the water transfer process is a voluntary action, transfers requiring export from the Delta are done at times when pumping and conveyance capacity at the CVP or SWP export facilities are available to move the water. Additionally, operations to accomplish these transfers must be carried out in coordination with CVP and SWP operations, such that project purposes and objectives are not diminished or limited in any way.

a. *Summary of Effects of Water Transfers*

CALSIM modeling results indicate water transfers would increase Delta exports from 200 to 600 TAF in about 80 percent of the years. Most transfers would occur during July through September. Since most juvenile salmonids are rarely present in the Delta in these months no increase in salvage due to water transfers during these months is anticipated. However, steelhead may be present in September if tributary flows are increased. Water transfers may also occur outside of the July through September period and would be subject to all current Delta Standards and pumping restrictions. The biological assessment further states that water transfers could be beneficial if Reclamation and DWR shift the time of year that water is pumped from the Delta from the winter and spring period to the summer, avoiding periods of higher salmonid abundance in the vicinity of the pumps. NOAA Fisheries does not concur that there are biological benefits to juvenile salmonids by shifting the availability of water from the winter and spring periods when environment (water) is used in the Delta to periods when transfers are not otherwise in the Delta. There may be operational conveniences for the operators but those conveniences are not the subject of ESA consultations and do not represent a beneficial effect for listed species.

The consequence of the integrated operations and water transfers described in the OCAP BA is not expected to adversely affect listed salmon or steelhead due to the infrequent occurrence of these actions (*i.e.*, use of upstream project integration occurred in only two years or 3 percent of the 72 years modeled by CALSIM). NOAA Fisheries examined the effects of increased Delta pumping for transfers from 200 to 600 TAF per year in most year, to as much as 800 to 1,000 TAF per year during dry and critical years when demand for transfers is high. These effects are included in the Delta Effects section for CVP/SWP Pumping Plants. The reduction in total and excess Delta outflow (OCAP BA Figure 8-5) due to increased pumping under the future operations was considered minor, approximately 2 and 4 percent, respectively, when compared to the baseline condition and can not be quantified at this time. Export of water transfers by the Project are included in this biological opinion, but actions taken to provide the transfer of water to the Delta are not described herein, so will have to be covered under separate ESA consultations.

VI. CUMULATIVE EFFECTS

Cumulative effects include those effects of future State, tribal, local, or private actions that are reasonably certain to occur within the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Non-Federal actions that may affect the action area include State angling regulation changes, voluntary State or private sponsored habitat restoration activities, State hatchery practices, agricultural practices, water withdrawals/diversions, increased population growth (*i.e.*, LOD), mining activities, and urbanization. Changes in State angling regulations generally are leading to greater restrictions on sport fishing that protect listed fish species. For example, new fishing regulations in 2002 protected steelhead populations in the Calaveras River that were previously not considered to be steelhead. In 2003, the in-river closure for Chinook salmon was lengthened from January 15 to January 1 to protect winter-run Chinook salmon adults. However, some angling regulations persist that allow the take of wild rainbow trout (recently proposed for inclusion in the steelhead ESU), such as on the upper Sacramento River. Additional loss of listed salmonids is expected in-river due to hooking mortality in the sport fishery. Lindsay *et.al.* (2004) found 3.2 percent of spring-run Chinook salmon died as a result of hooking mortality in Oregon. Since warmer water temperatures can diminish the recovery rate of fish from these contacts, California rivers would be expected to have higher rates.

Habitat restoration projects may have short-term harmful effects associated with in-water construction work, but these effects are temporary, localized, and the outcome beneficial to listed salmonids. Non-Federal hatchery (*e.g.*, Mokelumne and Merced Hatcheries) practices may hasten the decline of naturally-produced salmonids through genetic introgression, hybridization, competition, crowding, redd superimposition, and disease transmission resulting from hatchery introductions. Farming activities within or adjacent to the action area may reduce foraging behavior, decrease growth rates, increase water temperatures and increase susceptibility to disease for salmonids in the Sacramento River due to return water laden with agricultural chemicals. Essential features of critical habitat that are degraded on the Sacramento River include water, space, cover, and rearing along approximately 200 miles of mainstem river. In addition, the function of critical habitat will continue to be reduced through the cumulative loss of riparian areas along Central Valley rivers due to bank stabilization projects (FWS 2000), Reclamation District practices (*i.e.*,the removal of trees along the banks through spraying, cutting and burning), and urban growth and development (*e.g.*, boat docks, marinas, sewage out falls).

Cumulative effects include non-federal riprap projects. Depending on the scope of the action, some non-federal riprap projects carried out by State or local agencies do not require Federal permits. These types of actions, and illegal placement of non-federal riprap are common throughout the action area. The effects of such actions result in continued fragmentation of existing high-quality habitat, and conversion of complex nearshore aquatic to simplified habitats that affect salmonids in ways similar to the long-term effects of the proposed action.

Potential cumulative effects include future non-federal water withdrawals/diversions which affect salmonids by entraining, injuring or killing 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. Most of the largest diversions in the action area are screened or in planning phases with Federal cost share money. The thousands of smaller non-Project diversions (less than 40 cfs) are largely privately owned and may have a significant cumulative effect when considered together. These diversions include M & I uses as well as water for power plants. On the American River the cumulative effect of water withdrawals outside of the watershed was found to have a significant effect on steelhead in the LAR by increasing summer time water temperatures (SWRI 2001). In addition, water quality will be degraded from the return of M & I water back into the river where listed salmonids are rearing and migrating.

Additional cumulative effects may result from the discharge on point and nonpoint source chemical contaminant discharges. These contaminants include selenium and numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. The proliferation of exotic species may occur from increasing water temperatures due to future LOD or when the levees are breached (*e.g.*, Upper Jones Tract Break in 2004) or when separate creeks of river systems are reconnected during various projects. Exotic species can kill through predation or displace native species that provide food for larval fish. Contaminants may injure or kill salmonids by affecting food availability, growth rate, susceptibility to disease, or other physiological processes necessary for survival.

Future urban development and mining operations in the action area may adversely affect water quality, riparian function, and stream productivity. Many of the intermittent streams important for steelhead spawning are being rapidly destroyed by urban sprawl before adequate monitoring can even detect presence and/or absence. Examples of this abound in the Roseville area north of Sacramento where very little coordinated watershed planning exists.

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

Other potential cumulative effects on fish could include: wave action in the water channel caused by boats that may degrade riparian and wetland habitat and erode banks; dumping of domestic and industrial garbage; urban land uses that result in increased discharges of pesticides, herbicides, oil, and other contaminants into the water; and non-federal dredging practices. These actions and conditions also may injure or kill salmonids by affecting food availability, growth rate, susceptibility to disease, or other physiological processes necessary for survival.

VII. INTEGRATION AND SYNTHESIS OF THE EFFECTS

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. §1536), requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat that has been designated for those species. Regulations that implement section 7(b)(2) of the ESA define *jeopardize the continued existence of* as engaging in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). With respect to threatened and endangered species, then, federal actions are required to ensure that their actions would not be reasonably expected to appreciably reduce the species' likelihood of both surviving and recovering in the wild, by reducing the species' reproduction, numbers, or distribution. The final step of our assessment uses the results from our effects analyses to ask (1) what is likely to happen to different populations given the exposure and responses of individual members to the effects of the proposed formal and early consultation actions, and (2) what is likely to happen to the ESUs those populations comprise. These questions form the foundation for our jeopardy analyses.

Additionally, we complete separate analyses to determine if the proposed formal and early consultation actions are likely to destroy of adversely modify designated critical habitat. The regulations that defined destruction or adverse modification were first vacated by the Court in *Sierra Club* v *U.S. Fish and Wildlife Service and National Marine Fisheries Service* (Services; Fifth Circuit Court of Appeals; CA No. 98-3788-K-2 E.D. La). Subsequently, other Courts have found the regulation similarly invalid. Until NOAA Fisheries and the FWS promulgate a new regulatory definition, we apply the statutory definition of critical habitat: "(I) the specific areas within the geographical area occupied by the species, at the time it is listed ,..., on which are found those physical or biological features (ii) essential to the conservation of the species and (ii) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed,..., upon a determination by the Secretary that such areas are essential for the conservation of the species" (16 U.S.C. 1533(5)(A)) to our determination of destruction or adverse modification. If we determine that a proposed action is likely to render these areas or physical and biological features unuseable or inaccessible or degrade their conditions so that the listed species can no longer rely upon them for their conservation, then the proposed action is likely to destroy or adversely modify that critical habitat.

In the *Status of the Species* and *Environmental Baseline* sections of this Opinion, we discussed the various natural and human-related phenomena that caused the Chinook salmon, coho salmon, and steelhead ESUs to become threatened or endangered and continue to keep their populations suppressed, or in some cases, have improved the ESU's viability. For these ESUs, this section of the Opinion summarizes the physical, chemical, and biotic effects of the proposed operations of the Central Valley Project and State Water Project and their interrelated and interdependent actions to determine (a) if those effects can be expected to reduce the reproduction, numbers, or distribution of threatened or endangered species in the action area, (b) determine if any reductions in reproduction, numbers, or distribution would be expected to appreciably reduce the affected population's likelihood of surviving and recovering in the wild, and ©) if appreciable reductions in the population's likelihood of surviving and recovering in the wild would cause appreciable reductions in the ESU’s likelihood of surviving and recovering in the wild. For the second and third questions, NOAA Fisheries evaluates the effects of the proposed formal and early consultation actions when added to the status and environmental baseline of the ESUs and given the expected effects of future, non-Federal actions described in the *Cumulative Effects* section.

The two coastal listed salmonids, SONCC coho salmon and CCC steelhead, occur only in isolated portions of the action area, (*i.e.*, the Trinity River and Suisun Marsh, respectively), which should limit the complexity of potential Project impacts on these species. Although some adverse effects may occur (*e.g.*, mortality of juveniles due to stranding), overall Project impacts are expected to benefit SONCC coho salmon through implementation of the TRMFR program (considered separately from the proposed action), which will improve habitat suitability over the long-term. Project impacts to CCC steelhead in Suisun Marsh (*e.g.*, from the operation of the SMSCG) are expected to be minor because very few fish will be affected relative to the size of the CCC steelhead population, and some effects (*e.g.*, migration delays) will be transitory and non-lethal in nature.

Various life stages of the Central Valley species, on the other hand, occur throughout the project area due to their migration patterns. Consequently, Project effects on winter-run Chinook salmon, spring-run Chinook salmon, and steelhead have the potential to be both complex and extensive. Important factors contributing to our analysis of Project effects on these species include the current status of the species and habitat, the environmental baseline, and the large action area and long-term nature of the Project (*i.e.*, our analysis extends until 2020, or approximately 5 generations of salmonids). NOAA Fisheries notes that Project dams will continue to block access to hundreds of miles of upstream spawning and rearing habitat, and that although key large-scale habitat restoration efforts are planned (*e.g.*, CALFED actions in Battle Creek), these efforts are not considered a part of the proposed actions, nor are they certain to occur. Remaining habitat downstream of Project dams must be intensely managed in order to assure timely and adequate flows and water temperatures occur to meet competing species and life stage needs.

Project operations are designed, in part, to provide for the biological requirements of listed Central Valley species (including species protected under the jurisdiction of the FWS). However, some adverse effects to salmonid habitat and individual salmonids are expected to occur during the course of proposed operations. Project operations are likely to adversely affect winter-run Chinook salmon, spring-run Chinook salmon, and steelhead primarily by reducing the suitability and availability of habitat in the upstream areas of the Sacramento River (including critical habitat of winter-run Chinook salmon), Feather River, American River, Stanislaus River, and San Joaquin River (*i.e.*, all Project streams except for the Trinity and Mokelumne Rivers and Clear Creek); and by conveying large numbers of juveniles into the Central and South Delta, where they may be killed through direct entrainment in Project diversions or otherwise experience lower survival compared to individuals remaining in the mainstem Sacramento and San Joaquin Rivers; this effect is expected to be linked in part to DCC operations.

A. Upstream Effects

At certain times of the year, Project operations result in flows, water temperatures, and physical facility operations that reduce habitat availability and suitability. These habitat effects translate into impacts to individual fish such as delaying or blocking adult migration into suitable spawning habitat and decreasing spawning success, killing vulnerable life stages such as eggs, larvae, and juveniles due to stranding or elevated water temperatures, or increasing the likelihood of disease or juvenile vulnerability to predation due to temperature stress.

1. Trinity River and Clear Creek

Implementation of the proposed Trinity River ROD is expected to minimize adverse impacts to SONCC coho salmon and restore the natural channel forming processes of the river, which in the long-term should provide benefits to adult coho salmon through the improved quality and quantity of critical habitat. NOAA Fisheries expects in-river (*i.e.*, natural) spawning success of SONCC coho salmon to increase because adequate spawning and rearing habitat presently is limited in the Trinity River. Rearing habitat suitability for juveniles is expected to improve due to decreasing summer water temperatures more into the preferred range for this life stage. Overall, the Project is anticipated to increase the likelihood of survival and recovery of SONCC coho salmon in the Trinity River. In addition, adverse effects of Project operations (*e.g.*, migration delays or elevated water temperatures) on spring-run Chinook salmon and steelhead in Clear Creek generally are expected to be minor because they will be temporary or infrequent. Some increased take of winter-run Chinook salmon eggs and fry is expected in Clear Creek in future years due to straying of adult spawners into the lower reaches where temperatures are unsuitable; however, the loss in production of a few individuals is not considered significant to the population given the recent increase in numbers of adults spawning in the mainstem Sacramento River.

2. Sacramento River

Long-term average EOS carryover storage in Shasta Reservoir is reduced by 130 TAF under future conditions compared to today's (CALSIM Studies 3 vs 5a). Reductions are due to releases for SWP in-basin requirements and extra pumping capacity for JPOD, and occur under both formal and early consultation actions because of the relatively large impacts of the reduction in Trinity River exports during the summer and the increased 2020 LOD. Project operations are expected to increase the frequency of EOS carryover storage in Shasta Reservoir falling below 1.9 MAF by 4 percent or increase the probability of occurrence from 15 percent to 19 percent (Study 3 vs 5a). The result will be a reduced ability to control water temperatures in the upper Sacramento River and an increase in frequency of very low storage conditions (as indicated by EOS storage below 1.9 MAF).

Reclamation proposes to move the temperature compliance point to Ball’s Ferry, approximately 20 miles upstream of the baseline compliance point of Bend Bridge. Adaptive management processes are expected to be used to review and potentially revise the compliance point on a yearly basis given available information. However, for purposes of analysis in the Opinion, temperature impacts to salmon and steelhead populations were based on an assumed compliance point of Ball's Ferry in every year.

a. *Winter-run Chinook salmon*

Reclamation's Salmon Mortality Model estimates that the proposed operations will increase temperature-related losses of the early life stages of winter-run Chinook salmon on average 1-2 percent under both conditions today and in the future (*i.e.*, assuming 99 percent of adults spawn above Balls Ferry). Average mortality is less than 5 percent in most years except critically dry, as discussed below. Through the SRTTG, protective actions are anticipated to reduce this loss. Therefore, for most water years the increase in average egg and fry loss is not expected to be significant.

Based on the spawning distribution since operations of the gate at the RBDD changed in 1993, an average of 3.6 percent of the adult winter-run Chinook salmon population has spawned below Balls Ferry (DFG 2004e). The impact of proposed temperature operations for those fish that spawn below Ball's Ferry equates to a 0.54 percent loss of the total juvenile production on average, based on 8-15 percent of the eggs being lost due to a 1-2 degree difference in water temperatures.[6] Under future conditions, if the population increases or high winter flows shift spawning downstream, adults would be expected to utilize habitat below Balls Ferry to a greater extent than today, thus the loss in juvenile production would be expected to increase. In wet years there is likely to be sufficient cold water available to provide suitable water temperatures below Balls Ferry and to accommodate shifts in spawning distribution.

Increases in water temperatures during critically dry years in the winter-run Chinook salmon spawning area are expected to result in high levels of egg and larval mortality. Under baseline conditions, the winter-run Chinook salmon population experienced an estimated 41 percent mortality in 15 percent of the modeled 72 year period. The proposed formal consultation actions are expected to increase both the amount and frequency of these high mortality levels to 44 percent and 19 percent, respectively.

Through flexibility in real time operations and the adaptive management process (*i.e.*, SRTTG and B2IT) protective actions (*i.e.*, increased flows, warm water bypasses, use of the TCD, and low level outlets) would be taken early on to avoid temperature effects to early life stages of winter-run Chinook salmon.

b. *Central Valley spring-run Chinook salmon*

Adaptive management actions taken to protect winter-run Chinook salmon might have a negative effect (*e.g.*, through use of the cold water pool early in the summer) on spring-run Chinook salmon in the mainstem Sacramento River, however, NOAA Fisheries expects that real

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[6] using the relationship between temperature and mortality developed by the FWS and DFG (OCAP BA version May 24, 2004, Table 6-2).

time operations will include consideration of the needs of spring-run Chinook. Modeling analysis of Project effects (which cannot factor in the effects of adaptive management processes) indicate that average annual mortality for spring-run Chinook salmon increases approximately 5 percent, from 15, 17, and 76 percent under baseline conditions to 20, 22, and 82 percent in below normal, dry, and critical years, respectively.

c. *Central Valley steelhead*

Under proposed formal consultation actions, steelhead egg and fry mortality would remain unchanged from the baseline (*i.e.*, less than 2 percent) based on the assumption that the rate is similar to that for late fall-run Chinook salmon.

3. Red Bluff Diversion Dam

Based on the most current population estimates (DFG 2004b, 2004c, 69 FR 33102) and our analysis, current operations of the RBDD gates will block or delay approximately 7.2 percent of the spring-Chinook salmon population (760 adults), 15 percent of the winter-run Chinook population (1,220 adults), and 9.7 percent of the steelhead population (349 adults). In the future, passage delays are likely to increase due to more frequent early gate closures caused by increased demands for water in the upper Sacramento River Basin (*i.e.*, less water available in Black Butte Reservoir and greater demands in the Orland area). Chinook salmon delayed at RBDD can consume a greater amount of their energy stores than if there been no obstacle in their path which may subject them to: a greater chance of disease, especially if they have to hold over summer in warm water conditions prior to spawning (*e.g.*, spring-run Chinook salmon), increased adult pre-spawning mortality (Reclamation 1985), and decreased egg viability (Vogel *et al.*, 1988), all of which may result in the reduction in annual recruitment. Based on their reproductive strategy and condition when they reach the dam, adult delays at RBDD are not expected to be significant for steelhead.

Steelhead and spring-run Chinook salmon may lose access to their natal tributaries upstream of RBDD due to delays at the dam during the warmer months when low flows and thermal barriers can develop at the mouths of these tributaries. For example, delays of up to 20 days prevent adults from accessing natal streams above RBDD that dry up or formal thermal barriers at the mouth, like Cottonwood Creek or Clear Creek (Reclamation and TCCA 2004). A chronic loss of spawners from the small and remnant populations found in these tributaries could decrease the viability of these populations. Long-term habitat restoration projects in upper Sacramento River tributaries could be prevented from fully functioning *(i.e.*, meeting the carrying capacity of the habitat) because adult spawners are blocked or delayed from accessing these critical areas by RBDD gate operations.

Juveniles are expected to experience disorientation and predation as they pass under the gates based on previous studies before gate operations were modified. NOAA Fisheries does not know what predation rates are during the current 4 months “gates in” operation, but approximately 1.0 percent of the juvenile spring-Chinook salmon population, 39 percent of the winter-run Chinook population, and 36 percent of the steelhead juvenile populations are vulnerable to predation during the closure period.

4. American River

Average monthly releases from Folsom Dam for all water year types generally decrease due to the future LOD. Demand for water is predicted to increase by 310 TAF by the year 2020. Proposed operations result in detrimental effects to the steelhead population from flow fluctuations during spawning that dewater 5 to 15 percent of the redds, decreased flows that provide minimal habitat availability and suitability associated with unsuitable (*i.e.*, low elevation) habitat, decreased spawning success due to redd superimposition, and higher over-summer water temperatures resulting in predation and reduced fitness of juvenile steelhead .

5. Stanislaus River

NOAA Fisheries anticipates that steelhead numbers will continue to decline due to reduced suitability of instream habitat caused by operations that target flows less than 200 cfs below Goodwin Dam during the summer and early fall. Presently, operational plans do not include minimum base flows for the Stanislaus River. These proposed low flows limit and isolate the available habitat for refugia and may result in elevated water temperatures and stranding of juveniles in unsuitable habitat (NOAA Fisheries 1996).

6. Feather River

Year-round flows of 600 cfs in the Low Flow Channel of the Feather River will continue to maintain approximately five miles of habitat with preferred water temperatures for holding, spawning, and rearing spring-run Chinook salmon and steelhead. The Low Flow Channel is utilized by approximately 70 percent of the spawning populations of Chinook salmon and steelhead in the Feather River. Although preferred water temperatures within this five mile reach are met at a year round flow of 600 cfs, rearing habitat suitability for fry and juveniles is limited; especially for steelhead because only three riffle complexes are known to support summer rearing. Habitat suitability indices generally indicate that rearing habitat for both species reaches maximum suitability at flows of 1,000 cfs in the Low Flow Channel.

Flow fluctuations for flood control or dam safety inspections are expected to result in fry and juvenile spring-run Chinook salmon and steelhead being stranded in both the High-flow Channel and Low-flow Channel. These fluctuations are expected to occur on average every year and more frequently as the facility ages.

6. Freeport Regional Water Project

The FRWP diversion is located downstream of most other diversions and downstream of critical spawning and rearing areas. CVP water released to meet FRWP contract amounts will remain in the Sacramento or American River longer thus providing some habitat value to listed salmonids through increased releases during drought years. Since the screened diversion point is in the tidally influenced region of the lower Sacramento River it is unlikely that any reduction in water level attributable to diversion at the facility can be discerned. Overall, the FRWP is not anticipated to have an adverse effect on Central Valley salmonids.

7. Early Consultation

In some instances, early consultation components will increase Project impacts to listed Central Valley salmonids over formal consultation impacts. This effect would be greatest in the Sacramento River where, under early consultation, Shasta carryover storage is reduced by more than 200 TAF in most water year types causing higher water temperatures. The probability that less than 1.9 MAF will be available in carryover storage increases in dry years by 5 percent under 2020 LOD (CALSIM Studies 4 and 5). Frequency of water temperatures exceeding 56 °F at Ball's Ferry in all years would increase by 22 percent compared to 15 percent under formal consultation. Since most of these exceedances occur in September and October it is more likely that the individual reproductive success of some spring-run Chinook salmon will be reduced or impaired in the mainstem Sacramento River. Egg and fry mortality will increase more under early consultation as storage is reduced and temperature control decreases. Predicted average mortality is 9 percent for winter-run Chinook salmon, 25 percent for spring-run Chinook salmon, and 2 percent for steelhead (*i.e.*, using late-fall run Chinook salmon as a surrogate for steelhead).

On the American River, early consultation effects are expected to be greater than under formal consultation due to reduced habitat availability, increased redd superimposition, increased flow fluctuations, increased stranding and isolation and decreased habitat suitability from thermal stress and predation for over summering juvenile steelhead. Conversely, in the South Delta the construction and operation of permanent barriers will likely increase the survival of steelhead smolts originating from the Stanislaus River and other San Joaquin River tributaries.

B. Sacramento-San Joaquin Delta Operations (downstream)

In the Delta, many direct and indirect impacts of Project operations occur as a result of increased entrainment of salmonids into the Delta via the DCC and Georgiana Slough, and through changes in hydrology within the Delta due to pumping operations. Direct entrainment of juvenile Chinook salmon and steelhead will occur at the CVP/SWP export facilities and at the unscreened Rock Slough Diversion. The Project creates several adverse conditions for listed Central Valley salmonids in the Sacramento-San Joaquin Delta that result in mortality of juveniles. Sublethal responses also occur as juveniles are delayed or diverted in their migrations due to flow levels or facility operations and are exposed to water quality conditions (*e.g.* pollutant loads) that decrease their physiological condition. However, NOAA Fisheries cannot quantify the extent or consequence of these responses.

1. Delta Cross Channel

The primary avenues through which juvenile salmonids emigrating down the Sacramento River enter the interior Delta, and hence become vulnerable to entrainment by the export facilities and other adverse effects described below, are the DCC and Georgiana Slough. Therefore, operation of the DCC gates affects the survival of some juvenile salmonids emigrating from the

Sacramento River basin towards the ocean.

Newman and Rice (1997) found lower survival rates for salmon releases on the Sacramento River associated with the DCC gates being open. Using paired releases, Newman (2000) found that the DCC gates being held open had a negative effect on smolts migrating through the Delta and was confirmed using Bayesian and GLM modeling. Recent radio-tracking results (Vogel 2003) indicated when the DCC gates are closed, juvenile salmon movement into Georgiana Slough (*i.e.*, next opening downstream into the interior Delta) was unexpectedly high. Horn and Blake (2004) found that juvenile Chinook salmon were exposed to entrainment into the Central Delta through the DCC at least two times per day and possibly four times a day due to tidal exchanges. Extensive regression and correlation analyses of paired releases (*i.e.*,1993-1998) indicate that the survival of smolts released into Georgiana Slough and simultaneously at Ryde is increased as exports are reduced (Brandes and McLain 2001, FWS 2001-2004). These findings are the basis for reducing exports at the Delta pumps through the use of EWA and CVPIA b(2) water under early consultation actions to protect juvenile salmon migrating through the Delta.

During the periods of winter-run Chinook salmon emigration through the lower Sacramento River, approximately 20 to 50 percent of the Sacramento River flow can be diverted into the interior of the Delta through the DCC and Georgiana Slough. Modeling of the DCC shows 20% in November, 15% in December, and 9% in January of critical year types (OCAP BA figure 10-5). With the DCC gates closed or opened, approximately 15-20 percent of the river's flow is diverted down the Georgiana Slough channel (20 to 25% in critical years). Analysis of two week intervals (Low 2004) found significant positive relationships ($P < .01$) between the proportion of Sacramento River flow diverted into the interior of the Delta in December and January and the proportion of the juvenile winter-run Chinook salmon lost at the CVP/SWP export facilities in late December (December 15-31) and early January (January 1-15) periods.

In dry years, flow patterns are altered to a greater degree than in the wet years and are expected to result in a higher level of impact to emigrating winter-run Chinook salmon, spring-run Chinook salmon, and steelhead as they move into the interior Delta (*e.g.*, water quality demands require the DCC gates to be opened to freshen the interior Delta).

2. <u>CVP/SWP Pumps and Rock Slough Intake</u>

Based on the increase in pumping rates, the direct take at the CVP/SWP pumps is anticipated to increase on average by 10-12 percent over the baseline for all three listed Central Valley salmonids. Increased pumping at the CVP as a result of the Intertie will occur during the winter months when listed fish are present and will increase direct entrainment in both the formal and early action consultations. Average differences from the baseline vary by water year and location but are generally higher at the SWP than at the CVP. Losses at the CVP are probably underestimated due to problems with maintenance and cleaning that allow unscreened water to pass through the fish collection facility approximately 20-25 percent of the time (5 to 6 hours per day). Analysis of each month's pumping rates using CALSIM modeling indicates that the proportional loss rates for winter-run and spring-run Chinook salmon will increase the most in Below Normal, Above Normal and Wet Years at Banks pumping plant. Loss rates for winter-run and spring-run Chinook salmon in the future will proportionally increase by 7 percent in January to as much as 32 percent in March from Today's level during these year types. For steelhead the highest proportional increase in loss, 26 percent, occurs in March of a Wet year at Banks (Study 1 vs 5). Future operations increase entrainment mortality in winter months with or without early consultation actions. The significance of this increase can be viewed in light of juvenile production (Table 7). Increased pumping would entrain less than one percent of the juvenile winter-run Chinook salmon population entering the Delta under today and 2020 conditions. Compared to the temperature related losses upstream, the pumping loss would generally be less than the upstream losses except in critically dry years (*i.e.*, using smolt equivalents, 0.76 percent loss in smolts < 1.0 percent loss in eggs/fry mortality). Spring-run Chinook salmon pumping loss would fluctuate between 1 and 3 percent of the juvenile production depending on the water year, higher numbers would be taken in wet years when production is greater. Steelhead entrainment loss would almost double the current levels of salvaged fish. The increase in loss would likely reduce the annual juvenile production entering the Delta by 5 percent under future conditions assuming predation rates are similar to Chinook salmon (Table 8). Continual monitoring at the Delta pumps and use of adaptive management process (*i.e.*, DAT and WOMT) protective actions could minimize the likelihood of this increase occurring. However, the benefits of these protective actions (*i.e.*, export curtailments through the use of CVPIA(b)(2) and EWA water) at the population level appear to be small and not well understood (Kimmerer 2002) and are therefore used primarily to avoid exceeding incidental take levels.

Table 7. Average juveniles losses at the Delta Pumps based on 1993-2003, compared to juvenile production entering the Delta in 2003.

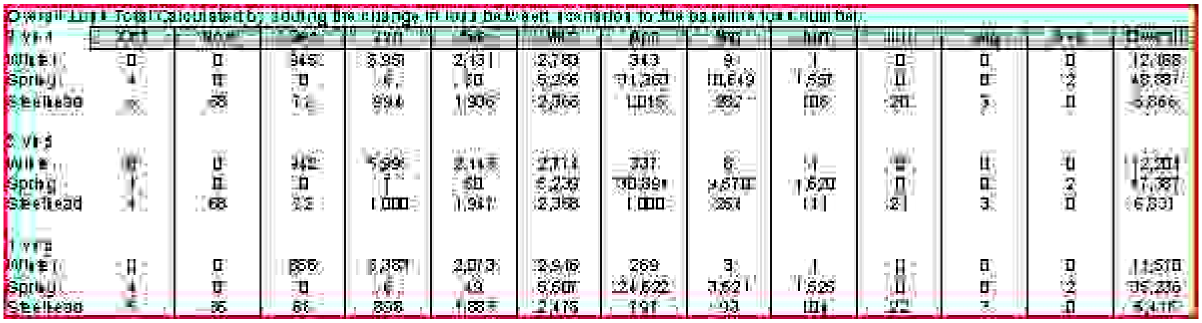
	Baseline yearly loss Today[1]	Future yearly loss w/SDIP[2]	Loss as a % of JPE Today[3]	Loss as a % of JPE Future	Population change
Dry Years					
winter-run	10,467	14,595	0.55	0.76	0.21
spring-run	15,180	20,137	0.80	1.06	0.26
steelhead	4,560	6,681	3.51	5.14	1.63
Wet Years					
winter-run	9,302	11,098	0.49	0.58	0.09
spring-run	49,394	59,525	2.60	3.13	0.53
steelhead	5,207	6,941	4.00	5.34	1.34

[1] Ten year averages (*i.e.*,1993-2003) from Tables A6-A9 and Sacramento River Index,

geometric mean used for unclipped steelhead loss. [2] Future loss based on Dry year data 1994, 2001, 2002 and Wet year data 1993, 1995-2000, and 2003 presented in OCAP BA, Tables 10-2 and 12-2, dated May 24, 2004. [3] JPE assumes population level in 2003 (*i.e.*,10,000 adult spring-run Chinook salmon, 8,133 adult winter-run Chinook salmon, and 130,000 wild steelhead smolts). Note: Steelhead loss assumes predation is similar to Chinook salmon.

Overall average loss for all water years at the Delta pumps compared to the baseline loss (*i.e.*, by adding the change in loss between Study 3 vs 5) would increase take at the pumps to 12,201 for winter-run Chinook salmon, 47,387 for spring-run Chinook salmon, and 6,837 for steelhead (Table 8).

Table 8. Overall loss calculations using the change from baseline (Today).



Overall Loss Total Calculated by adding the change in loss between scenarios to the baseline loss number.

[illegible] Yrs	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Overall
Winter	0	0	945	5,951	2,131	2,783	343	9	1	0	0	0	12,168
Spring	4	0	0	6	50	5,256	31,363	10,649	1,557	0	0	2	48,887
Steelhead	[illegible]	68	72	994	1,906	2,366	1,015	382	106	20	3	0	6,866
[illegible] Yrs													
Winter	[illegible]	0	942	5,996	2,143	2,714	337	8	1	[illegible]	0	0	12,201
Spring	[illegible]	0	0	[illegible]	60	5,239	30,391	9,570	1,620	0	0	2	47,387
Steelhead	[illegible]	68	72	1,000	1,941	2,358	1,000	257	111	21	3	0	6,837
[illegible] Yrs													
Winter	0	0	855	6,387	2,073	2,946	269	3	1	0	0	0	11,570
Spring	4	0	0	6	43	5,507	24,622	3,621	1,525	0	0	2	35,236
Steelhead	[illegible]	35	66	898	1,883	2,475	191	93	104	22	3	0	5,416

The increase in pumping rates under future conditions will increase the number of fish drawn to the pumps in the south Delta over the current baseline conditions. This means for the additional numbers of fish projected to be salvaged at the export facilities under the increased export demands, an appreciable number of fish must have entered from the north Delta. Under the assumptions of the model, certain months of the migration period for salmonids have substantial increases in pumping over the baseline conditions. For example, in a wet year, the SWP can increase pumping by almost 22 percent under the 4a study (without Banks at 8500) conditions in March, a peak month for both winter-run and spring-run Chinook salmon emigration as well as the peak in steelhead salvage at the export facilities. Any increase in water volume moving towards the pumps will carry additional fish through Georgiana Slough with it, hence the proportional increase in salvage numbers when pumping rates increase. Fish that are drawn to the export facilities will be killed not only from predation prior to being screened (75 percent at the SWP), but also from screen inefficiencies (*e.g,* cleaning, gaps, debris loads etc.) which allow fish to pass through to the pumps themselves. Un-quantified mortality occurs during the release of salvaged fish back into the Delta, but the release is generally considered beneficial as all of the salvaged fish might otherwise die at the pumping facilities.

Until Rock Slough Intake can be screened, juvenile direct losses due to entrainment may be expected to increase as Contra Costa water demands grow. Based on the best available data, extrapolated losses are expected to be 2,215 juvenile spring-Chinook salmon population, 257 winter-run Chinook population, and 738 steelhead. At the population level this loss would be insignificant by itself, but in combination with the CVP/SWP pump loss, it would be significant for steelhead (Tables 9 and 10 below). However, this analysis does not recognize the changed operations associated with the Los Vaqueros Project which is now the primary diversion point for CCWD during January through August each year.

3. Interior Delta Mortality

The Particle Tracking Model results and various Delta survival studies (FWS 2001-2004; Vogel 2004) support the conclusions that mortality can be substantial (*i.e.*, 37-50 percent of the fish entering the Delta via the DCC and Georgiana Slough in these studies) through the interior Delta due to predation and/or indirect effects. Substantial mortality under baseline conditions is anticipated to result from listed fish being drawn into the waters of the central Delta. Each fish physically recovered at the export facilities represents several dozen additional fish that are lost in the interior of the Delta. The evidence from the PTM, survival and abundance studies, radio telemetry studies, and the acoustic tracking studies all support the conceptual model that an appreciable number of salmonid juveniles are conveyed from the Sacramento River through the DCC and/or Georgiana Slough, and once in the Delta interior will be drawn southwards towards the export facilities. There will be little change (1% or less) from current conditions in the percent of fish from the Sacramento River diverted into the Delta through the DCC or Georgiana Slough. The predation data from the radiotelemetry studies (Vogel 2004) support the survival indices calculated from the abundance and survival studies. The FWS studies (Brandes and McLain 2001, FWS 2001- 2004) estimated mortality ranging from 33 percent to 95 percent of the fish entering the Delta, and Vogel's studies found a predation rate of 82 percent in Georgiana Slough. Vogel also found that predation in the Sacramento River was approximately 23 percent of the released fish. Those fish that are not lost to predation are susceptible to loss due to irrigation diversions in the central and south Delta. In addition, NOAA Fisheries anticipates that fish drawn into the central and south Delta will be subjected to adverse water quality, pollution, pathogens, and delayed migration which may lead to physiological stress, disease, disorientation, and overall decreased likelihood of successful outmigration and survival. The available data suggest that the increased mortality associated with the indirect effects of moving water and fish across the interior of the Delta can range from 4 to 40 percent in the baseline for the juvenile population entering the Delta (*i.e.*, using winter-run Chinook salmon juveniles)[1]. The incremental difference due to increased pumping rates probably ranges from one percent based on a mean survival rate of 17 percent in the Simple Model (Tables A10) to 16 percent based on mark-recapture data presented in salmon workshops (Brown and Kimmerer 2003). For other listed species such as steelhead, mortality is expected to be greater for those fish emigrating through the Delta from the San Joaquin River since a greater portion of that river's flow is exported at the Delta pumping facilities. Under formal consultation conditions, the equivalent of 100 percent of the San Joaquin River flow will be exported.

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[1] Forty percent loss would occur when cross-Delta survival is very low (*e.g.*, at a 95 percent mortality level) and the export salvage reaches 2 percent of the winter-run Chinook JPE. This would be a worst case condition. In the best case scenario, four percent of the winter-run Chinook JPE is lost crossing the Delta (*e.g.*, at a 33 percent mortality level).

In addition, CALSIM modeling predicts the long-term average Delta outflow is reduced by 239 TAF under today's condition. Total excess Delta outflow is decreased by 394 TAF under future conditions (OCAP BA Table 12-14). This reduction represents approximately 2 percent of total average Delta outflow and about 4 percent of the excess outflow. Reductions in Delta outflow are a direct result of increased pumping rates in the winter months (*i.e.*, October through March) when salmonids are present. The abundance or survival of Chinook salmon and estuarine-dependent species has been shown to increase with freshwater outflow (Kjelson 1981, Kimmerer 2002). Therefore, it is anticipated that the suitability and value of the Delta as important habitat for salmonid emigration and rearing will be further diminished in the future as the Delta outflow is reduced, but we cannot quantify to what degree this will affect listed salmon and steelhead populations.

The current practice of waiting for salmon numbers at the fish salvage facilities to increase before triggering protective actions is not anticipated to reduce or eliminate the increased loss due to mortality and morbidity incurred in the Delta interior from increased pumping activities. By the time sufficient numbers of listed salmonids are recovered at the export facilities, a substantial proportion of the population may already have been lost in the Delta.

4. Early Consultation

Effects to listed salmonids in the Sacramento-San Joaquin Delta in general are linked to CVP/SWP pumping rates, and are modeled as such in CALSIM. Therefore, early consultation elements are expected to increase the severity of the effects in the Delta identified under the formal consultation portion of the Project. CALSIM modeling predicts the long-term average Delta outflow is reduced by 343 TAF in the future with Banks at 8500. The additional pumping (*i.e.*, Banks 8500 and CVP/SWP Intertie) that will occur over current conditions at both the SWP and CVP export facilities will increase the number of winter-run Chinook salmon that will be salvaged under most conditions, and is expected to increase mortality through indirect effects as discussed earlier (*i.e.*, predation, water quality, loss of habitat, *etc.*). Effects on spring-run Chinook salmon and steelhead are expected to be similar. The increase in pumping rates simply will increase the number of fish drawn into the interior Delta and to the Delta pumps compared to current baseline conditions. The increase in pumping will not change what goes through the DCC or Georgiana Slough into the interior Delta so any increase in number of fish has to be mostly fish that are in the Delta anyway not new fish entering due to increased pumping.

C. Interrelated and Interdependent Actions

1. Hatcheries

Specific information on the effects of each hatchery was not available for this consultation. NOAA Fisheries expects the effects of hatchery activities on listed salmonids to be addressed in more detail in a future consultation. Generally, hatcheries within the action area (*i.e.*, Trinity River, Livingston Stone, Coleman, Feather River, and Nimbus) were established on Project streams as mitigation for habitat lost upstream of high dams. However, hatchery operations can also negatively affect the viability of natural fish populations through such mechanisms as the introduction of exotic strains of diseases, hybridization of hatchery fish with native local stocks of fish, and domestication (*i.e.*, selection for genetic traits advantageous in a hatchery setting and accompanied by a loss of fitness for natural rearing). Hatchery fish may increase the abundance of fish numbers, but there is evidence to demonstrate that they are not as productive or genetically fit in the natural environment as fish under natural selection (Chilcote 2003, *et al.* 1986; Berejikian *et al.* 1999; Fleming *et al.*1993, Unwin 1997).

For winter-run Chinook salmon, artificial propagation was identified as a necessary restoration action to prevent the extinction of the ESU, and so may be viewed as beneficial. However, for the other ESUs considered in this opinion, the naturally-spawning populations in Project streams are dominated by hatchery fish, due almost always to a scarcity of suitable spawning habitat coupled with production of large numbers of hatchery fish. NOAA Fisheries believes this to be a stressor for steelhead populations in virtually all project streams due to the very low numbers of naturally spawning fish (*e.g.*, fewer than 200 on the Feather River), which can easily be overwhelmed genetically by hatchery fish. For spring-run Chinook salmon, NOAA Fisheries anticipates that the naturally-spawning population will be lost on the Feather River due to introgression with hatchery-produced fall-run Chinook salmon.

2. Long-term Contracts

The greatest effect of long-term water contract renewals on listed salmonids is anticipated to be direct entrainment and mortality of juvenile salmonids in unscreened diversions. Based on the analysis in the OCAP BA (June 30, 2004, version), under future conditions no more than 2 percent of the winter-run and spring-run Chinook salmon juvenile production in the project area would be killed through the renewal of water contracts. For steelhead, the proportion of juveniles lost through entrainment at CVP contractor diversion facilities is expected to be higher due to their constant exposure while rearing for up to two years in areas where unscreened diversions are common (*e.g.*, Feather River, Stanislaus River, Calaveras River). NOAA Fisheries anticipates that approximately 3.5 percent of the juvenile steelhead population is entrained based on results from DFG's (2002) Merced River study. Actual losses for juvenile winter-run and spring-run Chinook salmon are expected to be higher then 2 percent for the next 10 years until screening of the largest of these diversions in the upper Sacramento River is completed. These are the general expected effects of water contracts and diversion of the water; NOAA Fisheries lacked specific information on individual water contracts to analyze the expected effects in more detail. Future individual section 7 consultations on long-term contracts are expected to analyze the impacts of unscreened diversions individually and cumulatively after the OCAP BO is completed.

Additional effects caused by the use of CVP contract water are a degradation of the quality of water in the Sacramento River while juvenile winter-run Chinook salmon are rearing and out-migrating. Since the majority of CVP contract water (1.8 MAF) is returned to the Sacramento River after being used for irrigation or flooding wetlands, juvenile salmonids are exposed to higher water temperatures, pesticides, and contaminants that may reduce the survival rate of some individuals before entering the Delta or before the first rains dilute the impact of the return water. It is unknown to what extent this affects the population, but it is known that there is a significant delay in emigration from RBDD to Knights Landing during the fall months (Low 2004) which may be due, in part, to poor water quality conditions that occur prior to the first winter storms.

D. Population Impacts and Potential for Recovery

Table 9 summarizes the expected effects of the proposed actions on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead ESUs in terms of the increased percentage loss to juvenile and adult life stages. The table includes the direct and indirect impacts of the proposed actions and interrelated and interdependent actions, where quantification was possible. Overall project effects are expected to result in the loss of an additional 3 to 20 percent of the winter-run Chinook salmon juvenile population, 5 to 20 percent of the spring-run Chinook salmon juvenile population, and 12.5 to 27.5 percent of the steelhead juvenile population over baseline conditions.

Table 9. Summary of population level effects based on CALSIM modeling and historical spawning distribution, shown as a percentage of the total juvenile or adult population.

Upstream Effects	Winter-run	Spring-run[1] (mainstem Sac. R only)	Steelhead
EOS carryover storage reduction in Shasta, juvenile mortality below Balls Ferry *	0.5% in 20% of the years	U/N	U/N
Average increase in mortality from water temperature (3 v 5) *	1-2%	0.4%	0.1%
Critical Year increase in mortality from water temperature (3 v 5)	3%	0.6%	0.3%
Flow fluctuations, based on redds dewatered *	minor	minor	1% juveniles
Delta Effects		(all juveniles)	
CVP/SWP Pumps, juvenile loss as a percentage of JPE (future formal and early actions)*	0.76 (dry) 0.58 (wet)	1.06 (dry) 3.13 (wet)	5.14 (dry) 5.34 (wet)
CVP/SWP Pumps, adults (3.5% of salvage)	N/A	N/A	1% adult
Indirect mortality increase due to pumping[2] *	1-16%	1-16%	1-16%

SMSCG (adults delayed 10-40 hrs)	U/N	U/N	U/N
Rock Slough mortality proportion of JPE *	0.01%	0.03%	0.56%
Long-term Contracts, juvenile entrainment *	< 2%	< 2%	~3.5%
Combined juvenile mortality for most years (Upstream + Delta effects) *	**3-20%**	**5-20%**	**12.5-27.5%**

U/N= unknown, N/A = not applicable

* Indicates which effects were summed for total Project mortality

[1] Assumes <10% of spring-run Chinook salmon present upstream of RBDD

[2] The 16 percent value is based on mark-recapture data presented at salmon workshops (Brown and Kimmer 2003)

Table 10 summarizes the expected effects of current operations on the winter-run Chinook salmon, spring-run Chinook salmon, and steelhead ESUs in terms of the percentage loss to juvenile and adult life stages. The table includes the direct and indirect impacts of CVP and SWP operations and interrelated and interdependent actions, where quantification was possible. Current operations result in the loss of 42 percent of the winter-run Chinook salmon juvenile population, 37 percent of the spring-run Chinook salmon juvenile population, and 39 percent of the steelhead juvenile population assuming that 33% of the population dies in the delta due to indirect effects of the project. Actually, some of this mortality would occur with or without the project.

Table10. Summary of Baseline Project Effects based on CALSIM modeling and historical spawning distribution shown as a percentage of the total juvenile or adult population.

Upstream Effects	Winter-run	Spring-run (mainstem Sac. R. Only)	Steelhead
Spawning habitat reduced as a proportion of total miles below Project Dams	42%	100%	26% (American and Feather Rivers only)
Spawning distribution reduced based on redd counts between Balls Ferry to Bend Bridge (10 year average)	3.6%	48.2%	U/N
Average early-life stage mortality all years and (critically dry years) from Today Study 3 *	8% (41)	2.1% (7.6)	2% (3)

Flow Fluctuations (based on redds dewatered)*	minor	minor	1%
RBDD operations (adults delayed or blocked)	15%	7.2%	9.7%
Delta Effects		(all juveniles)	
CVP/SWP Pumps juvenile loss as a proportion of JPE from Today Study 3*	0.50 (avg) 0.55 (dry) 0.49 (wet)	1.70 (avg) 0.80(dry) 2.60 (wet)	3.70 (avg) 3.51 (dry) 4.00 (wet)
Losses due to Indirect mortality (best case)*	33%	33%	33%
Combined juvenile losses (direct + indirect) for average years (all Upstream + Delta effects)*	**42%**	**37%**	**39%**
Combined juvenile losses for average years without indirect mortality	8.5%	3.8%	5.7%
Combined juvenile losses in critical years without indirect mortality	41.5%	9.3%	7.0%

U/N = unknown
* Indicates which effects were combined to get total Baseline mortality

This section analyzes the overall effects of the proposed actions, distinguishing between formal and early consultation effects where appropriate, to determine if the responses of affected individuals and populations are sufficient to decrease the likelihood of survival and recovery of the listed species in the wild. Operational effects that result in the local extirpation or reduced viability of a sub-population within an ESU may also increase the extinction risk of the ESU based on the relationship between local and regional persistence in species. Based on this relationship, the risk of regional extinction is lower than the risk of local extinction; however, as local probabilities change, the probability of regional persistence changes correspondingly.

Recent status reviews (NOAA Fisheries 2003) of the ESUs analyzed in this Opinion report various population characteristics such as mean log growth rate (μ) and finite rate of increase (λ). These measures are further discussed below to aid in understanding of current population conditions within the ESUs.

A population's mean log growth rate (μ) is a measure of the population's stochastic growth over time. In forecasts of a population's stochastic growth over time, some trajectories would increase, some would remain somewhat stable, while others would decrease. The mean log growth rate is a measure of the population's "average" growth rate assuming that some trajectories will increase, some will remain stable, and others will decrease (here, “average” is a geometric mean rather than an arithmetic mean because forecasts of population growth multiply a starting value by a rate; averages of multiplicative processes are best represented by geometric means). If a population’s mean log growth rate, $\mu > 0$, then most population trajectories will increase; if $\mu < 0$, then most population trajectories will decline.

A population’s finite rate of increase (λ) captures a population’s growth rate or the amount by which a population size multiplies from year to year. In the face of stable environmental conditions, this growth rate would be constant and a population would increase geometrically ($\lambda > 1$), decrease geometrically ($\lambda < 1$), or remain the same ($\lambda = 1$). However, in changing environments, a population’s birth and death rates will vary and the population’s growth rate will vary as well.

1. Sacramento River Winter-run Chinook Salmon

Analysis of population estimates taken at RBDD since 1986, indicates that the population growth rate (λ) for winter-run Chinook salmon is 0.97 (95 percent confidence intervals: 0.87 and 1.09), indicating a population that may be declining at 3 percent per year, although the confidence intervals around this average allow for a population that is decreasing at a rate of 13 percent per year or increasing at a rate of 9 percent per year. Estimated mean log growth rate (μ) indicates a population that is generally declining, although confidence interval values also indicate that the population may be generally increasing. Short-term productivity has been increasing, as indicated by the CRR, which was greater than 1.0 for last eight years. In the last three years, the population has been increasing due to hatchery supplementation, restrictions on ocean harvest, use of the TCD on Shasta Dam, and changes in Project operations due to the WRO. In the future, if CALFED restoration of Battle Creek is successful it is likely that an additional population can be established. For these reasons, NOAA Fisheries has proposed to change winter-run Chinook salmon listing status from "endangered" to "threatened" in 2004 (69 FR 33102).

Despite short-term increases in the population over the last three years, winter-run Chinook salmon remain susceptible to extinction due to the elimination of access to most of their historical spawning grounds and the reduction of their population structure to a single population dependent for its survival on cold water releases from Shasta Dam. Population abundance is low, with the average number of adults (males and females) over the past five years at 50 percent of the recovery goal (*i.e.*, 10,000 females for 13 years) as identified in the draft recovery plan (NOAA Fisheries 1997).

Combined Project impacts are likely to reduce the juvenile population by 3 to 20 percent over baseline conditions in most years (Table 9). Early life-stage mortality in the upstream spawning areas will increase by 3 percent over Today's condition to 44 percent in years with very low carryover storage (below 1.9 MAF). Due to proposed operations, these conditions will occur more frequently, occurring 19 percent of the time in the modeled period versus 15 percent under baseline conditions. The likelihood that an individual year class will be significantly reduced by drought conditions increases in two out of the three drought year sequences modeled by

CALSIM, adding one more year of sustained high mortality to the year classes. Proposed changes in temperature management could render approximately 42 percent of spawning habitat less suitable, reducing adult spawning distribution and success. Adaptive management based on actual spawning distributions and operation conditions is expected to decrease effects, although we cannot quantify to what extent. Loss of juveniles at non-Project unscreened diversions will also continue to occur at various locations along the mainstem Sacramento River and in the Delta. Under baseline conditions, this annual impact results in the loss of 33 percent of the winter-run Chinook salmon juvenile population. Proposed project operations are expected to increase this loss between 34 and 49 percent.

Given the positive indicators in the population observed over the last 8 years, it would appear that the winter-run Chinook salmon population is recovering. While it is concerning that future Project operations are likely to result in the loss of more juveniles from each year class, NOAA Fisheries expects that adaptive management processes will reduce these increased impacts to low levels. For example, the estimated 22 percent loss includes both a 2.4 percent loss due to decreased production for individuals spawning below Ball's Ferry and a 16 percent increase in indirect mortality from increased pumping, based on mark-recapture data presented in salmon workshops (Brown and Kimmerer 2003). As these losses may not occur in every year, due to both ecological and operational conditions and protective actions, Project effects in many years may be less than 5 percent. NOAA Fisheries reasons that these losses are not sufficient to reduce the likelihood of survival and recovery of the winter-run Chinook salmon based on the observed and estimated recovery rates in the ESU. Recent CRRs in the population have been high enough that minor reductions due to a 5 percent loss of juveniles would not cause the population to decline, however some reduction in the rate of ESU recovery may occur.

2. Central Valley Spring-run Chinook Salmon

Overall abundance in this ESU is low (Figure B2), but has increased since 1992 due to a large increase in spawning in three key tributaries *(i.e.*, Deer, Mill and Butte Creek). Population growth rates (λ) in these three tributaries are estimated at 1.17 (95 percent CI: 1.04, 1.35), 1.19 (1.00, 1.47), and 1.30 (1.09, 1.60), respectively (NOAA Fisheries 2003). The Butte Creek population may be at or near carrying capacity levels. The Deer and Mill Creek populations appear to be recovering to population levels similar to those seen in the 1940s and 1950s (Grover *et al.* 2004) On Clear Creek, small numbers of adults (*i.e.*, less than 50) have started to return due the removal of a diversion dam and improved operations (*e.g.*, flows and water temperatures).

The increase in population abundance in the tributaries masks the significant decline in the portions of the population residing in the mainstem Sacramento River and the Feather River; two rivers that were significant portions of the ESU. These populations have been declining due to hybridization with fall-run Chinook salmon and unsuitable habitat conditions caused by operations (*i.e.*, lack of cold water in September, flow fluctuations, redd dewatering, and lack of over-summer habitat for adults and juveniles). The Feather River and mainstem Sacramento River spring-run Chinook salmon populations probably represent 20-30 percent of the current total population (*i.e.*,10,000-13,000 adults; DFG 2004c); historically, these two areas represented approximately 60 percent of the population based on DFG counts from 1964-1980. For example, the spawning population in the Sacramento River above RBDD was estimated at 23,156 fish in 1982. DFG biologists believe that the spring-run Chinook salmon population has nearly disappeared from the mainstem Sacramento River (DFG 1998). Genetic analyses (Lindley *et al.* 2004), the existence of a springtime freshwater entry, and the potential for segregation of naturally-spawning spring-run fish in the Feather River system suggest that rescue of a spring-run may be possible. The conclusion of the Technical Recovery Team for the Central Valley was that this phenotype will not persist without immediate and direct intervention to preserve the genetic basis for spring run timing and that the Feather River population should be conserved because it may be all that is left of and important component of the ESU (Lindley *et al.* 2004).

Spatial structure of the spring-run Chinook salmon ESU is very limited. As discussed above, populations exist in Deer, Mill and Butte Creeks. Limited habitat exists in the remainder of the smaller tributaries like Antelope Creek, Beegum Creek, and Big Chico Creek, which can only produce small numbers of fish. In the upper Sacramento River, RBDD blocks or delays adults from re-establishing populations in the only available habitat for recovery (*i.e.*, Battle Creek).

On average, proposed Project operation impacts in the upstream areas of the Sacramento River are likely to reduce the mainstem Sacramento River juvenile spring-run Chinook salmon population by 4 percent over current conditions in most years, increasing total loss to 25 percent of the mainstem juvenile population (Tables 9 and 10). Project operations will continue to block and delay adults at RBDD and increase water temperatures in the upper Sacramento River during spawning (resulting in an egg and larval mortality rate of 21 percent on average and 82 percent in critically dry years, an increase of 6 percent over the baseline). Project related losses are expected to continue into the future under formal and early consultation and prevent the species from expanding it's distribution unless new areas can be restored (*e.g.* Battle Creek) or passage around Project dams can be achieved. Adaptive management is expected to reduce some of these impacts, however issues like water temperature effects are difficult to resolve for spring-run Chinook salmon based on their spawning timing in late summer and fall when cold water storage levels are low. We expect that proposed operations will continue the decline of the mainstem population and likely lead to its extirpation. In the Delta, project operations are expected to increase loss of juveniles 4 to 21 percent over baseline conditions, increasing total Delta effects to 39 to 60 percent of all juveniles entering the Delta from Central Valley rivers. In the Feather River, project operations are expected to provide generally adequate flows and temperatures for spring-run Chinook salmon spawning, incubation, and rearing. Rearing habitat will remain at current levels of suitability and availability, potentially affecting the population's ability to increase. In addition, flow fluctuations in both the High Flow Channel and Low Flow Channel are expected to result in the stranding of juveniles. We cannot quantify the effect of these losses on the population, but the expected increase in frequency of flow fluctuations due to safety inspections over the coming years is likely to harm the population.

Project operations in the Feather River are not expected to increase the primary threat to spring-run Chinook salmon in that river: redd super-imposition by fall-run Chinook salmon and hybridization with hatchery fish. Nor are project operations expected to reduce these threats.

Overall, Feather River operations are expected to result in an increase of the population's vulnerability to extinction due to chronic losses of juveniles due to flow fluctuations. However, we cannot measure or quantify this increase due to uncertainty in both the frequency with which flow fluctuations will occur and the number or proportion of spring-run Chinook salmon juveniles that may be stranded.

Harm to the Feather River population and loss of the mainstem Sacramento River population due to the direct and indirect effects of Project operations, are expected to reduce the ESU’s numbers, reproduction, and distribution. Continuation of and, in some cases, increases in the adverse direct and indirect effects of Project operations are expected to increase the probability of extinction of the Feather River and Sacramento River populations with little chance of recovery or re-establishment without implementation of other recovery measures. Given the apparently robust nature of the Deer, Mill, and Butte Creek populations, increases in the Feather River and Sacramento River’s already high probabilities of extinction are not likely to measurably change the overall ESU’s probability of extinction based on the proportional relationship between local and regional probabilities of persistence in species. However, the vulnerability of these populations will be problematic for recovery efforts and may require future operational changes to aid in the recovery or re-establishment of these populations.

3. Southern Oregon/Northern California Coast coho salmon

Currently, the average inriver escapement to the Trinity River (*i.e.*,1991-2002) for naturally produced coho salmon is 582 compared to 5,000 adults before Trinity Dam was built. Naturally produced coho salmon make up on average 7 percent of the total inriver annual escapement (TR SEIS/EIR 2004). The majority of coho salmon in the Trinity River are produced by the Trinity River Hatchery. The naturally spawning population may be indirectly adversely affected by current hatchery practices (see hatchery effects). However, SONCC coho salmon are expected to increase in abundance and spatial structure through implementation of the proposed Trinity ROD flows and TRMFR program in the future conditions. In order for naturally produced inriver coho salmon to respond to the long-term improvements in habitat suitability the impacts of the Trinity River Hatchery need to be investigated. Based on the best available information, SONCC coho salmon should benefit from the proposed action through improved habitat conditions, including critical habitat.

4. Central Valley Steelhead

The Central Valley steelhead ESU has been reduced to small, remnant populations both inside and outside the Project action area, and the most recent available data indicate that the natural population is continuing to decline and that hatchery steelhead dominate the catch entering the Bay-Delta region. For steelhead, the limited habitat below Project dams has declined in quality to a point where it can only support low population levels. Abundance estimates for steelhead in three of the five Project rivers in the action area (*i.e.*, the Stanislaus, Feather, and American Rivers) presently are so low that continued viability of the populations is questionable (McElhany *et al.* 2000). The resilience of these populations to further adverse impacts is likely to be impaired. The Clear Creek population may be increasing in abundance due to dam removal and restoration efforts. Recent spawning surveys of small Sacramento River tributaries (Deer, Mill, Antelope, Clear, and Beegum Creeks (Moore 2001)) and incidental capture of juvenile steelhead during Chinook monitoring (Calaveras, Cosumnes, Stanislaus, Tuolumne and Merced Rivers) have confirmed that steelhead are widespread throughout accessible streams and rivers (NOAA Fisheries 2003)

Productivity for steelhead is dependent on freshwater survival and over summering habitat which has been reduced by 95 percent in the baseline. There is no commercial or sport harvest and ocean conditions are assumed favorable; therefore, the decline in abundance is attributed to impacts in the freshwater life stages. This species is subject to greater in river mortality than most salmon species due to an extended fresh water life history (Meehan and Bjornn 1991). In order to compensate for this, steelhead have the ability to spawn more than once and use intermittent streams. Productivity is low due to the lack of remaining suitable habitat in river reaches that historically were used as migratory habitat. The Biological Review Team concluded the steelhead mean annual population growth rate is less than one ($\lambda = 0.95$, with confidence interval 0.90 to1.02) and the 5 year mean is 1,952 adults (NOAA Fisheries 2003). Estimates based on juvenile production indicate that the wild population may number and average of 3,628 female spawners (NOAA Fisheries 2003). On the Stanislaus River, less than 50 smolts are reported each year (Demko 2000). On the San Joaquin River, less than ten smolts are observed each year in the lower river (Mossdale trawl data Figure B4). On the Sacramento River, juvenile abundance has declined since the early 1990's at the Knight's Landing, Sacramento, and Chipps Island monitoring stations (Reclamation 2004).

Spatial structure for steelhead is fragmented and reduced by elimination or significant reduction of the major core populations (*i.e.* Sacramento River, Feather River, American River) that provided a source for the numerous smaller tributary and intermittent stream populations like Dry Creek, Auburn Ravine, Yuba River, Deer Creek, Mill Creek, and Antelope Creek. Tributary populations can likely never achieve the size and variability of the core populations in the long-term, generally due to the size and available resources of the tributaries. Steelhead redd and juvenile rearing surveys in the Feather River (DWR 2003, Cavallo *et al.,* 2003) indicate that spawning and rearing habitat is limited and primarily exists at only two locations; one at the upstream end of the Low-flow Channel, and one at the downstream extent of the Low-flow Channel. This limited amount of available habitat is likely to limit juvenile production and the carrying capacity for steelhead fry and juvenile rearing. Furthermore, the minimal population estimate of less than 200 spawning adults in this river is below established levels that are considered to be viable to ensure the continued existence of the species (NOAA Fisheries 1997, Botsford and Brittnacher 1998).

NOAA Fisheries does not know how many steelhead spawn in the upper Sacramento River since they cannot be distinguished from the sizable resident trout population that has developed as a result of managing for cold water all summer. NOAA Fisheries assumes that most of the adult steelhead passing RBDD spawn in tributaries since the habitat is more suitable. In addition, the loss of riparian habitat due to the cumulative effect of urban growth and development is expected to reduce the number of smaller streams in the Central Valley that contain isolated populations of steelhead. Finally, the Central Valley steelhead ESU has become less diverse through the introduction and reliance on out-of-basin stocks of hatchery produced fish, and the loss of the San Joaquin population due to low flows and diversions. The Stanislaus River weir has not been able to show a verifiable steelhead run exists after two years of operation.

Overall Project impacts are likely to reduce the juvenile population by 12 to 27 percent over current conditions (Table 9) in most years, resulting in an average total of 51 to 66 percent juvenile mortality when added to the effects of current operations. Mortality in the upstream spawning areas is likely to increase on the American and Feather rivers due to flow fluctuations, higher temperatures, and low flows. Habitat suitability in the upstream Project rivers is reduced through increased LOD by 2020; increased water temperatures, which results in increased predation due to both increased numbers of predators and feeding rates and increased susceptibility to diseases; and negative hatchery impacts. Approximately 10 percent of the adult population is delayed at RBDD. Steelhead migrate upstream as their gonads are sexually maturing, but a short-term delay in migration is not expected to negatively impact their reproductive viability. Predation is also likely to account for some juvenile loss at RBDD, as 36 percent of the population is disoriented from passing under the gates. Flow fluctuations in both the High Flow Channel and Low Flow Channel in the Feather River are expected to result in the stranding of juveniles, and fluctuations in the Low Flow Channel are expected to occur more frequently in the future. The abundance of naturally produced juvenile steelhead is low in the Feather River (DWR 2003), so frequent flow reductions may have a significant impact on the number of juveniles that survive to smolt. Adults that enter the San Joaquin River during the fall months are blocked by low DO and high temperatures leading to higher straying rates into non-natal streams. Future increases in pumping rates take a higher proportion of San Joaquin River water (see PTM results); therefore, it is unlikely that very many steelhead from the San Joaquin River will survive across the Delta, unless they exit during VAMP periods. Increased entrainment of juvenile steelhead at the Delta pumps is more critical to the steelhead population than salmon due to the lower survival rate (and therefore higher individual value to the population) of individual juvenile steelhead (Meehan and Bjornn 1991). As proposed, Project operations would kill 43 to 59 percent of the juveniles entering the Delta through direct entrainment at the pumps or other indirect sources of mortality. Additionally, 3.5 percent of the entrainment at the pumps are adult steelhead returning to the ocean. This proportion of the incidental take represents about one percent of the total adult population. It is expected that very few of the adults survive the salvage operation due to their poor condition post-spawning. Adaptive management processes are expected to reduce the magnitude of some of the effects, but we cannot quantify the extent of the reduction.

Given the trends observed in the steelhead populations throughout the action area, continuation of past project impacts and expected increases in losses of juveniles due to both future demands and early consultation actions, NOAA Fisheries expects that the proposed Project operations under both formal and early consultation will increase the likelihood of steelhead population extinction in most Project rivers. As a result, the ESU would be rendered more vulnerable to demographic and other stochastic extinction processes by reductions in the number of populations, population abundances, ESU diversity, and spatial distribution. Based on recent status and trends, the current ESU is comprised of several populations all with high probabilities of extinction. Minor increases in the likelihood of extinction of one or more populations within such a species could have measurable impacts on the regional probability of extinction, based on the proportional relationship between local and regional probabilities of persistence in species. However, given the widespread distribution of the species, we expect that the ESU's overall probability of extinction is buffered against appreciable changes.

5. Central California Coast steelhead

Although CCC steelhead have benefitted from protective restoration projects as part of the state's habitat restoration grant program both the biological review team and NOAA Fisheries findings concluded that the population as a whole is likely to become endangered in the foreseeable future throughout all of it's range (69 FR 33102, NOAA 2003). The area of the CCC steelhead ESU contained in the project action area is the migratory corridor within the north-western Delta leading to Suisun Creek and Greens Valley Creek. Recent studies have shown that both these creeks contain small populations of resident and anadromous steelhead (Hanson 2001). Due to the small number of naturally spawning steelhead in this ESU, these two creeks contribute to the diversity and spatial scale of this mainly coastal population. Projects impacts to the migratory corridor within the Delta are expected to be indirect and minimal to water quality through small changes in the relative position of X2 and small changes in the relation between inflow and outflow (*i.e.*, E/I Ratio). Since CCC steelhead typically do not spend much time rearing in the Delta, small changes in the water quality are not expected to adversely effect juvenile outmigration. Total Delta outflow is expected to be decreased in the future condition by 473 cfs (*i.e.*, CALSIM studies 3 vs 5) because of the increase capacity to pump water in the Delta, but this effect is not of sufficient magnitude to change flow patterns in the migratory corridor for adult or juvenile CCC steelhead since the tidal flux is so much greater. Increases in the number and amount of water transfers in the future may offset some of the decrease in Delta outflow. Since migratory and rearing time in the Delta are short term in nature, these indirect project effects are not anticipated to reduce the likelihood of survival and recovery of CCC steelhead.

6. Winter-run Chinook salmon designated critical habitat

Suitability of habitat between Ball's Ferry and Bend Bridge is reduced by defaulting to the more upstream temperature compliance point at Balls Ferry compared to Bend Bridge under both operations today and in the future. Planning for future temperature control operations at a higher compliance point could limit potential future spawning distribution. NOAA Fisheries anticipates that the spawning distribution routinely will be more contracted (*i.e.*, upstream of Ball's Ferry), therefore population abundance could be capped as these fish seek out areas of more suitable, cooler water for spawning and move farther upstream than they otherwise would do in some years. Reclamation has stated that it will manage the available cold water resources in a manner consistent with SWRCB Order 90-5, to the extent controllable. The suitability of habitat will be measured by the annual cold water resource management, not by geographic extent.

Based on IFIM studies, flows at the lowest range (*i.e.*, 3,250 cfs from November through March) provide enough spawning habitat spatially for a population of 14,000 winter-run Chinook salmon (Reclamation 2004) between Keswick Dam and Battle Creek (downstream of Balls Ferry). Flows at mid-range (*i.e.*, 8250 cfs) would provide enough habitat to meet the recovery goals (*i.e.*, 20,000 adults for 13 years). Therefore, even with the reduction in suitability compared to the present, spawning habitat area is not expected to be physically limiting to the winter-run Chinook salmon population. At present population levels, spawning adults could redistribute themselves into other locations with greater suitability for spawning. However, based on the past behavior of spawning adults, this is not anticipated to occur consistently. Winter-run Chinook salmon spawning distributions in Central Valley streams can vary depending on environmental conditions. If this variance contributes to the likelihood of survival of the population, then a larger area of spawning habitat than otherwise would be expected may be necessary to support a population.

Other factors that adversely affect critical habitat are the reduction in long-term average Delta outflow (2 percent on average decrease) and return flows from CVP contractors. Reductions in Delta outflow are a direct result of increased pumping rates in the winter months (*i.e.*, October through March) when salmonids are present. The abundance or survival of Chinook salmon and estuarine-dependent species has been shown to increase with freshwater outflow (Kjelson 1981, Kimmerer 2002). The value of Delta habitat for salmonid emigration and rearing is protected by the standards in the State Water Quality Control Plan. As long as the water projects comply with these standards, these values should be protected. The suitability and function of rearing areas are degraded by the return of irrigation water in the fall when the peak of juvenile winter-run Chinook salmon emigration occurs in the Sacramento River. Agricultural return water resulting from the diversion of CVP contract water at numerous points along the Sacramento River creates poor water quality conditions for out-migrants by exposure to high water temperatures, pesticides, and contaminants. Essential features of critical habitat that are degraded due to this action include water, space, cover, and rearing along approximately 200 miles of mainstem river. This impact has been occurring since the designation of critical habitat and is expected to continue at similar levels into the foreseeable future.

NOAA Fisheries does not expect that the above impacts on designated critical habitat will be sufficient to reduce the value those areas of habitat have for the conservation of the winter-run Chinook salmon population. In general, habitat space, resources, and flow conditions are expected to be adequate to support a recovered population.

VIII. CONCLUSION

A. Formal Consultation

1. Sacramento River winter-run Chinook salmon

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon. In addition, NOAA Fisheries has determined that the action, as proposed, is not likely to adversely modify critical habitat for Sacramento River winter-run Chinook salmon.

2. Central Valley spring-run Chinook salmon

After reviewing the best scientific and commercial information available, the current status of the listed species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of Central Valley spring-run Chinook salmon. Critical habitat for Central Valley spring-run Chinook salmon has not been designated, therefore, none will be affected.

3. Southern Oregon/Northern California Coast coho salmon

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of SONCC coho salmon. NOAA Fisheries has also determined that the action, as proposed, is not likely to destroy or adversely modify critical habitat for this species.

4. Central Valley steelhead

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of Central Valley steelhead. Critical habitat for Central Valley steelhead has not been designated, therefore, none will be affected.

5. Central California Coast steelhead

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of Central California Coast steelhead. Critical habitat for Central California Coast steelhead has not been designated, therefore, none will be affected.

B. Early Consultation

1. Sacramento River winter-run Chinook salmon

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries preliminary biological opinion that the early consultation actions, as proposed, are not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon. In addition, NOAA Fisheries has determined that the early actions, as proposed, are not likely to adversely modify critical habitat for Sacramento River winter-run Chinook salmon.

2. Central Valley spring-run Chinook salmon

After reviewing the best scientific and commercial information available, the current status of the listed species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries preliminary biological opinion that the early consultation actions, as proposed, are not likely to jeopardize the continued existence of Central Valley spring-run Chinook salmon. Critical habitat for Central Valley spring-run Chinook salmon has not been designated, therefore, none will be affected.

3. Southern Oregon/ Northern California Coast coho salmon

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries preliminary biological opinion that the early consultation actions, as proposed, are not likely to jeopardize the continued existence of SONCC coho salmon. NOAA Fisheries has also determined that the early consultation actions, as proposed, are not likely to destroy or adversely modify critical habitat for this species.

4. Central Valley steelhead

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries preliminary biological opinion that the early consultation actions, as proposed, are not likely to jeopardize the continued existence of Central Valley steelhead. Critical habitat for Central Valley steelhead has not been designated, therefore, none will be affected.

5. Central California Coast steelhead

After reviewing the best scientific and commercial information available, the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries preliminary biological opinion that the early consultation actions, as proposed, are not likely to jeopardize the continued existence of Central California Coast steelhead. Critical habitat for Central California Coast steelhead has not been designated, therefore, none will be affected.

IX. INCIDENTAL TAKE STATEMENT - FORMAL CONSULTATION

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 to include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary and must be implemented by Reclamation and DWR, for the exemption in section 7(o)(2) to apply. Reclamation and DWR have a continuing duty to regulate the activity covered in this incidental take statement. If Reclamation and/or DWR fail to assume and implement the terms and conditions of the incidental take statement, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation and DWR must report the progress of the action and its impact on the species to NOAA Fisheries as specified in this incidental take statement (50 CFR 402.14(I)(3)).

This incidental take statement is applicable to all activities related to the operation of the CVP and SWP described in this formal biological opinion. Unless modified, this incidental take statement does not cover activities that are not described and assessed within this opinion. In addition, unless modified, this incidental take statement does not cover the facilities or activities of any CVP or SWP contractor, or the facilities or activities of parties to agreements with the U.S. that recognize a previous vested water right.

A. Amount or Extent of Take - Formal Consultation

NOAA Fisheries anticipates that endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead will be taken as a result of this proposed action. The incidental take is expected to be in the form of death, injury, harm, capture, and collection. Death, injury, and harm to juvenile and adult winter-run Chinook salmon, spring-run Chinook salmon, and steelhead are anticipated from the depletion and storage of natural flows at CVP and SWP reservoirs. Reservoir operations are expected to significantly alter the natural hydrological cycle in the Sacramento River downstream of Shasta Dam, Clear Creek downstream of Whiskeytown Dam, the Feather River downstream of Oroville Dam, the American River downstream of Folsom Dam, and the Stanislaus River downstream of New Melones Dam.

Reservoir releases to downstream areas during flood control operations may result in the take of Chinook salmon and/or steelhead eggs and pre-emergent fry (sac-fry) through the scouring of redds. The potential amount and extent of take of Chinook salmon and/or steelhead eggs and sac-fry is difficult to predict, because it is directly dependent on precipitation patterns during the winter and spring months. Heavy rainfall within upstream basins is likely to trigger flood control operations at CVP and SWP reservoirs, resulting in short-term high flow events in the upper Sacramento River, Clear Creek, the Feather River, American River and the Stanislaus River. Extremely high flow events may scour Chinook salmon and steelhead redds and result in the injury and mortality of Chinook salmon and steelhead eggs and sac-fry. Incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead eggs and sac-fry due to flood control operations will be difficult to detect, because dead or injured fish will be within the gravel substrate of the streambed.

Flood control operations can also lead to the incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead fry and juveniles through stranding and isolation from the main stem river channels. Isolation may occur in areas that are not connected to the rivers except during periods of high flows. Heavy rainfall is likely to trigger flood control operations at CVP and SWP reservoirs, resulting in short-term high flow events in the upper Sacramento River, Clear Creek, the Feather River, American River and the Stanislaus River. During periods of high flows, juvenile Chinook salmon and steelhead may enter into areas that become isolated when flows recede. If additional high flow events do not follow within a short period of time, these isolated juveniles may be lost to predation, lethal water temperature conditions, or desiccation. Incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead fry and juveniles are anticipated if precipitation patterns result in flood control operations. However, the extent of incidental take associated with isolation will be difficult to detect and quantify due to the large geographic area that will be affected and because finding dead or injured juveniles would be difficult without extensive and systematic surveys immediately following these flood events.

Take of adult Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon is not anticipated due to flood control operations. Take of adult Central Valley steelhead is unlikely to occur as a result of flood control operations.

Delays to upstream migration of adult Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead will occur when the Red Bluff Diversion Dam (RBDD) gates are in the closed position between May 15 and September 15 each year. Average delays of 11 days (range from 1- 40 days) have been reported by radio-tagging experiments on spring-run Chinook salmon (FWS 1990). These delays are expected to increase the chance that spawning will be unsuccessful. In some cases, it is expected that adult spawners will be unable to access tributary streams above the RBDD, due to low flows and thermal barriers developing at the tributary mouth during the time the fish were delayed in their migration. The potential amount of take is difficult to predict. However, it anticipated that some adult winter-run or spring-run Chinook salmon will die prior to spawning as a result of blockage or delay. Of those that are able to continue migrating upstream after delays, spawning may be unsuccessful because their redds may be destroyed by later spawning fall-run Chinook salmon.

Dry conditions or moderate precipitation will create low instream flows below CVP and SWP controlled reservoirs. Such conditions could result in take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead eggs and pre-emergent fry through dewatering of redds. In addition, the take of juvenile Central Valley steelhead is also anticipated because of high water temperatures as a result of low summer flows. In the 90 percent exceedence forecast, water temperatures would reach lethal limits for juvenile steelhead in the Feather River low flow channel from June through August and in the American River from April through October. However, in the 50 percent exceedence forecast water temperatures are in the preferred range for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead for at least a portion of the streams directly below CVP and SWP dams. These areas are: 1) the Sacramento River from Keswick Dam to Red Bluff; 2) Clear Creek from Whiskeytown Dam to the Powerline Crossing Road (RM 5); 3) the Feather River from Oroville Dam to the Thermalito Afterbay; 4) the American River from Nimbus Dam to Watt Avenue; and 5) the Stanislaus River from Tulloch Dam to Oakdale. Water temperatures above the preferred ranges for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead will limit the availability and suitability of habitat in the above described reaches for juvenile rearing and emigration. Low flow conditions forecasted for dry conditions (90 percent exceedence forecast) or below normal precipitation can lead to rapid decreases in stream flows during critical spawning periods, which may dewater redds or stress adults. Low flow conditions can also prevent adults from reaching spawning areas within tributary streams by creating thermal barriers and subjecting them to increased poaching or predation in summer holding pools. Low flow conditions are particularly significant for Central Valley spring-run Chinook salmon and Central Valley steelhead.

Capture and collection of juvenile Central Valley steelhead in the Stanislaus River by screw traps is anticipated through fisheries studies to evaluate New Melones Reservoir operations on anadromous salmonids. Based on past sampling by screw trap at the Oakdale sampling site, up to 60 steelhead smolts and pre-smolts may be captured and released below the trapping site. Previous sampling experience with screw traps in the Stanislaus River indicates that all captured steelhead can be maintained in good physical condition and released unharmed back into the river.

Capture and collection of juvenile Central Valley spring-run Chinook salmon and Central Valley steelhead in the Feather River by rotary screw traps, fyke traps, and seines is anticipated through fisheries studies to evaluate the effect of flow fluctuations. Based on past monitoring by screw traps in the low flow channel and seining below the Thermalito outlet, fewer than 10 spring-run Chinook salmon yearlings, approximately 3,000 young-of-the-year spring-run Chinook salmon and 600 juvenile steelhead are expected be captured and released below the trapping site (DWR 2002, 2003, 2004). It is not expected that Central Valley spring-run Chinook salmon or steelhead fry will be captured because emergence is anticipated to occur before the start of the sampling period. Capture and collection of adult Central Valley spring-run Chinook salmon and Central Valley steelhead may also occur during sampling. However, based on previous sampling, no adult Central Valley spring-run Chinook salmon and fewer than 25 adult Central Valley steelhead are expected to be captured and released. Experience with trapping and seining in the Feather River indicates that all captured steelhead can be maintained in good physical condition and released unharmed back into the river.

In the Delta, death, injury, and harm to juvenile and adult Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead is anticipated due to changes in Delta hydrology created by the operation of the Delta Cross Channel (DCC) gates and at Tracy (CVP) and Harvey Banks (SWP) export pumping plants (Delta pumping plants). This take includes reduced survival of juvenile Chinook salmon diverted through the DCC into the central Delta from 1) elevated water temperatures and poorer water quality within the central Delta; 2) losses due to entrainment at unscreened water diversions within the central Delta; 3) predation associated with physical structures; 4) reverse flow conditions as a result of CVP/SWP pumping; and 5) direct loss at the Delta pumping facilities within the southern Delta. In addition, delays and increased straying are expected when adults encounter the backside of the DCC gates in the closed position. Additional juvenile loss is expected to increase at the unscreened Rock Slough diversion into the Contra Costa Canal. Incidental take through the collection, handling, trucking and release of salvaged juveniles and adults at the Tracy and Skinner Fish Collection Facilities is expected to increase as more fish are entrained. At the Suisun Marsh Salinity Control Structure delays in fish passage from tidal operations and collection of adults in fisheries studies to evaluate passage are expected.

Operation of the DCC gates and Delta pumping plants are expected to cause increased mortality of Sacramento River winter-run Chinook salmon, spring-run Chinook salmon and steelhead emigrating from the Sacramento River basin through entrainment into the central Delta where survival rates are expected to be reduced. In most years these losses will be minimized by intermittent DCC gate closures from October through January and mandatory closures from February 1 to May 20 (SWRCB, D-1641). Overall mortality of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead juveniles that are diverted into the central Delta ranges from 33 to 95 percent (Brandes and McLain 2001, FWS 2001-2004) depending on a variety of factors. These mortalities are generally attributed to increased residence time, a longer migration route, reverse flows, altered salinity gradient, predation, elevated water temperatures, contaminants, and reduced food supply (DFG 1998; McEwan 2001, Vogel 2004). While losses at the CVP and SWP Delta pumping facilities can generally be quantified through observations of salvaged fish at the Tracy and Skinner Fish collection facilities, the difference in through-Delta mortality as a result of proposed operation of the Delta pumping plants is difficult to detect and quantify because dead or injured juvenile fish can not be observed.

Although indirect losses in the Delta cannot be quantified, entrainment of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead juveniles can be monitored at the CVP and SWP Delta pumping facilities. Based on implementing actions described in the *Salmon Decision Process* to minimize direct and indirect losses, it is expected that the incidental take of juvenile Sacramento River winter-run Chinook salmon can generally be managed to less than 2 percent, cumulatively, between the CVP and SWP pumping plants. This incidental take is based on the estimated annual juvenile production of Sacramento River winter-run Chinook salmon entering the Delta.

The incidental take of juvenile Central Valley spring-run Chinook salmon, identified by CWT's or genetic markers, at the CVP Tracy pumping facility can be combined with the incidental take at the SWP Harvey Banks pumping facility from December 1 to May 30, annually. It is expected that the cumulative incidental take at the Delta pumping facilities can be managed to not exceed one percent, of the anticipated juvenile Central Valley spring-run Chinook salmon population entering the Delta in any year. However, due to their overlap in size with fall-run Chinook salmon, losses of YOY Central Valley spring-run Chinook salmon are not easily quantified or monitored through observations of fish salvaged at the CVP and SWP Delta pumping facilities. An analysis using combined fall-run and spring-run Chinook salmon YOY losses at the CVP and SWP pumping facilities from 1994 to 1998, showed Central Valley spring run Chinook salmon represented less than one percent of the total loss, whereas Sacramento River fall-run fish accounted for 7.4 percent and San Joaquin River fall-run fish made up the majority at 92.5 percent (DWR 1999). The total combined YOY loss from 1994 to 1998 ranged from 11,258 to 124,816, with an average loss of 74,087 per year. This average represents the anticipated combined loss of spring-run and fall-run YOY Chinook salmon from the proposed project operations. Therefore, the average loss of Central Valley spring-run Chinook YOY salmon is expected to be less than 741 individuals per year.

Due to expanded monitoring efforts in the upstream tributaries, wild Central Valley spring-run Chinook salmon juveniles are being tagged with CWT's as they migrate downstream to the Sacramento River. In 2003, there were 97,529 tagged in Butte Creek and 36,415 tagged in the Yuba River (DFG 2004b). Since it is standard practice at the Delta Fish Collection Facilities to kill all Chinook salmon that are CWT tagged for identification purposes, a certain amount of lethal take is expected for these wild Central Valley spring-run Chinook salmon. In the 2002-2003 Sacramento River winter-run Chinook Incidental Take Report (DWR 2004) no wild spring-run Chinook salmon were reported at the Delta fish collection facilities, however six tags were recovered from the FWS Sacramento trawl and Chipps Island trawl studies in April and May. NOAA Fisheries expects that in April and May a small number of tagged wild spring-run Chinook salmon will be entrained and therefore killed during the sampling process (*i.e.*, 10 minute counts) at the Delta Fish Collection Facilities.

Incidental take of yearling spring-run Chinook salmon at the CVP Tracy pumping facility can be combined with the estimated take at the SWP Harvey Banks pumping facility and can be based on observations of CWT late-fall Chinook salmon uniquely marked at Coleman National Fish Hatchery and released in the upper Sacramento Basin as Central Valley spring-run Chinook salmon surrogates. These uniquely marked late fall-run Chinook salmon are expected to serve as appropriate surrogates for Central Valley spring-run Chinook salmon because they would be released to begin their emigration and smoltification passage through the Delta at approximately the same time and size as wild Central Valley spring-run Chinook salmon. Spring-run Chinook salmon surrogate release groups will be identified by NOAA Fisheries, in consultation with FWS and DFG. Since the surrogates would experience the same conditions in the Sacramento River, NOAA Fisheries anticipates that they will be taken at comparable rates to the wild fish. Therefore conditions which result in the loss of one percent of the marked late fall-run Chinook salmon surrogates are expected to have also resulted in the loss of one percent of the juvenile Central Valley spring-run Chinook salmon population. Take will be calculated with the standard loss estimation procedures applicable at the respective fish collection facilities.

Although loss estimates for Cental Valley steelhead at the CVP and SWP Delta pumping facilities have not been determined, the level of take for steelhead can be anticipated from salvage estimates at these facilities in prior years. Based on salvage data from 1993 to 2003, the number of unclipped (wild) juvenile Central Valley steelhead salvaged from both facilities has ranged from 461 to 16,537 fish during the sampling season from October through June, with an average salvage rate of 3,719 steelhead. Generally, these fish are returned alive to the Delta waters through the collection, trucking and release program at the CVP and SWP pumping facilities.

At the Rock Slough diversion, direct losses due to entrainment are not expected to exceed 5 Sacramento River winter-run Chinook salmon juveniles, 10 Central Valley spring-run Chinook juveniles, and 5 Central Valley steelhead total (juveniles plus adults) annually. This incidental take is expected to account for the extrapolated loss due to predation in front of the pumps and the pumps themselves. Expanded losses (entrainment losses plus losses due to predation in front of the pumps) based on DFG monitoring from 1994 to 1996, is anticipated to be approximately 257 juvenile Sacramento River winter-run Chinook salmon, 2,215 juvenile Central Valley spring-run Chinook salmon, and 738 juvenile Central Valley steelhead. However, these losses are expected to be reduced due to integrated operations with screened diversions at Old River and Mallard Slough where the majority of pumping is planned. In addition, changes in diversions at Rock Slough from winter to summer months is expected to further reduce anticipated losses.

Incidental take of Central Valley steelhead at the CVP Tracy pumping facility can be combined with the incidental take at the SWP Harvey Banks pumping facility and will be based on yearly observations of unmarked steelhead at the CVP's Tracy and SWP's Skinner fish collection facilities during the period of October 1 through September 30. The combined cumulative salvage of unmarked juvenile and adult Central Valley steelhead at the CVP and SWP Delta pumping facilities is not expected to exceed one percent of the previous years estimated juvenile steelhead production, based on Chipps Island Trawl data. The juvenile production estimate (JPE) for Central Valley steelhead will be developed by NOAA Fisheries in consultation with DFG and FWS. For the year 2004-2005, and until a suitable JPE is developed, the combined cumulative salvage at the CVP and SWP pumping facilities is not expected to exceed 3,000 juvenile steelhead.

An unquantifiable amount of take is also anticipated as a result of the interrelated and interdependent effects of hatchery operations conducted as mitigation for the CVP and/or SWP. These effects primarily stem from the competition for space and hybridization between natural or wild spawners and hatchery produced salmon and steelhead. As these activities will be addressed in more detail under separate ESA section 7 consultations, this biological opinion does not exempt take associated with the Trinity River Hatchery (Trinity River), Coleman National Fish Hatchery (Sacramento River), Feather River Hatchery (Feather River), or the Nimbus Fish Hatchery (American River).

Reclamation and DWR have proposed to operate CVP and SWP facilities in accordance with either plans, agreements, or specific criteria outlined in this biological opinion. Total upstream plus Delta losses above the current baseline, due to the proposed action, are estimated at 7 percent for Sacramento River winter-run Chinook salmon, 10 percent for Central Valley spring-run Chinook salmon, and 18 percent for Central Valley steelhead in all but critically dry water year conditions. No additional losses, above the baseline, are anticipated for SONCC coho salmon or Central California Coast steelhead. Critically dry water year conditions and deviations during all other years from current plans, agreements, or criteria may result in additional loss and adverse effects to Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead that have not been analyzed in this opinion. In this event, formal consultation shall be reinitiated immediately to analyze these additional effects and to determine if the changes are likely to jeopardize these species or result in additional incidental take.

B. Effect of the Take - Formal Consultation

The expected effect of the proposed action in the up river areas will consist of fish behavior modification, temporary loss of habitat, and potential death or injury of egg, fry and juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. These effects are the result of intensively managed flows within the upper Sacramento River, Clear Creek, the Feather River, the American River, and the Stanislaus River which are anticipated to elevate instream water temperatures, reduce the availability and suitability of spawning and rearing habitat, cause redds to be desiccated and juveniles stranded and generally limit the amount of habitat available to salmon and steelhead. In addition, gate closures at the Red Bluff Diversion Dam will adversely effect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead by blocking or delaying adult migration to the upper Sacramento River and upstream tributaries to spawn. It is anticipated that blockage or delay at the RBDD will adversely effect the populations of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead by reducing spawning success and juvenile survival. In the Delta, this action will alter fish behavior, result in modification of habitat value, and result in the death and injury of juvenile and adult salmon and steelhead due to entrainment into the central Delta through the Delta Cross Channel, altered Delta hydrology, and the direct loss of juvenile salmon and juvenile and adult steelhead at the CVP and SWP pumping facilities and the Rock Slough Intake. These effects are reduced by the real time adjustments made in operation of temperature control strategies, minimum flow requirements, closures of the DCC gates, use of b(2) water and the EWA.

In the accompanying formal biological opinion, NOAA Fisheries has determined that the anticipated level of take associate with proposed project operations is not likely to result in jeopardy to the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead.

C. Reasonable and Prudent Measures - Formal Consultation

NOAA Fisheries believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead.

Joint Central Valley Project and State Water Project Measures:

1. Reclamation and DWR shall gather information regarding the effects of water temperatures and flow fluctuations on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead downstream of CVP and SWP reservoirs, develop long-term ramping criteria, and operate to water temperature objectives that will avoid or minimize adverse effects to listed salmonids, consistent with meeting applicable conditions in CVP and SWP water right permits.

2. Reclamation and DWR shall augment spawning gravel within the Sacramento River,

Feather River, American River, and the Stanislaus River, as necessary, based on recommendations from DFG, FWS and NOAA Fisheries.

3. Reclamation and DWR shall continue the real-time monitoring of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead in the lower Sacramento River, the lower San Joaquin River and the Delta to establish presence and timing to serve as a basis for the management of Delta Cross Channel gate operations and CVP and SWP Delta pumping operations consistent with the *Salmon Decision Process*.

4. Reclamation and DWR shall monitor the extent of incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead, associated with the operation of the CVP's Tracy and SWP's Harvey Banks pumping facilities.

Central Valley Project Measures:

General

5. Reclamation shall make its February 15 forecast of deliverable water based on an estimate of precipitation and runoff within the Sacramento River basin at least as conservatively as the 90 percent probability of exceedence. Subsequent updates of water delivery commitments must be based on forecasts at least as conservatively as the 90 percent probability of exceedence.

Shasta Division/Whiskeytown Reservoir Operations

6. Reclamation shall manage the cold water supply within Shasta Reservoir and make cold water releases from Shasta Reservoir to provide suitable habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead in the Sacramento River between Keswick Dam and Bend Bridge.

7. Reclamation shall minimize the adverse effects of flow fluctuations associated with Shasta Reservoir and Whiskeytown Reservoir operations on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead spawning, egg incubation, and fry and juvenile rearing within the upper Sacramento River and Clear Creek.

Sacramento River Division

8. Reclamation shall implement all measures practicable to provide unimpeded passage upstream and downstream at the Red Bluff Diversion Dam during the period of September 1 through June 30 each year.

American River Division

9. Reclamation shall manage the cold water supply within Folsom Reservoir and make cold water releases from Folsom Reservoir to balance the needs of Central Valley steelhead with fall-run Chinook salmon in the American River downstream of Nimbus Dam.

10. Reclamation shall minimize the adverse effects of flow fluctuations associated with Folsom Reservoir and Nimbus Dam operations on Central Valley steelhead spawning, egg incubation, and fry and juvenile rearing within the American River.

New Melones Division

11. Reclamation shall manage the cold water supply within New Melones Reservoir and make cold water releases from New Melones Reservoir to provide suitable rearing habitat for Central Valley steelhead in the Stanislaus River downstream of Goodwin Dam.

12. Reclamation shall minimize the adverse effects of flow fluctuations associated with New Melones Reservoir and Goodwin Dam operations on Central Valley steelhead spawning, egg incubation, and fry and juvenile rearing within the Stanislaus River.

CVP Delta Operations

13. Reclamation shall operate the gates at the Delta Cross Channel (DCC) during the period of October 1 through April 30 each year to minimize the diversion of juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead from the Sacramento River basin into the central Delta.

14. Reclamation shall improve and maintain in good working order fish screens at the Tracy pumping facility to minimize entrainment of juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead as a result of Delta export operations. This shall include fish screen inspections and developing and implementing a collection and release program, designed to provide for the survival of fish salvaged at the facility.

15. Reclamation, in cooperation with the Contra Costa Water District (CCWD), shall continue to collect additional data at the Tracy Fish Collection Facility and the Rock Slough Intake to monitor the extent of incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead associated with the operation of the CVP's Tracy and CCWD's Rock Slough pumping facilities.

State Water Project Measures:

Oroville/Feather River Operations

NOAA Fisheries considered the issue of spring run/fall run hybridization, which is largely attributable to the existence of Oroville Dam, in its jeopardy analysis. NOAA fisheries also evaluated the effects of instream flows on juvenile Chinook and steelhead rearing habitat in the low flow channel under the existing regulatory regime. Although terms and conditions could be specified here to minimize take that might be attributable to in-river conditions resulting from the operations of the dam, NOAA Fisheries has decided to reiterate terms and conditions from its interim opinion with respect to cold water releases from Oroville Reservoir and ramping of flows to ensure those protective measures remain in place to minimize take associated with ongoing operations and to defer development of additional measures to the ongoing FERC relicensing process in which it is participating. DWR holds a license for Oroville from FERC, which is currently undergoing review in the context of a relicensing proceeding. In the FERC relicensing proceeding, the effects of Oroville Dam and its operations on listed species will be considered, and NOAA Fisheries will have the opportunity to develop recommendations to avoid or mitigate adverse effects on listed species not only through the ESA but through the additional authorities granted to NOAA Fisheries under the Federal Power Act. NOAA Fisheries has broad authority to prescribe fish passage measures under section 18 of the Federal Power Act (FPA) and to recommend measures to improve or maintain habitat downstream of a dam pursuant to section 10(j) of the FPA. As part of the FERC relicensing process, DWR is completing studies and negotiating measures to address these issues. Rather than risk complicating or frustrating those negotiations with terms and conditions that might prove to be incompatible with the final section 18 and 10(j) recommendations, NOAA Fisheries will defer the specification of any additional reasonable and prudent measures to the FERC process and consultation on reissuance of the license.

16. The California Department of Water Resources (DWR) shall investigate and implement all measures practicable to avoid or minimize adverse effects of Oroville Reservoir operations and to improve natural production of Central Valley spring-run Chinook salmon and Central Valley steelhead in the Feather River below Oroville Dam.

17. DWR shall manage cold water storage in Oroville Reservoir and make cold water releases from Oroville Reservoir to provide suitable spawning and rearing habitat within the Feather River for Central Valley spring-run Chinook salmon and Central Valley steelhead between the Fish Barrier Dam and Robinsons Riffle (RM 61.6).

SWP Delta Operations

18. DWR shall improve and maintain in good working order fish screens at the Harvey Banks pumping facility to minimize entrainment of juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead as a result of Delta export operations. This shall include developing and implementing a collection and release program for salvaged fish designed to provide for the survival of fish salvaged at the facility.

19. DWR shall collect additional data at the Clifton Court Forebay, the John Skinner Fish Collection Facility, and the Harvey Banks pumping facility to monitor the incidental take

of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead and to develop improvements to pumping facility operations to further reduce or minimize losses of listed salmonids.

SWP Suisun Marsh Operations

20. DWR shall operate the of Suisun Marsh Salinity Control Gate to minimize delay and blockage of adult Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead migrating upstream.

D. Terms and Conditions - Formal Consultation

Reclamation and DWR must comply or ensure compliance by their contractor(s) with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

Joint Central Valley Project and State Water Project Terms and Conditions:

1. Reclamation and DWR shall gather information regarding the effects of water temperatures and flow fluctuations on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead downstream of CVP and SWP reservoirs, develop long-term ramping criteria, and operate to water temperature objectives that will avoid or minimize adverse effects to listed salmonids, consistent with meeting applicable conditions in CVP and SWP water right permits.

    - Reclamation and DWR shall participate in the design, implementation, and funding of a CALFED steelhead monitoring program that includes adult and juvenile direct counts, redd surveys, and escapement estimates on CVP and SWP controlled streams. If appropriate, authorization for any incidental take associated with the implementation of this monitoring program will be provided to Reclamation, DWR, or their agent, after NOAA Fisheries review and approval of the study plans.

    - Reclamation and DWR shall ensure that all monitoring programs regarding the effects of CVP and SWP operations and which result in the direct take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon or Central Valley steelhead are conducted by a person or entity that has been authorized by NOAA Fisheries. Reclamation and DWR shall establish a contact person to coordinate these activities with NOAA Fisheries.

    - Reclamation and DWR shall submit weekly reports to the interagency Data Assessment Team (DAT) regarding the results of monitoring and incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead associated with operations of project facilities.

- Reclamation and DWR shall provide an annual written report to NOAA Fisheries no later than October 1 of each year. This report shall provide the data gathered and summarize the results of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead monitoring and incidental take associated with the operation of the Delta pumping plants(including the Rock Slough Pumping Plant). All juvenile mortality must be minimized and reported, including those from special studies conducted during salvage operations. This report should be sent to NOAA Fisheries (Southwest Region, Protected Resources Division, Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814-4706).

2. Reclamation and DWR shall augment spawning gravel within the Sacramento River, Feather River, American River, and the Stanislaus River, as necessary, based on recommendations from DFG, FWS and NOAA Fisheries.

    a. Reclamation and DWR shall develop a spawning gravel augmentation plan, in consultation with DFG, FWS, and NOAA Fisheries, for the Sacramento River, Clear Creek, Feather River, American River, and Stanislaus River, no later than December 31, 2005.

    b. Reclamation and DWR shall implement the spawning gravel enhancement program, as described in the spawning gravel augmentation plan, as soon as possible.

3. Reclamation and DWR shall continue the real-time monitoring of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead in the lower Sacramento River, the lower San Joaquin River and the Delta to establish presence and timing to serve as a basis for the management of Delta Cross Channel gate operations and CVP and SWP Delta pumping operations consistent with the *Salmon Decision Process*.

    a. Reclamation and DWR shall conduct continuous real-time monitoring must be conducted between October 1 and May 31 of each year commencing in 2004.

    b. Reclamation and DWR shall submit weekly DAT reports and an annual written report to NOAA Fisheries describing the results of real-time monitoring of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead associated with operations of the DCC and CVP and SWP Delta pumping facilities.

4. Reclamation and DWR shall monitor the extent of incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead, associated with the operation of the CVP's Tracy and SWP's Harvey Banks pumping facilities.

a. Reclamation and DWR shall calculated salmon and steelhead loss at the Tracy and Banks pumping plants on a real-time basis from October 1 through May 31 each year.

b. Reclamation and DWR will monitor the loss of juvenile Sacramento River winter-run Chinook salmon at the CVP and SWP Delta pumping facilities and will use that information to determine whether the anticipated level of loss is likely to exceed the authorized level of 2%, cumulatively, of the estimated number of juvenile Sacramento River winter-run Chinook salmon entering the Delta annually. If either agency or NOAA Fisheries determines the rate of loss has exceeded 1%, cumulatively, Reclamation and DWR shall immediately convene the Water Operations Management Team to explore additional measures which can be implemented to reduce the rate of take and ensure the identified 2% level of take is not exceeded. If either agency or NOAA Fisheries determines the rate of loss is sufficiently high that the estimated loss will likely exceed the 2% identified level, consultation shall be reinitiated immediately.

c. Reclamation and DWR will monitor the loss of identified Central Valley spring-run Chinook salmon surrogate release groups at the CVP and SWP Delta pumping facilities and use that information to determine whether the cumulative estimated level of loss is expected to exceed one percent. If the estimated rate of loss approaches 1% Reclamation and DWR shall immediately convene the Water Operations Management Team to explore additional measures which can be implemented to reduce the rate of take. If the rate of loss exceeds 1%, consultation shall be reinitiated immediately.

d. Reclamation and DWR will monitor the loss of Central Valley steelhead at the CVP and SWP Delta pumping facilities and use that information to determine whether the cumulative estimated level of loss is expected to exceed one percent of the juvenile production estimate (JPE) for steelhead entering the Delta. Until such time as a suitable JPE has been developed, the cumulative take at the CVP and SWP delta pumping facilities shall not exceed 3,000 steelhead (juveniles and adults combined). If the take level anticipated for Central Valley steelhead is exceeded, Reclamation and DWR shall immediately convene the Water Operations Management Team to explore additional measures which can be implemented to reduce the rate of take. If suitable measures to reduce the rate of take can not be implemented, consultation shall be reinitiated immediately.

Central Valley Project Terms and Conditions:

General

5. Reclamation shall make its February 15 forecast of deliverable water based on an estimate of precipitation and runoff within the Sacramento River basin at least as conservatively as the 90 percent probability of exceedence. Subsequent updates of water

delivery commitments must be based on monthly forecasts at least as conservatively as the 90 percent probability of exceedence.

a. Reclamation shall provide to the Regional Administrator, NOAA Fisheries, Southwest Region, the results of the February 90 percent exceedence forecast of runoff and planned CVP operations, including predictive water temperature models at least 3 working days prior to the first water allocations announcement for the current year and all subsequent updates for that year.

b. Reclamation shall provide NOAA Fisheries with the opportunity to review the proposed operations forecasts prior to the first water allocations announced each year and all subsequent updates for the purpose of ensuring their consistency with the objective of providing to the extent controllable habitat availability and suitability for listed salmonids.

c. Reclamation shall cooperate with DFG to fund and implement aerial surveys of redd distribution so that current information is available for consideration in making within year water management decisions.

Shasta Division/Whiskeytown Reservoir Operations

6. Reclamation shall manage the cold water supply within Shasta Reservoir and make cold water releases from Shasta Reservoir to provide suitable habitat for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead in the Sacramento River between Keswick Dam and Bend Bridge.

   a. Reclamation shall target a minimum end-of-year (September 30) carryover storage in Shasta Reservoir of 1.9 MAF for improvement of cold water resources in the following water year.

   b. Reclamation shall target daily average water temperatures in the Sacramento River between Keswick Dam and Bend Bridge as follows:

      i. Not in excess of 56 °F at compliance locations between Balls Ferry and Bend Bridge from April 15 through September 30, and not in excess of 60°F at the same compliance locations between Balls Ferry and Bend Bridge from October 1 through October 31, provided operations and temperature forecasts demonstrate the capability to achieve and sustain compliance.

      ii. If annual conditions cannot support project compliance at Balls Ferry, Reclamation shall reinitiate consultation and convene the SRTTF to provide input regarding annual cold water management alternatives prior to announcement of the CVP water service delivery allocations.

iii. The selection of compliance locations downstream of Balls Ferry shall be accomplished through an annual adaptive management process, initiated by Reclamation in consultation with NOAA Fisheries, utilizing input from the SRTTF (as described in the OCAP BA, Appendix B), and based on the technical assessment of cold water resources information and projections available in the spring months (*i.e.*, March, April, May).

iv. The annual adaptive management process will focus efforts to analyze annual cold water management flexibility to provide thermal protections to winter-run Chinook salmon, spring-run Chinook salmon, and steelhead as envisioned in the SWRCB Order 90-5. Initial technical analysis will consider the following selection of compliance locations based on the projected cold water availability and spawning distribution in the upper Sacramento River:

May 1, Shasta cold water volume below 52 °F	Compliance Target
< 3.3 MAF	Balls Ferry
> 3.3 MAF but < 3.6 MAF	Jellys Ferry
> 3.6 MAF	Bend Bridge

d. Reclamation shall develop guidelines for use of the current temperature model to analyze information produced by the model in combination with measured temperature profiles to evaluate seasonal risks of cold water management. In 2005 Reclamation, in coordination with NOAA Fisheries and other representatives of the SRTTF, will assess potential improvements to the model and guidelines to increase its effectiveness and identify a schedule for implementation of the improvements.

e. In critical water years, when temperature mortality of winter-run and spring-run Chinook salmon eggs and fry within the mainstem Sacramento River in September and October is expected to be high (*e.g.*, > 40% mortality using Reclamation’s Salmon Mortality Model), Reclamation shall consider all options for fully utilizing cold water available in Shasta Reservoir, including use of low level outlets.

7. Reclamation shall minimize the adverse effects of flow fluctuations associated with Shasta Reservoir and Whiskeytown Reservoir operations on Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead spawning, egg incubation, and fry and juvenile rearing within the upper Sacramento River and Clear Creek.

a. Reclamation shall coordinate with NOAA Fisheries before reducing releases downstream of Keswick Dam when monitoring suggests such changes may have adverse effects.

b. Reclamation, as described in the CVPIA, shall develop a Fisheries Management Plan (FMP)for Clear Creek downstream of Whiskeytown Reservoir with input from the Clear Creek Technical Team, a working group comprised of fishery biologists, geologists, and other river and land management specialists from DFG, FWS, NOAA Fisheries, Reclamation, and BLM. The Clear Creek FMP should balance instream flow and temperature requirements of spring-run Chinook salmon, fall-run Chinook salmon, and steelhead with the operations for other CVP objectives, including water supply, power, and temperature control for winter-run Chinook salmon in the Sacramento River. In the absence of an FMP, Reclamation shall seek input from the Clear Creek Technical Team on these considerations, and will develop annual plans for avoiding or minimizing adverse impacts, and optimizing conditions for anadromous fish. Prior to implementation, these annual plans shall be reviewed and approved by NOAA Fisheries.

c. Reclamation shall manage Whiskeytown releases, to the maximum extent practical, to meet a daily water temperature of: 1) 60 ^{o}F at the Igo gage from June 1 through September 15 to protect over-summering steelhead and pre-spawning spring-run Chinook from thermal stress; and 2) 56 ^{o}F from September 15th to October 31st for spring-run Chinook spawning and steelhead rearing. In 2005 Reclamation, in coordination with NOAA Fisheries will assess improvements to modeling water temperatures in Clear Creek and identify a schedule for making improvements.

d. Reclamation shall schedule the ramping down of non-Glory Hole releases from Whiskeytown Reservoir to not exceed 0.1 foot / hour (estimated at RM 3.03 in attached table of maximum ramping rates). Ramping rates for releases greater than 300 cfs would be made after consultation with the Clear Creek Technical Team, considering: time of year of the change, time of day, timing change to occur with natural changes in flow and or turbidity, size of fish present in creek, species and protected status of vulnerable fish, the amount of water required, and relative costs or benefits of proposed flow. Reclamation shall time flow decreases so that the most juvenile Chinook salmon and steelhead experience the stage decrease during darkness. Maximum ramping rate of flow releases from Whiskeytown Dam into Clear Creek shall be accomplished based on the following targets within the precision of the outlet works or the City of Redding powerplant equipment.

Discharge	**Ramping Rate**
600-330 cfs	16 cfs / hour
330-105 cfs	15 cfs / hour

105-50 cfs	14 cfs / hour

e. Reclamation shall coordinate with DFG and FWS on conducting an IFIM study to aid in determining long term flow needs, including channel forming pulse flows, of Clear Creek as mandated under CVPIA. Upon completion of the study, Reclamation and FWS shall consider allocation of CVPIA 3406(b)(1) and (b)(2) resources to provide the recommended flows that provide habitat conditions for anadromous salmonids.

f. Reclamation will coordinate with NOAA Fisheries, FWS, and DFG to continue implementation and funding of fisheries monitoring of spring-run Chinook salmon and steelhead (including adult snorkel surveys, population estimates for steelhead, and rotary screw trapping) in Clear Creek to aide in determining the benefits of flow and temperature management.

Sacramento River Division

8. Reclamation shall implement all measures practicable to provide unimpeded passage upstream and downstream at the Red Bluff Diversion Dam during the period of September 1 through June 30 each year.

a. As a minimum, Reclamation shall provide unimpeded upstream and downstream passage at the Red Bluff Diversion Dam from September 15 through May 14 each year.

b. NOAA Fisheries will review proposals for early gate closures (prior to May 15) of up to 10 days, one time per year, only in emergency situations where the alternative water supplies (*i.e.*, new 4th pump at Red Bluff Pumping Plant and Stony Creek) are unable to meet TCCA demands. Reclamation will reopen the gates for a minimum of five consecutive days, prior to June 15 of the same year in a manner that will be least likely to adversely affect water deliveries.

c. Reclamation shall further investigate and implement all practicable opportunities, including improvements to fish ladders, to improve or provide unimpeded upstream and downstream passage at Red Bluff Diversion Dam from May 15 through June 30 and from September 1 through September 15 each year.

d. Reclamation, in coordination with FWS and DFG, shall further investigate the results of blockage or delays in the migration of adult Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon at the RBDD as a result of gate closures between May 15 and June 30 and from September 1 through September 15. Written reports shall be provided to NOAA Fisheries as investigations are completed.

American River Division

9. Reclamation shall manage the cold water supply within Folsom Reservoir and make cold water releases from Folsom Reservoir to balance the needs of Central Valley steelhead with fall-run Chinook salmon in the American River downstream of Nimbus Dam.

    a. Reclamation shall coordinate with the B2IT group to target a spring filling (May or June) of at least 700 TAF of storage in Folsom Reservoir in order to conserve available cold water resources and to develop a water temperature control plan.

    b. Reclamation shall develop a water temperature control plan for review and approval of NOAA Fisheries. The draft annual temperature control plan will be submitted by Reclamation for review by NOAA Fisheries not later than May 1 of each year. In the development of that annual temperature control plan, Reclamation shall seek input from the membership of the American River Operations Group (AROG).

    c. The water temperature control plan will give a preference to utilization of available cold water resources and Folsom Dam shutter management for the protection of steelhead by targeting 68 °F at Watt Avenue Bridge, before assessing cold water reserves available for the fall. A target of 68 °F at Watt Ave will likely provide a limited section of habitat between Nimbus Dam and Watt Ave in the preferred 65 °F range without seasonally exhausting the limited cold water available. If sufficient cold water availability exists to seasonally provide 68 °F at Watt Ave., then and only then would the potential to reserve the last shutter pull for the fall season exist.

10. Reclamation shall minimize the adverse effects of flow fluctuations associated with Folsom and Nimbus Reservoir operations on Central Valley steelhead spawning, egg incubation, and fry and juvenile rearing within the American River.

    a. During periods outside of flood control operations and to the extent controllable during flood control operations, Reclamation shall ramp down releases in the American River below Nimbus Dam as follows:

Lower American River Daily Rate of Change (cfs)	Amount of decrease in 24 hrs (cfs)	Maximum change per step (cfs)
20,000 to 16,000	4,000	1,350
16,000 to 13,000	3,000	1,000
13,000 to 11,000	2,000	700

11,000 to 9,500	1,500	500
9,500 to 8,300	1,200	400
8,300 to 7,300	1,000	350
7,300 to 6,400	900	300
6,400 to 5,650	750	250
5,650 to 5,000	650	250
<5,000	500	100

b. From January 1 through April 31 each year, Reclamation must coordinate with NOAA Fisheries, DFG and FWS to implement and fund monitoring of steelhead egg and juvenile stranding or dewatering events in order to estimate the incidental take associated with flow reductions in this time period from Nimbus Dam to the American River. All efforts shall be made to minimize dewatering of steelhead redds or adverse effects to incubating eggs, fry or juveniles.

New Melones Division

11. Reclamation shall manage the cold water supply within New Melones Reservoir and make cold water releases from New Melones Reservoir to optimize suitable rearing habitat for Central Valley steelhead in the Stanislaus River downstream of Goodwin Dam.

    a. Reclamation shall manage cold water releases from New Melones Reservoir to maintain daily average water temperature in the Stanislaus River between Goodwin Dam and the Orange Blossom Road bridge at no more than 65°F during the period of June 1 through November 30 to protect rearing juvenile Central Valley steelhead.

    b. Reclamation shall coordinate water temperature releases with DFG and FWS to use fishery release water, to the extent possible, consistent with NMIPO, D-1641, and CVPIA.

    c. If it becomes necessary to deviate from condition 7.a. above, Reclamation shall consult with DFG, FWS and NOAA Fisheries to develop a plan using all means possible to maximize suitable rearing habitat for Central Valley steelhead juveniles within the Stanislaus River below Goodwin Dam prior to June 1 each year.

12. Reclamation shall minimize the adverse effects of flow fluctuations associated with New Melones Reservoir and Goodwin Dam operations on Central Valley steelhead spawning, egg incubation, and fry and juvenile rearing within the Stanislaus River.

a. During periods outside of flood control operations and to the extent controllable during flood control operations, Reclamation shall ramp down releases in the Stanislaus River below Goodwin Dam as follows:

Existing Release Level (cfs)	Rate of Increase (cfs)	Rate of Decrease (cfs)
at or above 4,500	500 per 4 hours	500 per 4 hours
2,000 to 4,499	500 per 2 hours	500 per 4 hours
500 to 1,999	250 per 2 hours	200 per 4 hours
300 to 499	100 per 2 hours	100 per 4 hours

CVP Delta Operations

13. Reclamation shall operate the gates at the Delta Cross Channel (DCC) during the period of October 1 through April 30 each year to minimize the diversion of juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead from the Sacramento River basin into the central Delta.

a. Reclamation shall operate the gates of the DCC consistent with recommendations from the CALFED Operations Group, SWRCB D-1641 and the *Salmon Decision Process (i.e., see OCAP Appendix B).* Reclamation in coordination with the interagency Data Assessment Team (DAT), will monitor fish movement and water quality conditions within the Delta from October 1 through May 15. Gate openings for water quality improvements shall be coordinated with NOAA Fisheries, DFG, and FWS through the Water Operations Management Team (WOMT) and shall be minimized if fishery monitoring results indicate that juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead are migrating through the area and are in the vicinity of the DCC.

b. To facilitate common understanding of the potential competing objectives of water quality maintenance, export water supplies, and fisheries protection, Reclamation in cooperation with DWR shall develop a document addressing specific water quality criteria, operational rules, and a decision making process for operation of the DCC gates during the period between October 1 and May 15. This effort shall include investigation of whether hydrodynamic models can be used to predict potential water quality problems and develop alternative operations scenarios for the DCC gates and the Delta export pumps. This document, including updated water quality criteria, operational rules, and the decision-making process shall be completed and provided to NOAA Fisheries, Southwest Region, for review and approval no later than December 31, 2005. As necessary this document shall be updated or revised, with NOAA Fisheries approval, annually thereafter.

14. Reclamation shall improve and maintain in good working order fish screens at the Tracy pumping facility to minimize entrainment of juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead as a result of Delta export operations. This shall include fish screen inspections and developing and implementing a collection and release program, designed to provide for the survival of fish salvaged at the facility.

    a. Reclamation shall submit to NOAA Fisheries for approval one or more solutions to reduce losses associated with cleaning operations of the primary and secondary louver screens and secondary channel dewatering at the Tracy Fish Collection Facility (TFCF) no later than September 30, 2005. Upon approval by NOAA Fisheries, the selected solution shall be implemented as soon as possible.

    b. Prior to and until such time as a reasonable solution to losses associated with cleaning operations at the TFCF is implemented, Reclamations shall coordinate with NOAA Fisheries and revise the loss calculation formula for the Tracy pumping facility to reflect the expected higher losses not previously considered. This updated loss calculation formula shall be developed and submitted to NOAA fisheries for review and approval no later than December 15, 2004.

    c. Reclamation shall conduct annual fish screen inspections, in coordination with NOAA Fisheries, of all Tracy pumping facility fish screens and permit reasonable unannounced access to the TFCF by NOAA Fisheries staff at least one additional time each year for additional inspections. These inspections shall include access all to records of operation, fish salvage, and fish transportation and release activities.

    d. Reclamation shall ensure that fish transportation runs conducted as part of the collection and release (salvage) program for listed salmonids are conducted at least every 12 hours or more frequently if required by the “Bates Table” calculations made at each count and recorded on the monthly report.

15. Reclamation, in cooperation with the Contra Costa Water District (CCWD), shall continue to collect additional data at the Tracy Fish Collection Facility and the Rock Slough Intake to monitor the extent of incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead associated with the operation of the CVP’s Tracy and CCWD’s Rock Slough pumping facilities.

a. Incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead shall be monitored daily at the Tracy pumping facility and Rock Slough Intake from October 1 through May 31 of each year. Tissue samples from salvaged fish shall be collected for genetic analysis and provided to a lab identified by NOAA Fisheries. Loss and salvage at each facility shall be computed using formulas developed in consultation with DFG and FWS and approved by NOAA Fisheries.

b. At the Tracy pumping facility, the following monitoring procedures must be performed at the Tracy Fish Collection Facility by personnel experienced in salmon biology. For a minimum period of 10 minutes within each 2 hour interval throughout the day and night (minimum of 120 minutes per day) all salmon and steelhead are to be measured (fork length to the nearest millimeter), examined for the presence or absence of the adipose fin and enumerated. At the Rock Slough Intake a monitoring program must be implemented similar to the expanded monitoring plan developed by DFG and implemented in 2004 and performed by personnel experienced in salmon biology.

c. Reclamation, in cooperation with CCWD, will monitor the loss of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead at the Rock Slough diversion from October 1 through May 31 each year. Monitoring information shall be used to determine whether the estimated levels of take at the Rock Slough diversion are expected to exceed 5 Sacramento River winter-run Chinook salmon juveniles, 10 Central Valley spring-run Chinook juveniles, and 5 Central Valley steelhead total (juveniles plus adults) annually. If the take levels above are exceeded, Reclamation and CCWD shall immediately consult NOAA Fisheries to explore additional measures which can be implemented to reduce the level of take. If suitable measure to reduce take are not available, Reclamation and CCWD shall immediately reinitiate consultation.

d. Reclamation shall submit weekly reports to the interagency DAT and provide an annual written report to NOAA Fisheries. As a minimum, these reports shall describe the estimated loss and salvage of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead associated with operations of the Tracy and Rock Slough pumping facilities. The annual written report shall be submitted to NOAA Fisheries no later than October 1.

State Water Project Operations:

Oroville Reservoir and Feather River Operations

16. The California Department of Water Resources (DWR) shall investigate and implement all measures practicable to avoid or minimize adverse effects of Oroville Reservoir

operations and to improve natural production of Central Valley spring-run Chinook salmon and Central Valley steelhead in the Feather River below Oroville Dam.

a. DWR will establish and chair a Feather River Interagency Anadromous Fishery Technical Team (Feather River Technical Team). The Feather River Technical Team should include fishery biologists, hatchery specialists, and river morphology specialists from DWR, DFG, FWS, and NOAA Fisheries. The Feather River Technical Team will meet monthly, quarterly, or as needed to review, and deliberate O&M actions that may adversely affect anadromous salmonids and their habitat, and will develop recommendations for avoiding or minimizing adverse impacts that may result from such actions.

b. DWR will coordinate Dam safety inspections that involve the need to fluctuate flows in the low flow channel to ensure the inspections are conducted at a time or in a manner that minimize the potential for adverse effects to spawning and/or rearing salmon and steelhead without affecting flood control or water supply operations and minimizes effects on power generation.

c. During periods outside of flood control operations and to the extent controllable during flood control operations, DWR shall ramp down releases to the low flow channel as presented in the table below:

Feather River Low-Flow Channel Releases (cfs)	Rate of Decrease (cfs) per 24 hours
5,000 to 3,501	1,000
3,500 to 2,501	500
2,500 to 600	300

d. DWR shall provide a written report containing the results of rotary screw traps, fyke traps, snorkel surveys, creel census and tissue sampling for monitoring studies to NOAA Fisheries (Southwest Region, Protected Resources Division, Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814-4706). In addition, DWR will continue with the stranding and isolation study as proposed in the project description. A written report summarizing study findings shall be provided to NOAA Fisheries annually, no later than December 31, each year. Additional studies are needed to determine (1) in-river abundance, (2) spawning habitat utilization, and (3) suitability of annual flow patterns for all life-stages of steelhead and spring-run Chinook salmon.

17. DWR shall manage cold water storage in Oroville Reservoir and make cold water releases from Oroville Reservoir to provide suitable spawning and rearing habitat within

the Feather River for Central Valley spring-run Chinook salmon and Central Valley steelhead between the Fish Barrier Dam and Robinson's Riffle (RM 61.6).

a. DWR shall maintain daily average water temperatures in the Feather River, between the Fish Barrier Dam and Robinson's Riffle (RM 61.6) from June 1 through September 30 less than or equal to 65 ºF to protect over-summering steelhead. This term is not intended to preclude pump-back operations at the Oroville Facilities that are needed to assist the State of California with supplying energy during periods when the California ISO has anticipated Stage 2 or higher alerts.

b. DWR shall consult with the Feather River Technical Team and receive approval from NOAA Fisheries, prior to making any necessary deviations from the average daily water temperature compliance criteria as described in 2.a above.

SWP Delta Operations

18. DWR shall improve and maintain in good working order fish screens at the Harvey Banks pumping facility to minimize entrainment of juvenile Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead as a result of Delta export operations. This shall include developing and implementing a collection and release program for salvaged fish designed to provide for the survival of fish salvaged at the facility.

    a. Incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead shall be monitored daily at the Skinner Fish Collection Facility. Loss and salvage shall be computed using formulas developed in consultation with DFG and FWS and approved by NOAA Fisheries.

    b. If the trigger for incidental take (identified in *amount of take* section) for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead at the SWP Harvey Banks pumping facility combined with the estimated take at the CVP Tracy pumping facility is exceeded Reclamation and DWR, in consultation with the DAT and WOMT, shall develop and implement actions to avoid further loss.

19. DWR shall collect additional data at the Clifton Court Forebay, the John Skinner Fish Collection Facility, and the Harvey Banks pumping plant to monitor the incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook

salmon, and Central Valley steelhead and to develop and implement improvements to pumping facility operations to further reduce or minimize losses of listed salmonids.

a. DNA tissue samples and CWT samples from juvenile spring-run and winter-run Chinook salmon and steelhead at the Tracy and Skinner fish collection facilities shall be collected by DWR or DFG for genetic analysis or tag removal/reading pursuant to the sampling protocols established by the IEP Salmon Genetics Project Work Team. Tissues shall be stored at the DFG tissue bank at Rancho Cordova for subsequent analysis by Oregon State University or similar lab approved by NOAA Fisheries. Whole fish or heads for CWT processing and identification shall be stored at the FWS Bay/Delta Office in Stockton. All samples shall be clearly marked according to office protocol and a log maintained at each storage facility. Unclipped steelhead samples for DFG otolith studies may be collected and stored at the above facilities after providing NOAA Fisheries, Sacramento Office with a detailed study plan.

b. DWR shall submit weekly reports to the interagency DAT and an annual written report to NOAA Fisheries describing, as a minimum, the estimated loss and salvage of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead associated with operations of the Harvey Banks pumping facility. This annual written report shall be submitted no later than October 1.

SWP Suisun Marsh Operations

20. DWR shall operate the of Suisun Marsh Salinity Control Gate to minimize delay and blockage of adult Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead migrating upstream.

a. Incidental take for the Suisun Marsh Salinity Control Gates shall be based upon DFG monitoring studies associated with gate operations. It is anticipated that some adult steelhead may be caught during these studies, therefore up to 10 adult steelhead may be tagged to determine their migratory patterns.

i. Beginning no later than November 15, 2004, hold the boat lock “open” at all times when the flashboards are installed at the SMSCG. The boat lock may be closed temporarily to facilitate the passage of vessels traveling through Montezuma Slough and for fish passage investigations. This term and condition will continue to be in effect after September 2005 in conjunction with the implementation of term and condition “ii” below.

ii. Reclamation and DWR shall continue to work with DFG, FWS, and NOAA Fisheries through the SMSCG Steering Committee to develop a proposal that will improve fish passage at the SMSCG. The proposal shall include feasible measures to remove and re-install the SMSCG flashboards in a timely and efficient manner between September and May during periods when operation of the structure is not required for water quality. The proposal shall be submitted to NOAA Fisheries for review and concurrence by June 1, 2005.

X. PRELIMINARY INCIDENTAL TAKE STATEMENT - EARLY CONSULTATION

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 to include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with this Incidental Take Statement.

Because the prospective actions considered in the early consultation and preliminary biological opinion are likely to result in the taking of listed salmonids incidental to the action, NOAA Fisheries has included this preliminary incidental take statement pursuant to section 7(b)(4) of the Act. However, because this is an early consultation on the prospective action, this preliminary incidental take statement does not eliminate Reclamations or DWR’s liability under the taking prohibitions of section 9 of the Act. Instead, this preliminary incidental take statement provides Reclamation and DWR with the foreknowledge of the terms and conditions that will be required if this prospective action is taken.

The following reasonable and prudent measures and implementing terms and conditions become effective only after NOAA Fisheries confirms the preliminary biological opinion as a final biological opinion on the prospective action. Reclamation and DWR must request that NOAA Fisheries confirm this preliminary biological opinion as a final biological opinion on the prospective action in writing. If NOAA Fisheries reviews the proposed action and finds that there are no significant changes in the action as planned or in the information used during the early consultation, it will confirm the preliminary biological opinion as a final biological opinion on the project and no further section 7 consultation will be necessary except when one or more of the criteria described in Section XII of this opinion (Reinitiation of Consultation) are met.

This preliminary incidental take statement is applicable to all activities related to the operation of the CVP and SWP described in the preliminary biological opinion. This preliminary incidental take statement does not cover activities that are not described and assessed within the preliminary biological opinion. In addition, this preliminary incidental take statement does not cover the facilities or activities of any CVP or SWP contractor, or the facilities or activities of parties to agreements with the U.S. that recognize a previous vested water right.

A. Preliminary Amount or Extent of Take - Early Consultation

NOAA Fisheries anticipates that the implementation of prospective actions considered in this early consultation will increase project impacts to endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead over those anticipated as a result of the formal consultation. This additional incidental take is expected to be in the form of death, injury, harm, capture, and collection.

Death, injury, and harm to juvenile and adult winter-run Chinook salmon, spring-run Chinook salmon, and steelhead are anticipated due to reduced storage in upstream CVP and SWP reservoirs, further altering the natural hydrological cycle downstream of CVP and SWP dams. The frequency of water temperatures exceeding 56 ^{0}F at Ball's Ferry on the Sacramento River, for example, is anticipated to increase by 7% over that expected in the formal consultation. Since these exceedances are expected to occur in September and October it is likely that individual reproductive success of Central Valley spring-run Chinook salmon will be most affected. Egg and fry mortality is anticipated to increase under the prospective actions of the early consultation as storage will be reduced and the ability to control water temperatures downstream decreases. Predicted additional average mortality over that anticipated in the formal consultation is 1% for winter-run Chinook salmon, 5% for spring-run Chinook salmon, and 1% for steelhead. On the American River, prospective actions considered under early consultation are also expected to be greater than those anticipated under formal consultation and include: 1) further reductions in available and suitable habitat; 2) increased redd superimposition; 3) increased flow fluctuations; and, 4) increased predation on juvenile steelhead.

Prospective actions considered in the early consultation are also expected to increase the severity of effects in the Delta compared to those anticipated in the formal consultation. Additional effects in the Delta are primarily linked to additional pumping that will occur when pumping at Banks increases to 8,500 cfs and the CVP/SWP Intertie is completed. While it is anticipated that the incidental take of juvenile Sacramento River winter-run Chinook salmon can still generally be managed to less than 2 percent, cumulatively, between the CVP and SWP pumping plants as a result of prospective actions considered in the early consultation, it is anticipated that the incidental take of Central Valley spring-run Chinook salmon and Central Valley steelhead may increase by 1% of the estimated juvenile population entering the Delta.

Additional changes in Delta hydrology created by prospective actions considered in the early consultation are also expected to increase incidental take levels. This take includes further reduced survival of juvenile Chinook salmon diverted through the DCC into the central Delta from 1) elevated water temperatures and poorer water quality within the central Delta; 2) losses due to entrainment at unscreened water diversions within the central Delta; 3) predation associated with physical structures; 4) reverse flow conditions as a result of CVP/SWP pumping; and 5) direct loss at the Delta pumping facilities within the southern Delta.

B. Preliminary Effect of the Take - Early Consultation

The expected effect of prospective actions considered in the early consultation are generally the same as those described for the formal consultation.

In the accompanying preliminary biological opinion, NOAA Fisheries has determined that the anticipated level of take associate with prospective project operations is not likely to result in jeopardy to the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead.

C. Preliminary Reasonable and Prudent Measures - Early Consultation

NOAA Fisheries believes that the reasonable and prudent measures described previously in the incidental take statement for the formal consultation (Section IX.C.) combined with the following preliminary reasonable and prudent measure are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead.

1. Reclamation and DWR shall monitor the extent of incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead, associated with the operation of the CVP’s Tracy and SWP’s Harvey Banks pumping facilities.

2. DWR shall reduce predation and loss of Central Valley steelhead due to increased pumping to 8,500 cfs at the Harvey Banks pumping facility at Clifton Court Forebay, the John Skinner Fish Collection Facility and the associated collection, trucking, and release program.

D. Preliminary Terms and Conditions - Early Consultation

Reclamation and DWR must comply or ensure compliance by their contractor(s) with all terms and conditions described previously (Section IX. D.) for the formal consultation and the following additional terms and conditions, which implement the reasonable and prudent measures described above for early consultation. These terms and conditions are non-discretionary.

1. Reclamation and DWR shall monitor the extent of incidental take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central

Valley steelhead, associated with the operation of the CVP's Tracy and SWP's Harvey Banks pumping facilities.

a. Reclamation and DWR shall calculated salmon and steelhead loss at the Tracy and Banks pumping plants on a real-time basis from October 1 through May 31 each year.

b. Reclamation and DWR will monitor the loss of juvenile Sacramento River winter-run Chinook salmon at the CVP and SWP Delta pumping facilities and will use that information to determine whether the anticipated level of loss is likely to exceed the authorized level of 2%, cumulatively, of the estimated number of juvenile Sacramento River winter-run Chinook salmon entering the Delta annually. If either agency or NOAA Fisheries determines the rate of loss has exceeded 1%, cumulatively, Reclamation and DWR shall immediately convene the Water Operations Management Team to explore additional measures which can be implemented to reduce the rate of take and ensure the identified 2% level of take is not exceeded. If either agency or NOAA Fisheries determines the rate of loss is sufficiently high that the estimated loss will likely exceed the 2% identified level, consultation shall be reinitiated immediately.

c. Reclamation and DWR will monitor the loss of identified Central Valley spring-run Chinook salmon surrogate release groups at the CVP and SWP Delta pumping facilities and use that information to determine whether the cumulative estimated level of loss is expected to exceed one percent. If the estimated rate of loss exceeds 1% Reclamation and DWR shall immediately convene the Water Operations Management Team to explore additional measures which can be implemented to reduce the rate of take. If the rate of loss exceeds 2%, consultation shall be reinitiated immediately.

d. Reclamation and DWR will monitor the loss of Central Valley steelhead at the CVP and SWP Delta pumping facilities and use that information to determine whether the cumulative estimated level of loss is expected to exceed 2% of the juvenile production estimate (JPE) for steelhead entering the Delta. Until such time as a suitable steelhead JPE has been developed, the cumulative take at the CVP and SWP delta pumping facilities shall not exceed 4,500 steelhead (juveniles and adults combined). If the take level anticipated for Central Valley steelhead is exceeded, Reclamation and DWR shall immediately convene the Water Operations Management Team to explore additional measures which can be implemented to reduce the rate of take. If suitable measures to reduce the rate of take can not be implemented, consultation shall be reinitiated immediately.

2. DWR shall reduce predation and loss of Central Valley steelhead due to increased pumping to 8,500 cfs at the Harvey Banks pumping facility at Clifton Court Forebay, the

John Skinner Fish Collection Facility and the associated collection, trucking, and release program.

a. DWR shall design, implement, and complete studies to document the rate of predation on Central Valley steelhead while in Clifton Court Forebay (CCF) and prior to salvage at the John Skinner Fish Collection Facility. Initial studies shall be completed prior to permanent barriers being constructed and increased pumping at the Banks pumping facility to 8,500 cfs.

b. Upon completion of initial studies, DWR shall take appropriate action to reduce the predation rate on Central Valley steelhead, while in Clifton Court Forebay.

XI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These "conservation recommendations" include discretionary measures that Reclamation and DWR can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, the NOAA Fisheries provides the following conservation recommendations that would reduce or avoid adverse impacts on the listed species:

1. Reclamation and DWR should support and expand salmon and steelhead monitoring programs throughout the Central Valley to improve understanding of the life history of these listed species and improve the ability to provide Fisheries protection through real-time management of CVP/SWP facilities. This information can be used to better implement real-time operational decisions, such as the closing of the DCC gates and arrival of listed salmonids in the Delta (See Monitoring (Table A1), spawner surveys, adult counts, rotary screw trapping).

2. Reclamation and DWR should participate in watershed planning efforts (including the San Joaquin River), and support measures to protect adequate instream flows, and equitable approaches to increasing stream flows and water available for flow augmentation.

3. Reclamation should adopt a new minimum flow standard on the American River consistent with the Water Forum Agreement referenced in the OCAP project description that maintains the suitability of habitat below Nimbus Dam for steelhead spawning and over-summering.

4. Reclamation and DWR should support and promote aquatic and riparian habitat restoration downstream of CVP/SWP reservoirs with special emphasis upon the protection and restoration of critical habitat (*i.e.*, shaded riverine aquatic cover) that increase the existing stream meander zone.

5. Reclamation, consistent with the CVPIA, shall consider funding channel restoration activities such as 1) implementing recommendations of the Clear Creek Gravel Management Plan, as amended by the Clear Creek Technical Team; 2) maintaining a stockpile of clean spawning gravel at the Whiskeytown Dam site; 3) supplementing gravel supply within Clear Creek from Whiskeytown Dam downstream to the Clear Creek Road Bridge; and 4) developing a detailed sediment transport budget for use in determining required supplementation rates.

6. Reclamation and DWR should continue to provide benefits to winter-run Chinook salmon, spring-run Chinook salmon and steelhead to mitigate losses associated with the CVP/SWP Delta Facilities.

    a. DWR should continue to implement and/or fund projects pursuant to the 4-Pumps Agreement with DFG.

    b. Reclamation should continue to develop and implement measures to minimize fish passage problems at RBDD as required under CVPIA Section 3406(b)(10).

    c. Reclamation should include NOAA Fisheries in the review of projects implemented or funded pursuant to the Tracy Fish Facility Agreement consistent with CVPIA Section 3406(b)(4).

7. Reclamation and DWR shall work with NOAA Fisheries staff to minimize take from unscreened diversions that are a part of water contract renewals.

    a. Reclamation should complete funding and construction of fish screens pursuant to CVPIA Section 3406(b)(21), to reduce entrainment of listed salmonids that receive CVP contract water (*e.g.*, Rock Slough Intake, City of Redding, Reclamation District 108, Sutter Mutual, Natomas Mutual).

    b. DWR should proceed with constructing a fish screen at the Morrow Island Distribution system intake during 2005 to eliminate this source of fish mortality in Suisun Marsh.

    c. Reclamation should provide current information on the effects of agricultural return flows from CVP water contracts on listed salmonids in the Sacramento River prior to the renewal of long-term contracts.

8. Reclamation and DWR shall work with NOAA Fisheries, FWS and DFG to implement and/or fund any monitoring associated with projects that Reclamation, DWR, DFG, FWS or NOAA Fisheries agree are necessary and appropriate to determine incidental take levels (including genetic identification research, predation studies, and post-release studies) or provide for the protection and/or recovery of spring-run Chinook salmon or steelhead.

9. An adaptive management approach, including monitoring of salmon and steelhead status and response to flow fluctuations, if they occur, should be established for each river to minimize the loss associated with isolation and stranding events. If inadequate water resources are anticipated, Reclamation and DWR should expedite the purchase of water from willing sellers through EWA or (b)(3) to ensure meeting their environmental responsibilities.

10. Pursue opportunities to conserve water and manage water more efficiently, including but not limited to: improving water measurement, accurate water accounting, minimizing conveyance losses, and minimizing environmental impacts to instream resources.

11. Reclamation should initiate section 7 consultation for Trinity River Hatchery and Nimbus Hatchery within one year of issuance of this biological opinion to determine the effects of those hatcheries on listed species (*i.e.*, SONCC coho salmon and Central Valley steelhead) and critical habitat. Reclamation and DWR should pursue mass marking of all hatchery origin fish produced as mitigation for the Project to determine their effect on natural spawning populations.

12. NOAA Fisheries recommends that Reclamation, and DWR should conduct a Fish Passage Feasibility Study to evaluate the best opportunity for listed salmonids at all CVP and SWP dams by no later than September 15, 2008.

13. The Reclamation and DWR should expedite, to the extent possible funding is available, implementation and completion of the Battle Creek Restoration Project.

XII. REINITIATION OF CONSULTATION

This concludes formal and early consultation on the proposed actions outlined in the biological opinion for the long-term operation of the CVP and SWP. In order to confirm the preliminary portion of this biological opinion on proposed early actions (*i.e.*, 8500 Banks, long-term EWA, SDIP, and Project Integration), Reclamation and DWR should request in writing that the early consultation be considered in a final biological opinion. If after NOAA Fisheries reviews the proposed early consultation actions and finds that there are no significant changes in the actions as planned or in the information used during the early consultation, it will **confirm** the preliminary biological opinion as a final biological opinion on the project and no further section 7 consultation will be necessary except when one of the following criteria for reinitiation is met:

(1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat 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, formal consultation shall be reinitiated immediately.

If NOAA Fisheries does not confirm this preliminary biological opinion as a final biological opinion on the prospective early actions, Reclamation and DWR are required to initiate formal consultation with NOAA Fisheries.

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APPENDIX A - ADDITIONAL TABLES

Table A1: Salmon and Steelhead monitoring programs in the Sacramento - San Joaquin and Trinity River basins, and Suisun Marsh.

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
Central Valley	***Chinook Salmon, Steelhead***	Sacramento River	Scale and otolith collection	Coleman National Hatchery, Sacramento River and tributaries	Scale and otolith microstructure analysis	All year	CDFG
		Sacramento River and San Joaquin River	Central Valley Angler Survey	Sacramento and San Joaquin rivers and tributaries downstream to Carquinez	In-river harvest	8 or 9 times per month, year round	CDFG
		Sacramento River	Rotary screw trapping	Upper Sacramento River at Balls Ferry and Deschutes Road Bridge	Juvenile emigration timing and abundance	Year round	CDFG
		Sacramento River	Rotary screw trapping	Upper Sacramento River at RBDD	Juvenile emigration timing and abundance	Year round	FWS
		Sacramento River	Ladder counts	Upper Sacramento River at RBDD	Escapement estimates, population size	Variable, May - Jul	FWS
		Sacramento River	Beach seining	Sacramento River, Caldwell Park to Delta	Spatial and temporal distribution	Bi-weekly or monthly, year-round	FWS
		Sacramento River	Beach seining, snorkel survey, habitat mapping	Upper Sacramento River from Battle Creek to Caldwell Park	Evaluate rearing habitat	Random, year-round	CDFG
		Sacramento River	Rotary Screw Trap	Lower Sacramento River at Knight's Landing	Juvenile emigration and post-spawner adult steelhead migration	Year-round	CDFG
		Sacramento-San Joaquin basin	Kodiak/Midwater trawling	Sacramento river at Sacramento, Chipps Island, San Joaquin River at Mossdale	Juvenile outmigration	Variable, year-round	FWS
		Sacramento-San Joaquin Delta	Kodiak trawling	Various locations in the Delta	Presence and movement of juvenile salmonids	Daily, Apr - Jun	IEP

Geographic Region	**Species**	**Watershed**	**Methods**	**Geographic Area Covered**	**Monitoring Parameters**	**Monitoring Period**	**Implementing Agency**
		Sacramento-San Joaquin Delta	Kodiak trawling	Jersey Point	Mark and recapture studies on juvenile salmonids	Daily, Apr - Jun	Hanson Environmental Consultants
Central Valley	*Chinook Salmon, Steelhead, Continued*	Sacramento-San Joaquin Delta	Salvage sampling	CVP and SWP south delta pumps	Estimate salvage and loss of juvenile salmonids	Daily	USBR/CDFG
		Battle Creek	Rotary screw trapping	Above and below Coleman Hatchery barrier	Juvenile emigration	Daily, year-round	FWS
		Battle Creek	Weir trap, carcass counts, snorkel/ kayak survey	Battle Creek	Escapement, migration patterns, demographics	Variable, year-round	FWS
		Clear Creek	Rotary screw trapping	Lower Clear Creek	Juvenile emigration	Daily, mid Dec-Jun	FWS
		Feather River	Rotary screw trapping, Beach seining, Snorkel survey	Feather River	Juvenile emigration and rearing, population estimates	Daily, Dec - Jun	DWR
		Yuba River	Rotary screw trap	lower Yuba River	Life history evaluation, juvenile abundance, timing of emergence and migration, health index	Daily, Oct - Jun	CDFG
		Feather River	Ladder at hatchery	Feather River Hatchery	Survival and spawning success of hatchery fish (spring-run Chinook), determine wild vs. hatchery adults (steelhead)	Variable, Apr - Jun	DWR, CDFG
		Mokelumne River	Habitat typing	Lower Mokelumne River between Camanche Dam and Cosumnes River confluence	Habitat use evaluation as part of limiting factors analysis	Various, when river conditions allow	EBMUD

Geographic Region	**Species**	**Watershed**	**Methods**	**Geographic Area Covered**	**Monitoring Parameters**	**Monitoring Period**	**Implementing Agency**
		Mokelumne River	Redd surveys	Lower Mokelumne River between Camanche Dam and Hwy 26 bridge	Escapement estimate	Twice monthly, Oct 1- Jan 1	EBMUD
		Mokelumne River	Rotary screw trapping, mark/recapture	Mokelumne River, below Woodbridge Dam	Juvenile emigration and survival	Daily, Dec- Jul	EBMUD
Central Valley	*Chinook Salmon, Steelhead, Continued*	Mokelumne River	Angler survey	Lower Mokelumne River below Camanche Dam to Lake Lodi	In-river harvest rates	Various, year-round	EBMUD
		Mokelumne River	Beach seining, electrofishing	Lower Mokelumne	Distribution and habitat use	Various locations at various times throughout the year	EBMUD
		Mokelumne River	Video monitoring	Woodbridge Dam	Adult migration timing, population estimates	Daily, Aug - Mar	EBMUD
		Calaveras River	Adult weir, snorkel survey, electrofishing	Lower Calaveras River	Population estimate, migration timing, emigration timing	Variable, year-round	Fishery Foundation
		Stanislaus River	Rotary screw trapping	lower Stanislaus River at Oakdale and Caswell State Park	Juvenile outmigration	Daily, Jan - Jun, dependent on flow	S.P Cramer
		San Joaquin River basin	Fyke nets, snorkel surveys, hook and line survey, beach seining, electrofishing	Stanislaus, Tuolumne, Merced, and mainstem San Joaquin rivers	Presence and distribution, habitat use, and abundance	Variable, Mar- Jul	CDFG
	CV Steelhead	Sacramento River	Angler Survey	RBDD to Redding	In-river harvest	Random Days, Jul 15 - Mar 15	CDFG
		Battle Creek	Hatchery counts	Coleman National Fish Hatchery	Returns to hatchery	Daily, Jul 1 - Mar 31	FWS

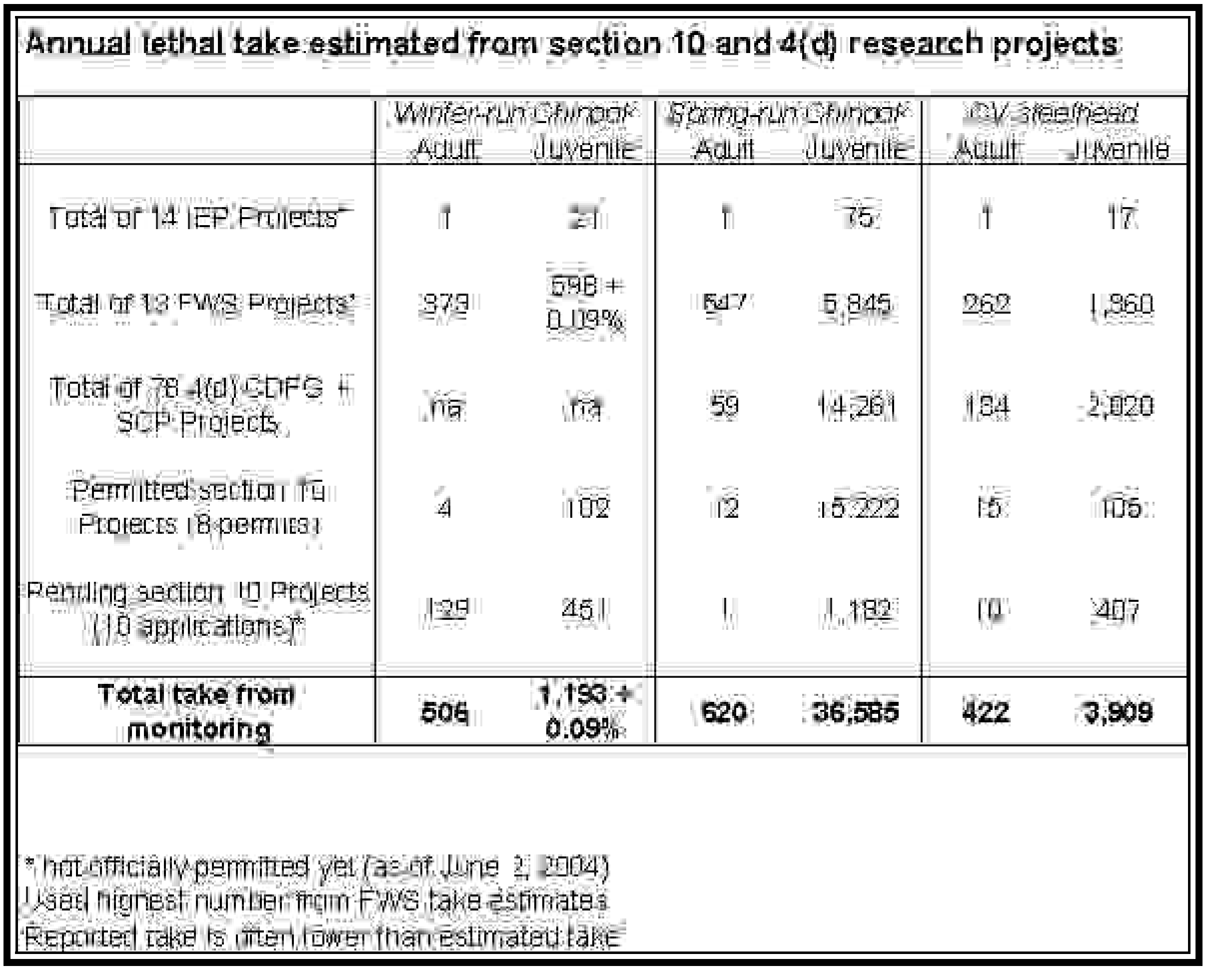
Geographic Region	**Species**	**Watershed**	**Methods**	**Geographic Area Covered**	**Monitoring Parameters**	**Monitoring Period**	**Implementing Agency**
		Clear Creek	Snorkel survey, redd counts	Clear Creek	Juvenile and spawning adult habitat use	Variable, dependent on river conditions	FWS
		Mill Creek, Antelope Creek, Beegum Creek	Spawning survey - snorkel and foot	Upper Mill, Antelope, and Beegum Creeks	Spawning habitat availability and use	Random days when conditions allow, Feb - Apr	DFG
Central Valley	***CV Steelhead*** continued	Mill Creek, Deer Creek, Antelope Creek	Physical habitat survey	Upper Mill, Deer, and Antelope Creeks	Physical habitat conditions	Variable	USFS
		Dry Creek	Rotary screw trapping	Miner and Secret Ravine's confluence	Downstream movement of emigrating juveniles and post-spawner adults	Daily, Nov- Apr	DFG
		Dry Creek	Habitat survey, snorkel survey, PIT tagging study	Dry Creek, Miner and Secret Ravine's	Habitat availability and use	Variable	DFG
		Battle Creek	Otolith analysis	Coleman Hatchery	Determine anadromy or freshwater residency of fish returning to hatchery	Variable, dependent on return timing	FWS
		Feather River	Hatchery coded wire tagging	Feather River Hatchery	Return rate, straying rate, and survival	Daily, Jul - Apr	DWR
		Feather River	Snorkel survey	Feather River	Escapement estimates	Monthly, Mar to Aug (upper river), once annually (entire river)	DWR
		Yuba River	Adult trap	lower Yuba River	Life history, run composition, origin, age determination	Year-round	Jones and Stokes
		American River	Rotary screw trapping	Lower American River, Watt Ave. Bridge	Juvenile emigration	Daily, Oct- Jun	DFG

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
		American River	Beach seine, snorkel survey, electrofishing	American River, Nimbus Dam to Paradise Beach	Emergence timing, juvenile habitat use, population estimates	Variable	DFG
		American River	Redd surveys	American River, Nimbus Dam to Paradise Beach	Escapement estimates	Once, Feb - Mar	DFG, BOR
		Mokelumne River	Electrofishing, gastric lavage	Lower Mokelumne River	Diet analysis as part of limiting factor analysis	Variable	EBMUD
Central Valley	***CV Steelhead*** continued	Mokelumne River	Electrofishing, hatchery returns	Lower Mokelumne River, Mokelumne River hatchery	O. Mykiss genetic analysis to compare hatchery returning steelhead to residents	Variable	EBMUD
		Calaveras River	Rotary screw trap, pit tagging, beach seining, electrofishing	lower Calaveras River	Population estimate, migration patterns, life history	Variable, year-round	SP Cramer
		San Joaquin River basin	Fyke nets, snorkel survey, hook and line survey, beach seining, electrofishing, fish traps/weirs	Stanislaus, Tuolumne, Merced, and mainstem San Joaquin rivers	Presence, origin, distribution, habitat use, migration timing, and abundance	Variable, Jun - Apr	DFG
		Merced River	Rotary screw trapping	Lower Merced River	Juvenile oumigration	Variable, Jan-Jun	Natural Resource Scientists, Inc.
		Central Valley-wide	Carcass survey, hook and line survey, electrofishing, traps, nets	Upper Sacramento, Yuba, Mokelumne, Calaveras, Tuolumne, Feather, Cosumnes and Stanislaus Rivers, and Mill, Deer, Battle, and Clear Creeks	Occurrence and distribution of *O. Mykiss*	Variable, year-round	DFG

Geographic Region	Species	Watershed	Methods	Geographic Area Covered	Monitoring Parameters	Monitoring Period	Implementing Agency
		Central Valley -wide	Scale and otolith sampling	Coleman NFH, Feather, Nimbus, Mokelumne River hatcheries	Stock identification, juvenile residence time, adult age structure, hatchery contribution	Variable upon availability	DFG
		Central Valley -wide	Hatchery marking	All Central Valley Hatcheries	Hatchery contribution	Variable	FWS, DFG
	SR Winter-run Chinook salmon	Sacramento River	Aerial redd counts	Keswick Dam to Princeton	Number and proportion of reds above and below RBDD	Weekly, May 1-July 15	DFG
		Sacramento River	Carcass survey	Keswick Dam to RBDD	In-river spawning escapement	Weekly, Apr 15-Aug 15	FWS, DFG
	SR Winter-run Chinook salmon	Battle Creek	Hatchery marking	Colemen National Fish Hatchery	Hatchery contribution	Variable	FWS, DFG
		Sacramento River	Ladder counts	RBDD	Run-size above RBDD	Daily, Mar 30- Jun 30	FWS
		Pacific Ocean	Ocean Harvest	California ports south of Point Arena	Ocean landings	May 1- Sept 30 (commercial), Feb 15 - Nov 15 (sport)	DFG
	CV Spring-run Chinook salmon	Mill, Deer, Antelope, Cottonwood, Butte, Big Chico Creeks	Rotary screw trapping, snorkel survey, electrofishing, beach seining	upper Mill, Deer, Antelope, Cottonwood, Butte, and Big Chico creeks	Life history assessment, presence, adult escapement estimates	Variable, year-round	DFG
		Feather River	Fyke trapping, angling, radio tagging	Feather River	Adult migration and holding behavior	Variable, Apr-June	DWR
		Yuba River	Fish trap	lower Yuba River, Daguerre Point Dam	Timing and duration of migration, population estimate	Daily, Jan - Dec	DFG
Suisun Marsh	***Chinook salmon***	Suisun Marsh	Otter trawling, beach seining	Suisun Marsh	Relative population estimates and habitat use	Monthly, year-round	UCDavis

Geographic Region	**Species**	**Watershed**	**Methods**	**Geographic Area Covered**	**Monitoring Parameters**	**Monitoring Period**	**Implementing Agency**
		Suisun Marsh	Gillnetting	Suisun Marsh Salinity Control Gates	Fish passage	Variable, Jun - Dec	DFG
Trinity River	***Chinook and coho salmon***	Trinity River	Rotary screw trapping	lower Trinity River	Abundance, emigration timing, life history	Daily, Apr- Aug	FWS
		Trinity River	Adult weir counts	Trinity River at Willow Creek	Migration timing, population estimate	Daily, late Aug-mid-Nov	DFG
		Trinity River	Carcass/spawning survey	Trinity River	Escapement estimate, distribution, pre-spawn mortality, sex composition, wild vs. hatchery fish ratio	Variable, Sept - Dec	DFG

Table A2:



Annual lethal take estimated from section 10 and 4(d) research projects

	Winter-run Chinook		Spring-run Chinook		CV steelhead	
	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
Total of 14 IEP Projects"	1	21	1	75	1	17
Total of 13 FWS Projects'	379	598 + 0.09%	547	5,845	262	1,360
Total of 78 4(d) CDFG + SCP Projects	na	na	59	14,261	134	2,020
Permitted section 10 Projects (8 permits)	4	102	12	15,222	15	105
Pending section 10 Projects (10 applications)*	122	451	1	1,182	10	407
Total take from monitoring	**506**	**1,193 + 0.09%**	**620**	**36,585**	**422**	**3,909**

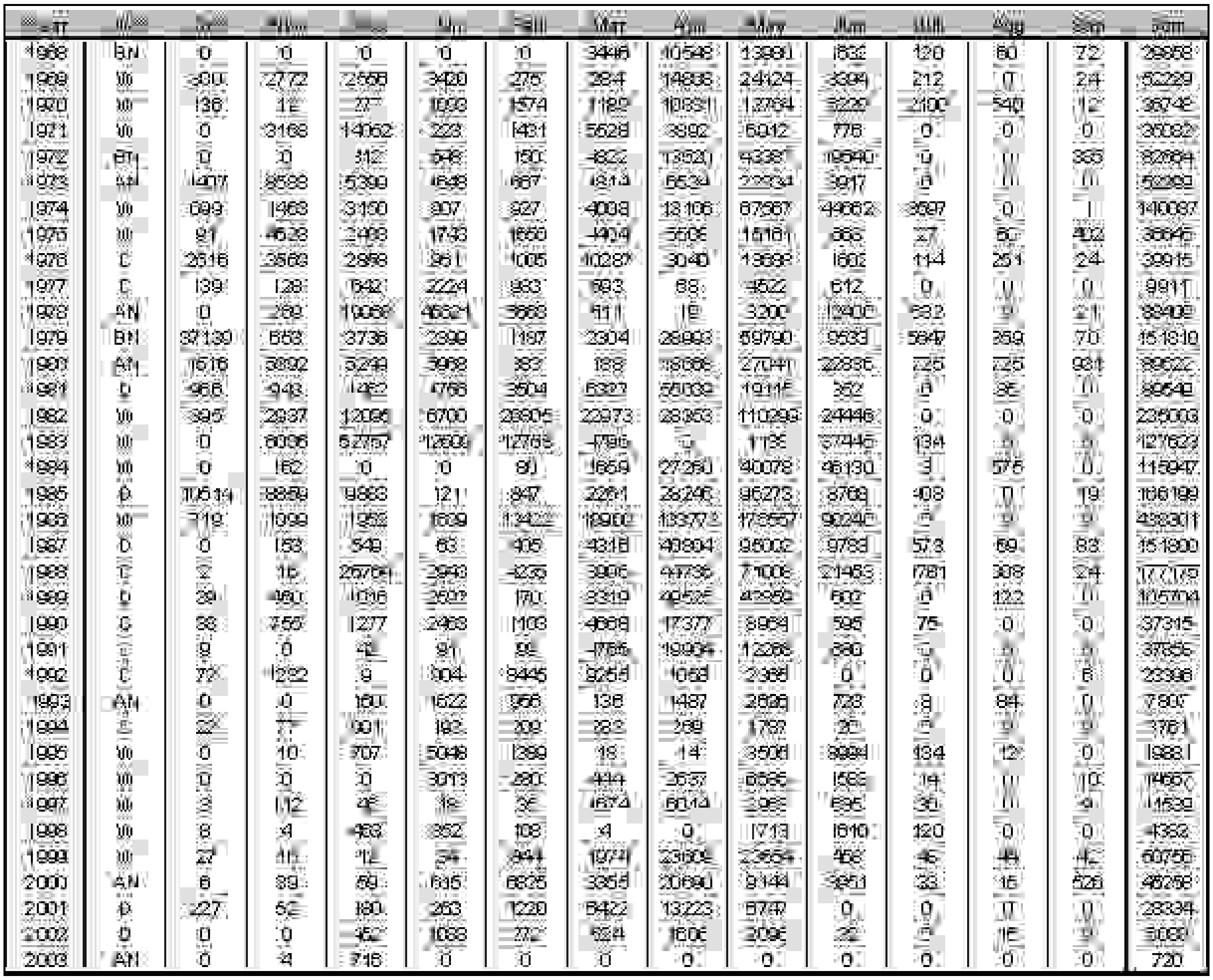
* not officially permitted yet (as of June 2, 2004)

' Used highest number from FWS take estimates

" Reported take is often lower than estimated take

Table A3:
Historical Chinook salmon salvage numbers from the SWP and CVP export facilities.

SWP Export Facilities



Year	WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1968	BN	0	0	0	0	0	3446	10548	13981	1632	120	80	72	29858
1969	W	330	2772	2558	3420	275	284	14836	24124	3394	212	0	24	52229
1970	W	136	12	277	1099	1574	1182	10831	12764	3229	2100	540	12	36748
1971	W	0	3168	14062	223	1431	5628	3892	5012	778	0	0	0	35082
1972	BN	0	0	312	548	150	4822	13520	4338	19540	0	0	335	82684
1973	AN	1407	8598	5399	1648	667	1814	6534	22334	3917	0	0	0	52299
1974	W	699	1463	3150	907	927	4008	13106	67567	44662	3597	0	1	140087
1975	W	91	4628	2498	1743	1650	4404	5506	16161	866	27	60	402	38045
1976	C	2516	3569	2898	961	1005	10287	3040	13698	1602	114	251	24	39915
1977	C	139	128	642	2224	983	693	88	4522	612	0	0	0	9911
1978	AN	0	269	19068	46621	3568	111	19	3200	12400	532	9	21	85409
1979	BN	37130	553	3736	2399	1197	2304	28993	59790	9533	5647	359	70	151810
1980	AN	1516	3892	5249	3968	383	188	18086	27041	22836	725	225	931	89622
1981	D	958	943	1482	4766	3504	6327	55039	19115	352	0	35	0	92549
1982	W	395	2937	12096	6700	29905	22973	28353	110299	24446	0	0	0	238003
1983	W	0	8096	52757	12699	12788	4795	0	1135	37445	134	0	0	127623
1984	W	0	162	0	0	80	1659	27290	40078	46130	3	575	0	115947
1985	D	10514	8859	9883	121	847	2261	28246	96273	8768	408	0	19	166199
1986	W	719	1099	1252	1609	13422	18900	133773	173557	90240	5	9	9	433011
1987	D	0	153	549	63	405	4318	40904	96002	9783	573	69	83	151800
1988	C	2	16	25709	3940	4235	3906	44736	71006	21463	1781	308	24	177179
1989	D	39	460	1016	2502	170	3319	49525	42959	602	0	122	0	105704
1990	C	88	755	1277	2468	1103	4668	17377	8964	595	75	0	0	37315
1991	C	9	0	42	91	99	4755	19904	12265	880	0	0	0	37855
1992	C	72	1222	9	904	8445	9255	4058	2368	0	0	0	6	26339
1993	AN	0	0	160	1622	956	136	1487	2898	723	8	84	0	7809
1994	C	22	77	901	192	209	232	289	1797	30	0	9	9	3761
1995	W	0	10	707	5048	1399	18	14	3508	8994	134	12	0	19881
1996	W	0	0	0	3013	280	444	2557	6595	1569	14	0	10	14657
1997	W	3	112	45	18	35	1674	6014	2969	695	30	0	9	11539
1998	W	8	4	483	352	108	4	0	1713	1610	120	0	0	4392
1999	W	27	11	12	34	944	1974	23909	23654	458	46	49	42	50756
2000	AN	6	89	59	635	6825	3355	20690	9144	3951	33	16	526	45258
2001	D	227	52	180	263	1220	6422	13223	5747	0	0	0	0	28334
2002	D	0	0	452	1088	272	524	1606	2096	22	0	15	9	6088
2003	AN	0	4	716	0	0	0	0	0	0	0	0	0	720

Table A3: continued
Historical Chinook salmon salvage numbers from the SWP and CVP export facilities.

CVP Export Facilities

Year	WYT	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Sum
1957	AN	0	0	0	0	0	3288	118684	86407	11600	612	312	192	217995
1958	W	0	0	0	0	0	0	0	0	0	528	48	0	576
1959	BN	0	0	0	0	0	29098	45475	19812	7149	276	84	48	100922
1960	D	0	0	0	0	0	8868	26340	25140	105584	432	48	0	166412
1961	D	0	0	0	0	0	4512	21444	25380	18792	408	72	0	70608
1962	BN	0	0	0	0	0	0	20424	58032	13944	312	48	0	92760
1963	W	0	0	0	0	0	0	0	14040	8196	336	48	60	22680
1964	D	0	0	0	0	372	1776	30144	67926	29864	888	0	198	131088
1965	W	0	0	0	0	0	2062	6864	226816	87072	3264	84	192	332144
1966	BN	12	0	0	0	0	11028	68556	23844	14668	288	84	72	118462
1967	W	96	0	0	0	0	4475	1140	29340	15900	2400	850	24	57744
1968	BN	72	0	0	1236	48552	35768	54312	47256	8584	0	48	1020	197953
1969	W	4008	6228	744	6328	1152	660	12826	36566	7032	504	0	132	76182
1970	W	744	0	0	0	25624	57100	135348	26032	17060	180	0	324	262389
1971	W	276	60	0	0	1200	21504	92700	193116	119196	3456	24	0	431492
1972	BN	144	3300	7464	0	3194	22680	59664	148352	68140	60	12	288	309952
1973	AN	684	0	0	0	1868	4242	79480	79818	12096	144	0	0	176330
1974	W	34808	11856	1932	0	980	25444	43476	166916	31068	2328	24	36	318968
1975	W	1158	0	0	672	2124	9736	36760	51758	19404	432	122	60	114294
1976	C	252	121	28	0	976	13482	32616	51216	15900	0	216	24	115646
1977	C	216	240	312	2232	1044	204	1920	5418	1800	0	0	0	13416
1978	AN	0	0	108	0	0	360	384	4332	4260	192	0	0	10236
1979	BN	26592	2448	3480	2784	169	1068	62304	40100	5468	0	0	194	144576
1980	AN	0	746	0	0	125	399	93925	50065	7320	1182	0	0	153564
1981	D	316	1328	308	96	0	4709	23907	23975	5458	0	0	0	67096
1982	W	2300	488	5872	2911	5419	13170	6535	95864	68290	295	233	0	202432
1983	W	0	14635	12214	3962	4110	3149	4766	112807	21835	929	0	0	235947
1984	W	2302	459	66	162	0	8461	86803	81617	1904	990	0	0	182764
1985	D	10714	8671	3089	0	7319	4840	45780	59700	1663	108	0	0	142469
1986	W	8063	3898	5060	4810	401293	34136	87644	189079	46168	10257	0	0	767367
1987	D	642	75	966	306	504	718	47962	38077	0	0	0	0	90250
1988	C	0	0	2396	3726	2196	1464	24195	22219	205	67	0	0	56478
1989	D	0	0	302	73	0	6151	13539	20685	2489	0	0	0	43239
1990	C	0	0	0	92	108	71	2085	2940	916	0	0	0	6107
1991	C	0	0	0	0	192	2527	18980	7006	292	0	0	0	28382
1992	C	0	2705	138	510	3907	18002	17349	1892	0	0	0	0	44604
1993	AN	0	0	24	36	360	360	3364	11724	1020	0	0	0	16888
1994	C	12	492	1134	258	3798	4566	4293	393	36	0	0	0	14575
1995	W	12	0	2262	3862	816	684	9390	24516	23820	1044	0	0	66396
1996	W	144	0	182	864	1044	96	19086	15486	3077	0	0	0	39906
1997	W	24	192	72	192	12	16296	19728	13260	3860	12	12	24	53684
1998	W	48	48	341	49512	37762	11002	12552	43872	12216	180	0	0	168123
1999	W	0	84	0	2196	38148	9772	39954	36851	12252	36	36		132730
2000	AN	12	96	132	1242	27472	7298	30024	9846	1872	36	0	204	78202
2001	D	36	48	168	276	1176	2977	21804	2560	616	0	12	0	29563
2002	D	0	0	168	308	204	4839	4274	1786	663	12	12	0	11487
2003	BN	180	155	535	0	0	0	0	0	0	0	0	0	870

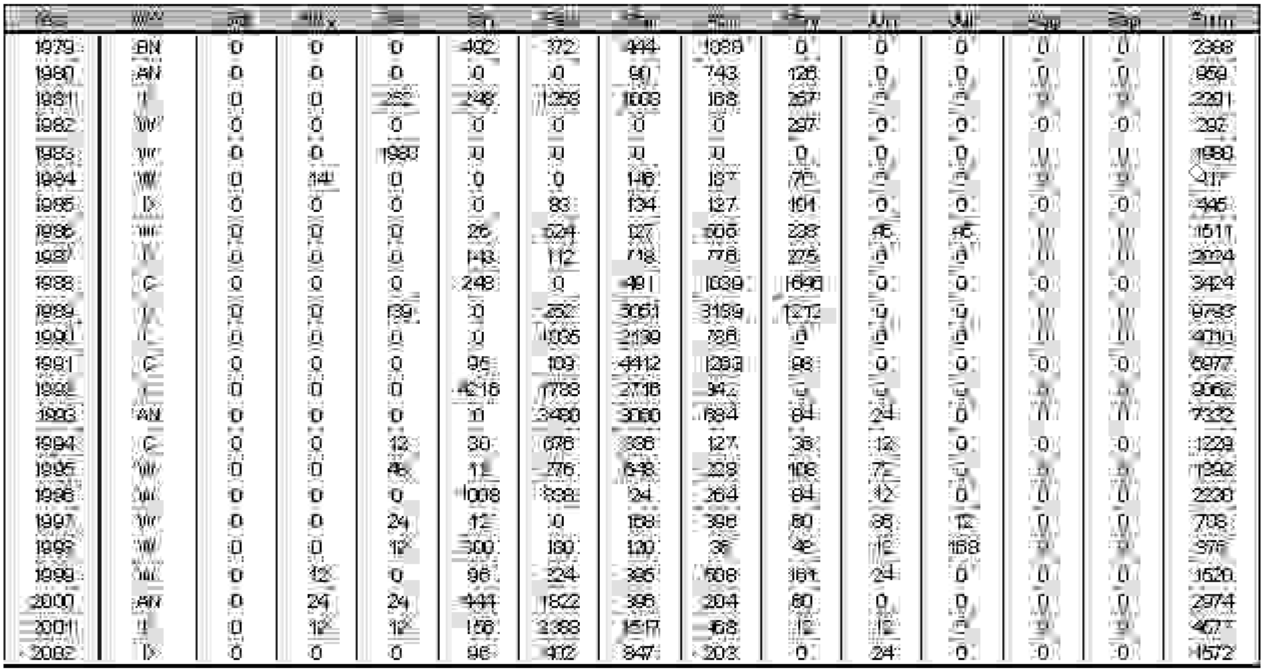
Table A4:
Historical Central Valley steelhead salvage from the SWP and CVP export facilities.

SWP Export Facilities

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Jun	Jul	[illegible]	[illegible]	[illegible]
1968	BN	0	0	0	0	0	758	744	348	84	0	0	12	1954
1969	W	0	12	24	36	13	55	9	20	60	0	0	0	229
1970	W	0	24	120	170	12	25	242	6	6	24	0	0	619
1971	W	0	0	48	36	96	384	348	72	0	0	0	0	984
1972	BN	0	12	0	48	60	1813	710	141	0	0	0	0	2784
1973	AN	0	0	105	41	72	48	76	46	239	0	0	0	632
1974	W	0	0	0	0	59	879	141	11	480	0	0	21	1591
1975	W	1	0	0	0	336	2494	1116	229	48	0	0	12	4236
1976	C	8	120	0	62	384	1596	341	96	0	0	0	8	2615
1977	C	8	7	2	6	169	428	123	222	2	1230	0	0	2197
1978	AN	0	5	2268	390	6117	264	85	66	436	0	0	0	9631
1979	BN	0	0	0	16	25	454	1011	968	0	0	0	0	2474
1980	AN	0	20	23	381	835	74	118	210	80	0	0	0	1741
1981	D	33	0	25	119	1509	3088	4902	0	0	0	0	0	9676
1982	W	0	0	309	792	1432	1110	10965	2441	179	0	0	0	17228
1983	W	17	0	0	280	89	0	0	256	0	0	0	0	642
1984	W	0	0	0	0	0	21	357	38	0	0	0	0	416
1985	D	0	0	22	0	325	1221	1165	647	0	0	0	0	3380
1986	W	0	0	0	0	139	54	1328	446	0	0	0	0	1967
1987	D	0	0	1253	0	82	3337	478	448	0	0	0	0	8148
1988	C	0	0	172	88	2403	823	2116	426	25	0	0	0	6053
1989	D	0	0	0	46	499	4707	2165	404	0	0	0	0	7821
1990	C	0	0	0	0	1317	2195	1039	119	0	0	0	0	4670
1991	C	0	0	0	22	23	5799	91	0	0	0	0	0	5935
1992	C	92	189	0	148	5418	3983	201	38	0	0	0	0	10049
1993	AN	0	0	16	1330	8561	792	353	200	0	0	0	0	11252
1994	C	0	0	0	21	107	154	22	61	9	16	0	0	390
1995	W	2	0	4	360	362	79	8	86	117	30	0	0	1048
1996	W	4	0	0	2009	597	190	192	151	7	0	0	0	3150
1997	W	0	17	17	0	9	88	101	23	0	0	0	0	255
1998	W	28	0	30	52	16	0	0	0	6	0	0	0	132
1999	W	39	0	0	13	7	177	587	195	42	6	4	0	1070
2000	AN	6	36	4	721	4405	791	231	27	56	5	0	0	6282
2001	D	3	54	173	387	2932	4468	258	57	0	0	0	0	8332
2002	D	0	0	2	612	537	656	159	22	18	12	0	0	2018

Table A4: continued
Historical Central Valley steelhead salvage from the SWP and CVP export facilities.

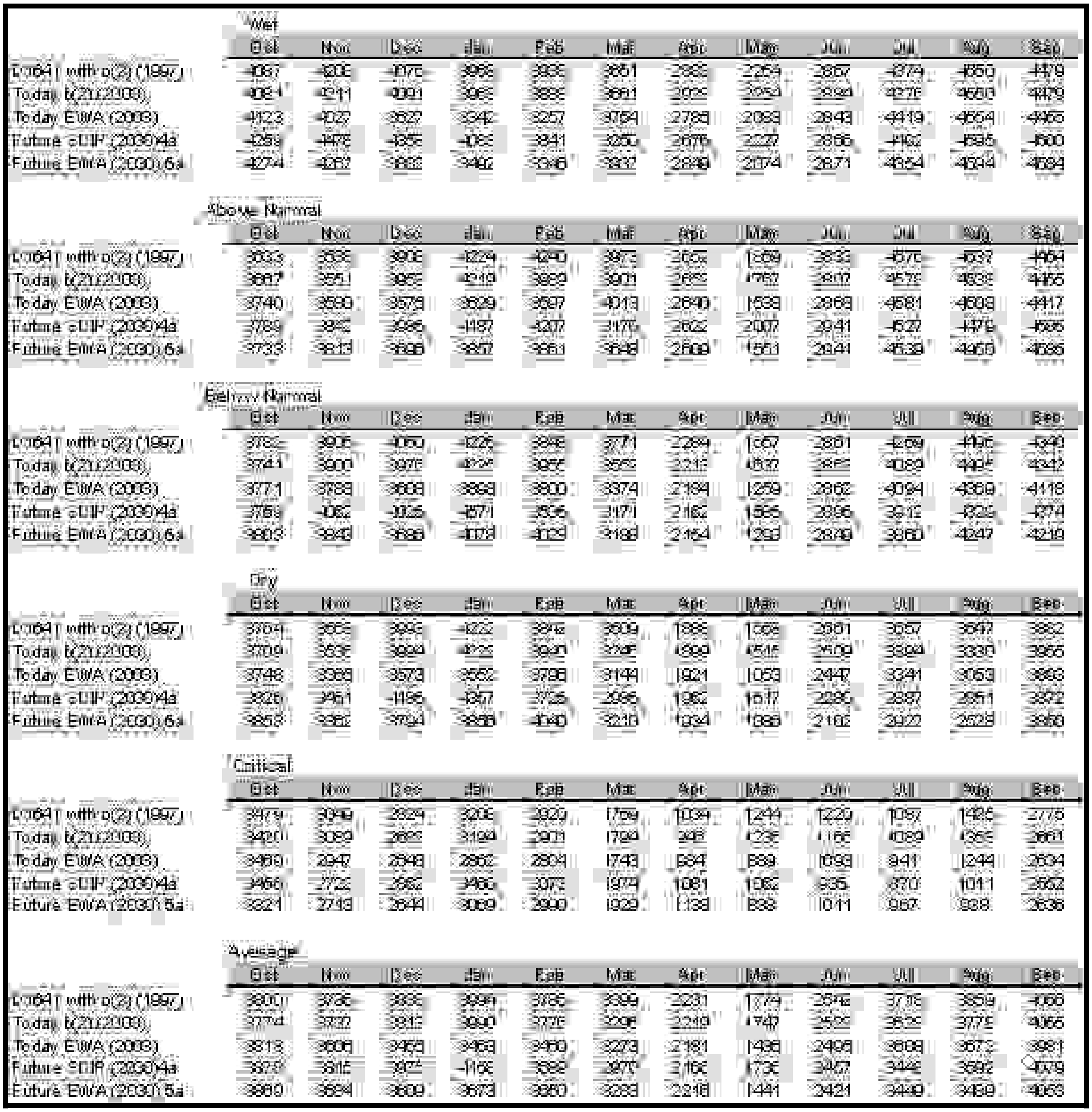
CVP Export Facilities



Year	WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	BN	0	0	0	402	372	444	1088	0	0	0	0	0	2338
1980	AN	0	0	0	0	0	90	743	126	0	0	0	0	959
1981	[illegible]	0	0	252	248	358	1008	168	257	0	0	0	0	2291
1982	W	0	0	0	0	0	0	0	297	0	0	0	0	297
1983	W	0	0	1980	0	0	0	0	0	0	0	0	0	1980
1984	W	0	14	0	0	0	146	187	70	0	0	0	0	417
1985	D	0	0	0	0	83	134	127	101	0	0	0	0	445
1986	W	0	0	0	26	524	127	606	238	45	45	0	0	1611
1987	[illegible]	0	0	0	143	112	718	776	275	0	0	0	0	2024
1988	C	0	0	0	248	0	491	1039	1646	0	0	0	0	3424
1989	[illegible]	0	0	139	0	252	3051	3169	1272	0	0	0	0	7883
1990	[illegible]	0	0	0	0	1035	2189	786	0	0	0	0	0	4010
1991	C	0	0	0	95	109	4412	1263	98	0	0	0	0	5977
1992	[illegible]	0	0	0	4216	1788	2716	942	0	0	0	0	0	9662
1993	AN	0	0	0	0	3480	3060	684	84	24	0	0	0	7332
1994	C	0	0	12	30	676	336	127	36	12	0	0	0	1229
1995	W	0	0	48	12	276	648	228	108	72	0	0	0	1392
1996	W	0	0	0	1008	838	24	264	84	12	0	0	0	2230
1997	W	0	0	24	12	0	168	396	60	36	12	0	0	708
1998	W	0	0	12	300	180	120	36	48	12	168	0	0	876
1999	W	0	12	0	96	224	396	608	160	24	0	0	0	1520
2000	AN	0	24	24	444	1822	396	204	60	0	0	0	0	2974
2001	[illegible]	0	12	12	156	2388	1517	468	12	12	0	0	0	4577
2002	D	0	0	0	96	402	847	203	0	24	0	0	0	1572

Note:
CVP historical Central Valley steelhead salvage numbers from 1979 to 2003. Verifiable steelhead identification did not start at until 1979 at the CVP.

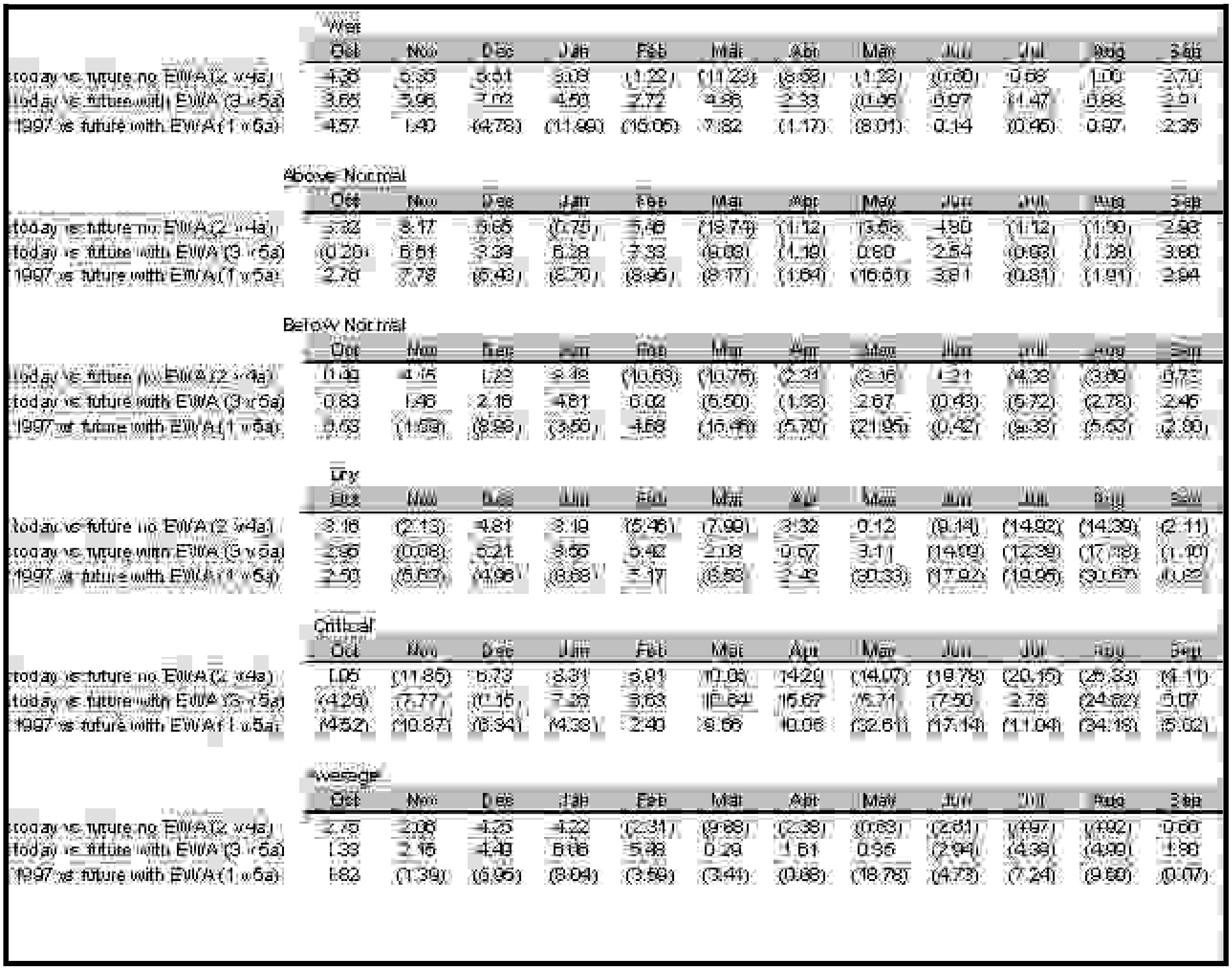
Table A5:
CALSIM II modeling values at the CVP Export Facilities (in cfs).



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
D1641 with b(2) (1997)	4067	4208	4076	3968	3935	3851	2888	2264	2867	4379	4650	4479
Today b(2) (2003)	4081	4211	4091	3963	3885	3861	2922	2254	2894	4276	4650	4479
Today EWA (2003)	4123	4027	3627	3342	3257	3764	2785	2083	2843	4419	4654	4465
Future SDIP (2030) 4a	4259	4475	4355	4083	3841	3250	2675	2227	2866	4162	4595	4600
Future EWA (2030) 5a	4274	4262	3833	3462	3346	3337	2849	2074	2871	4354	4594	4584
Above Normal												
D1641 with b(2) (1997)	3633	3535	3906	4224	4240	3973	2652	1859	2833	4575	4537	4464
Today b(2) (2003)	3667	3551	3952	4219	3989	3901	2652	1767	2807	4579	4533	4455
Today EWA (2003)	3740	3590	3575	3529	3597	4013	2640	1538	2869	4581	4608	4417
Future SDIP (2030) 4a	3789	3842	3986	4157	4207	3176	2622	2007	2941	4527	4479	4595
Future EWA (2030) 5a	3733	3813	3696	3857	3861	3648	2609	1551	2944	4539	4950	4586
Below Normal												
D1641 with b(2) (1997)	3782	3906	4060	4226	3848	3771	2284	1657	2801	4259	4496	4340
Today b(2) (2003)	3741	3900	3976	4225	3955	3552	2213	1537	2855	4089	4495	4342
Today EWA (2003)	3771	3788	3608	3898	3800	3374	2184	1259	2862	4094	4369	4118
Future SDIP (2030) 4a	3789	4062	4025	4571	3536	3171	2162	1565	2896	3912	4326	4374
Future EWA (2030) 5a	3803	3848	3686	4078	4029	3188	2154	1293	2879	3860	4247	4219
Dry												
D1641 with b(2) (1997)	3704	3665	3993	4222	3842	3609	1885	1568	2561	3657	3647	3862
Today b(2) (2003)	3709	3635	3924	4222	3940	3248	1899	1516	2509	3394	3330	3955
Today EWA (2003)	3748	3365	3573	3552	3798	3144	1921	1053	2447	3341	3053	3863
Future SDIP (2030) 4a	3826	3461	4195	4357	3725	2995	1962	1617	2285	2887	2851	3372
Future EWA (2030) 5a	3853	3362	3794	3858	4040	3210	1334	1088	2162	2922	2528	3950
Critical												
D1641 with b(2) (1997)	3479	3049	2824	3206	2929	1759	1034	1244	1229	1057	1425	2775
Today b(2) (2003)	3420	3089	2685	3194	2901	1794	948	1235	1166	1089	1355	2661
Today EWA (2003)	3469	2947	2548	2852	2804	1743	684	889	1093	941	1244	2634
Future SDIP (2030) 4a	3456	2722	2562	3466	3073	1974	1081	1062	935	870	1011	2562
Future EWA (2030) 5a	3221	2713	2644	3069	2990	1929	1138	833	1011	967	938	2636
Average												
D1641 with b(2) (1997)	3800	3736	3835	3994	3785	3399	2231	1774	2542	3716	3859	4060
Today b(2) (2003)	3774	3737	3813	3990	3776	3296	2219	1747	2522	3625	3775	4065
Today EWA (2003)	3818	3606	3455	3453	3460	3273	2181	1436	2495	3608	3672	3981
Future SDIP (2030) 4a	3879	3815	3974	4156	3599	2976	2166	1736	2457	3442	3592	4079
Future EWA (2030) 5a	3869	3684	3609	3673	3860	3283	2218	1441	2421	3449	3489	4063

Note:
CALSIM II modeling values for the studies 1 through 3 and studies 4a and 5a at the CVP export facilities. Values are in cubic feet per second (cfs). The CALSIM II modeling runs used data from 72 years of historical hydrological records. Modeling runs are divided into hydrological year types and are an average of those years falling into a particular water year classification.

Table A5: continued
Percentage changes in pumping rates at the CVP Export Facilities.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
today vs future no EWA (2 v4a)	4.36	5.35	5.01	3.08	(1.22)	(11.23)	(8.58)	(1.28)	(0.60)	0.68	1.00	2.70
today vs future with EWA (3 v5a)	3.65	5.96	7.02	4.50	2.72	4.36	2.33	(1.95)	0.97	(1.47)	0.88	2.91
1997 vs future with EWA (1 v5a)	4.57	1.40	(4.78)	(11.99)	(16.05)	7.82	(1.17)	(8.01)	0.14	(0.45)	0.97	2.35
Above Normal												
today vs future no EWA (2 v4a)	3.32	8.17	6.65	(1.75)	5.46	(18.74)	(1.12)	(3.56)	4.90	(1.12)	(1.30)	2.93
today vs future with EWA (3 v5a)	(0.20)	6.61	3.39	6.28	7.33	(9.08)	(1.19)	0.60	2.54	(0.63)	(1.28)	3.60
1997 vs future with EWA (1 v5a)	2.70	7.78	(5.43)	(8.70)	(8.95)	(8.17)	(1.64)	(16.61)	3.81	(0.81)	(1.91)	2.94
Below Normal												
today vs future no EWA (2 v4a)	(1.49)	4.15	1.22	8.48	(10.63)	(10.76)	(2.31)	(2.16)	4.21	(4.38)	(3.89)	0.73
today vs future with EWA (3 v5a)	0.83	1.46	2.16	4.81	6.02	(5.50)	(1.33)	2.67	(0.43)	(5.72)	(2.78)	2.46
1997 vs future with EWA (1 v5a)	0.63	(1.58)	(8.98)	(3.50)	4.68	(15.45)	(5.70)	(21.95)	(0.42)	(9.38)	(5.63)	(2.80)
Dry												
today vs future no EWA (2 v4a)	3.16	(2.13)	4.81	3.19	(5.46)	(7.99)	3.32	0.12	(9.14)	(14.92)	(14.39)	(2.11)
today vs future with EWA (3 v5a)	2.95	(0.08)	5.21	3.55	5.42	2.18	0.67	3.11	(14.09)	(12.39)	(17.78)	(1.10)
1997 vs future with EWA (1 v5a)	2.50	(5.63)	(4.96)	(8.68)	3.17	(6.58)	2.42	(30.33)	(17.92)	(19.95)	(30.67)	(0.82)
Critical												
today vs future no EWA (2 v4a)	1.05	(11.85)	6.73	8.31	3.81	10.08	14.29	(14.07)	(19.78)	(20.15)	(25.33)	(4.11)
today vs future with EWA (3 v5a)	(4.26)	(7.77)	(1.15)	7.26	3.63	10.64	15.67	(5.71)	(7.50)	2.78	(24.62)	5.07
1997 vs future with EWA (1 v5a)	(4.52)	(10.87)	(6.34)	(4.38)	2.40	8.66	10.06	(32.61)	(17.14)	(11.04)	(34.18)	(5.02)
Average												
today vs future no EWA (2 v4a)	2.75	2.06	4.25	4.22	(2.31)	(9.68)	(2.38)	(0.63)	(2.61)	(4.97)	(4.92)	0.60
today vs future with EWA (3 v5a)	1.33	2.15	4.49	6.06	5.48	0.29	1.61	0.95	(2.94)	(4.39)	(4.99)	1.98
1997 vs future with EWA (1 v5a)	1.62	(1.39)	(6.95)	(8.04)	(3.59)	(3.44)	(0.88)	(18.78)	(4.73)	(7.24)	(9.80)	(0.07)

Note:
Percentage changes in the pumping rates between study 4a and 2, and study 5a and studies 1 and 3 at the CVP export facilities. Numbers in parenthesis indicate that the future condition is less than the current baseline condition.

Table A6: Salvage Projections for Winter-run Chinook Salmon

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Grand Total	WY
1993														
Salvage Number			516	1471	1126	344	33	0	0				3588	AN
today vs future no EWA (2 v 4a)	5	2	(8)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v 5a)	5	2	(1)	1	2	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(8)	(8)	(4)	9	(17)	(39)	(3)	7	16	(2)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			(78)	(39)	48	9	3	0	0				(7)	(0)
today vs future with EWA (3 v 5a)			(8)	11	33	13	1	(0)	0				51	1
1997 vs future with EWA (1 v 5a)			(31)	(124)	(98)	33	(14)	0	0				(186)	(5)
1994														
Salvage Number			238	215	2941	1625	432	6	0				5457	C
today vs future no EWA (2 v 4a)	(1)	(3)	2	2	9	8	7	(7)	(7)	(12)	(8)	(7)		
today vs future with EWA (3 v 5a)	(1)	(7)	(0)	6	1	9	8	(6)	3	3	(18)	(3)		
1997 vs future with EWA (1 v 5a)	3	(8)	(3)	(8)	5	5	1	(35)	8	52	37	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			5	5	322	136	30	(0)	0				391	7
today vs future with EWA (3 v 5a)			(1)	12	24	132	34	(0)	0				200	4
1997 vs future with EWA (1 v 5a)			(7)	(12)	138	89	4	(2)	0				210	4
1995														
Salvage Number			38	4082	268	34	384	16	0				4820	W
today vs future no EWA (2 v 4a)	4	4	8	5	5	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA (3 v 5a)	5	3	7	5	4	6	4	8	3	1	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			2	189	12	3	7	0	0				214	4
today vs future with EWA (3 v 5a)			3	216	11	2	16	1	0				248	5
1997 vs future with EWA (1 v 5a)			(1)	(120)	(10)	7	(46)	(6)	0				(172)	(4)
1996														
Salvage Number			38	3281	386	73	40	12	0				3828	W
today vs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(6)	(0)		
today vs future with EWA (3 v 5a)	5	3	7	5	4	6	4	8	3	1	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			2	152	18	6	1	(0)	0				179	5
today vs future with EWA (3 v 5a)			3	123	18	3	2	1	0				198	5
1997 vs future with EWA (1 v 5a)			(1)	(98)	(14)	16	(5)	(4)	0				(103)	(3)
1997														
Salvage Number			420	11	0	337	23	40	0				831	W
today vs future no EWA (2 v 4a)	4	4	6	7	6	8	2	1	(2)	4	(5)	(0)		
today vs future with EWA (3 v 5a)	5	3	7	5	4	5	4	8	3	1	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			33	0	0	28	0	0	0				62	7
today vs future with EWA (3 v 5a)			37	0	0	15	1	0	0				53	6
1997 vs future with EWA (1 v 5a)			(7)	(0)	0	73	(3)	0	0				63	7

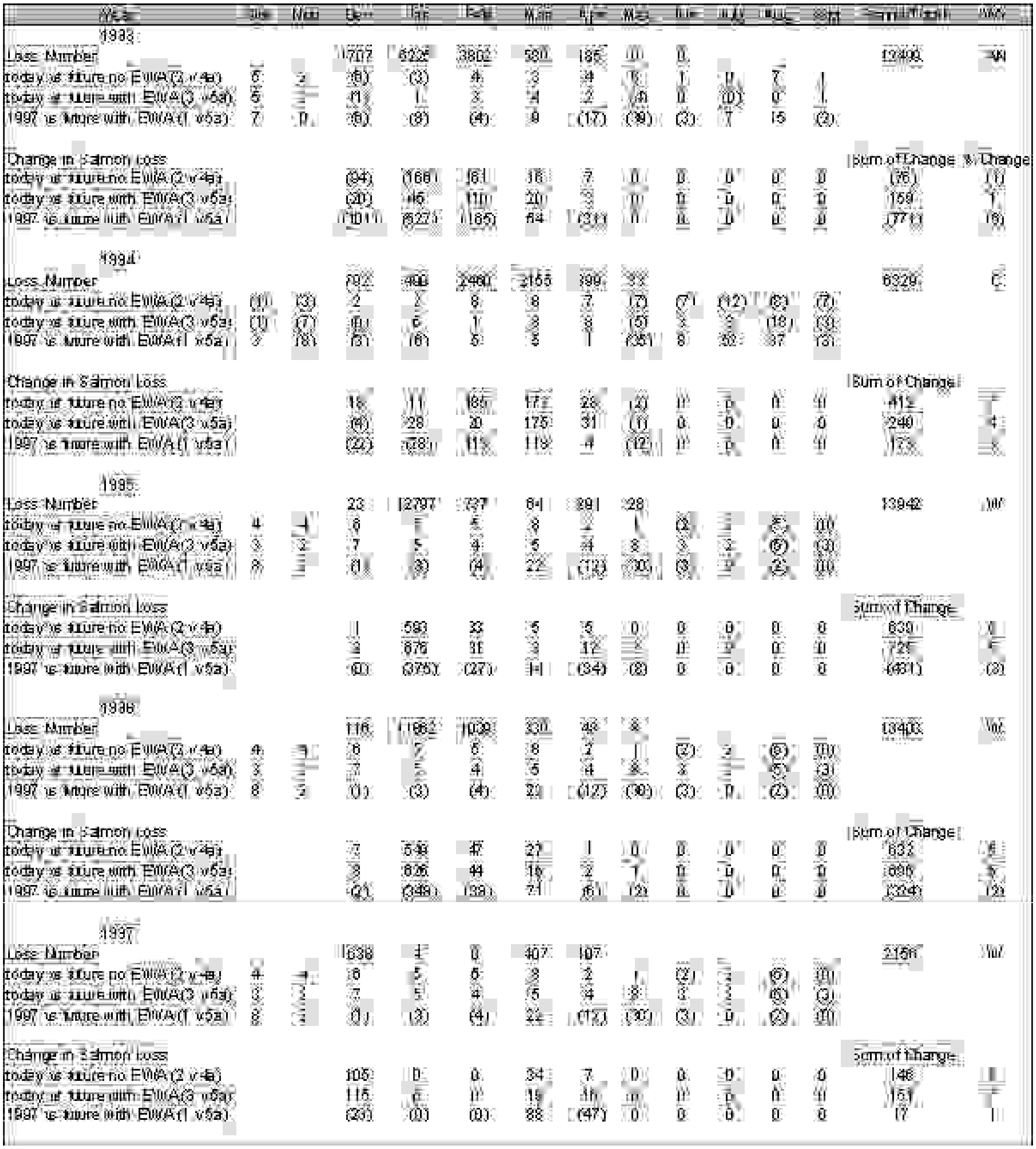
Table A6: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Grand Total	WY
1998														
Salvage Number			4	400	108	198	12	0	0				720	W
today vs future no EWA (2 v4a)	4	4	6	5	4	6	2	1	(2)	1	(6)	(0)		
today vs future with EWA (3 v5a)	3	2	7	5	4	5	4	3	3	2	(5)	(3)		
1997 vs future with EWA (1 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			0	19	5	16	0	0	0				40	6
today vs future with EWA (3 v5a)			0	21	5	9	0	0	0				35	5
1997 vs future with EWA (1 v 5a)			(0)	(12)	(4)	42	(1)	0	0				25	3
1999														
Salvage Number			48	56	85	1108	435	0	0				1732	W
today vs future no EWA (2 v4a)	4	4	6	5	5	8	2	1	(2)	3	(5)	(0)		
today vs future with EWA (3 v5a)	3	2	7	6	4	5	4	3	3	3	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			3	3	4	91	8	0	0				109	6
today vs future with EWA (3 v5a)			3	3	4	51	17	0	0				78	5
1997 vs future with EWA (1 v 5a)			(1)	(2)	(3)	239	(51)	0	0				183	11
2000														
Salvage Number			128	975	1148	590	166	0	0				3002	AN
today vs future no EWA (2 v4a)	5	2	(6)	(3)	4	3	4	0	1	0	7	1		
today vs future with EWA (3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(6)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			(7)	(26)	48	16	7	0	0				38	1
today vs future with EWA (3 v5a)			(1)	7	33	21	2	0	0				62	2
1997 vs future with EWA (1 v 5a)			(8)	(82)	(50)	55	(28)	0	0				(113)	(4)
2001														
Salvage Number			504	509	2261	3861	138	0	0				7273	D
today vs future no EWA (2 v4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(6)	(4)		
today vs future with EWA (3 v5a)	(1)	1	5	6	3	3	1	4	(8)	(4)	(6)	(7)		
1997 vs future with EWA (1 v 5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			15	13	(37)	(56)	5	0	0				(60)	(1)
today vs future with EWA (3 v5a)			26	29	62	98	2	0	0				217	3
1997 vs future with EWA (1 v 5a)			(11)	(35)	56	(86)	(11)	0	0				(87)	(1)
2002														
Salvage Number			850	1623	379	1057	138	0	0				4047	D
today vs future no EWA (2 v4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(6)	(4)		
today vs future with EWA (3 v5a)	(1)	1	5	6	3	3	1	4	(8)	(4)	(6)	(7)		
1997 vs future with EWA (1 v 5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			26	43	(8)	(15)	5	0	0				51	1
today vs future with EWA (3 v5a)			44	92	10	27	2	0	0				175	4
1997 vs future with EWA (1 v 5a)			(18)	(110)	9	(24)	(11)	0	0				(153)	(4)
2003														
Salvage Number			210	6830	1120	1128	64	24	12				9388	AN
today vs future no EWA (2 v4a)	5	2	(6)	(3)	4	3	4	0	1	0	7	1		
today vs future with EWA (3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(6)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			(12)	(182)	48	30	3	1	0				(112)	(1)
today vs future with EWA (3 v5a)			(2)	49	32	40	1	(1)	0				119	1
1997 vs future with EWA (1 v 5a)			(12)	(678)	(48)	105	(11)	(9)	(0)				(653)	(6)

Table A6: Note

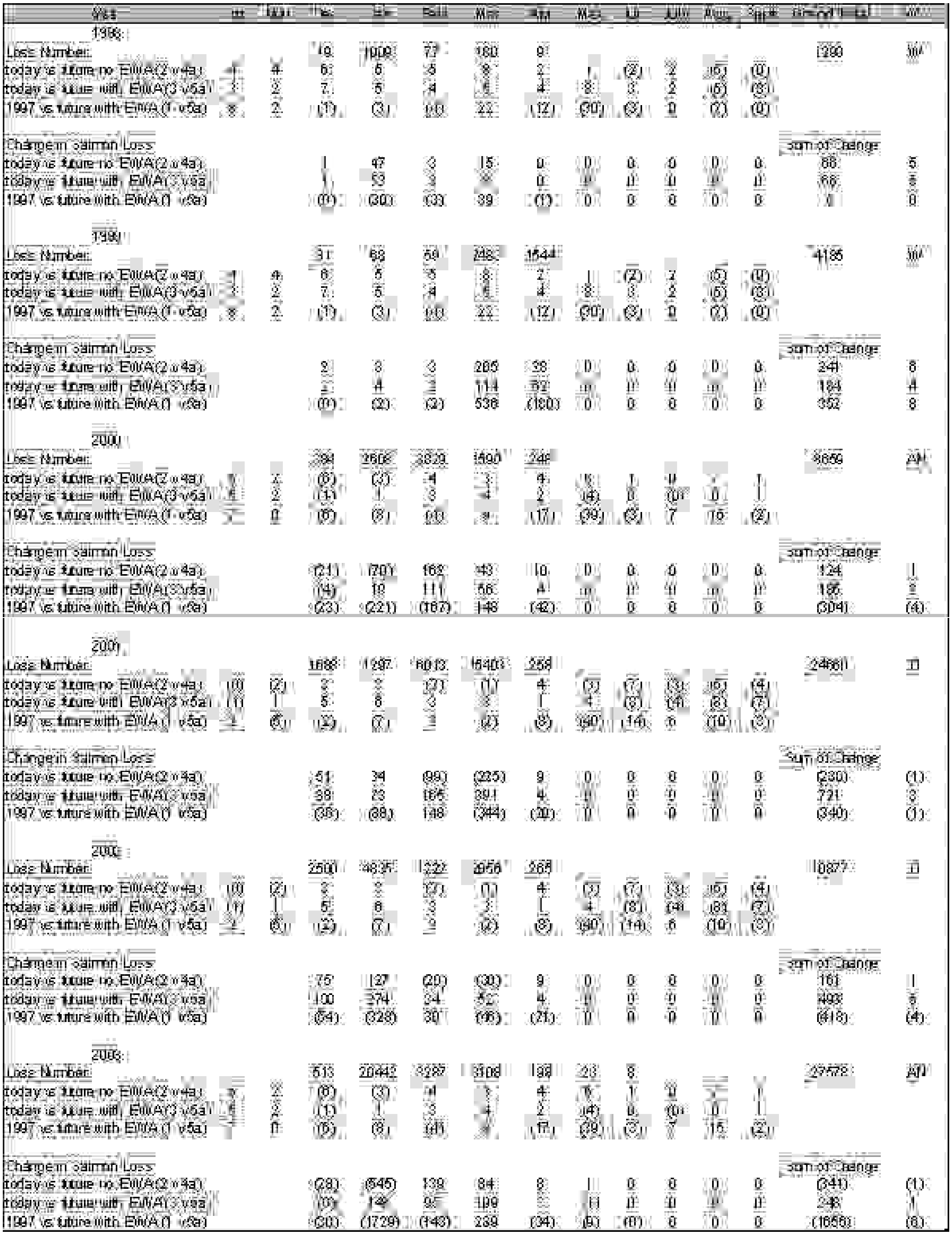
This table presents the combined salvage numbers for winter-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the salvage numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in salvage numbers.

Table A7: Loss Projections for Winter-run Chinook Salmon



Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	[illegible]	WY
1993														
Loss Number			1707	6225	3802	580	185	0	0				12499	AN
today vs future no EWA (2 v 4a)	6	2	(6)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v 5a)	5	3	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(6)	(8)	(4)	9	(17)	(39)	(3)	1	15	(2)		
Change in Salmon Loss													Sum of Change	% Change
today vs future no EWA (2 v 4a)			(94)	(168)	161	16	7	0	0	0	0	0	(76)	(1)
today vs future with EWA (3 v 5a)			(20)	45	110	20	3	0	0	0	0	0	159	1
1997 vs future with EWA (1 v 5a)			(101)	(527)	(165)	54	(31)	0	0	0	0	0	(771)	(6)
1994														
Loss Number			792	470	2480	2155	399	33					6329	C
today vs future no EWA (2 v 4a)	(1)	(3)	2	2	8	8	7	(7)	(7)	(12)	(6)	(7)		
today vs future with EWA (3 v 5a)	(1)	(7)	(1)	6	1	8	8	(5)	3	3	(18)	(3)		
1997 vs future with EWA (1 v 5a)	2	(8)	(3)	(6)	5	5	1	(35)	8	32	37	(3)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			18	11	185	172	28	(2)	0	0	0	0	412	7
today vs future with EWA (3 v 5a)			(8)	28	20	175	31	(1)	0	0	0	0	240	4
1997 vs future with EWA (1 v 5a)			(22)	(28)	113	118	4	(12)	0	0	0	0	173	3
1995														
Loss Number			23	12797	737	64	293	28					13942	W
today vs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	3	(6)	(10)		
today vs future with EWA (3 v 5a)	3	2	7	5	4	5	4	8	3	2	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	3	(1)	(3)	(4)	22	(12)	(30)	(3)	3	(2)	(10)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			1	593	33	5	5	0	0	0	0	0	639	5
today vs future with EWA (3 v 5a)			2	676	31	3	12	2	0	0	0	0	725	5
1997 vs future with EWA (1 v 5a)			(0)	(375)	(27)	14	(34)	(8)	0	0	0	0	(431)	(3)
1996														
Loss Number			116	11862	1039	330	48	8					13403	W
today vs future no EWA (2 v 4a)	4	3	6	5	5	8	2	1	(2)	3	(6)	(10)		
today vs future with EWA (3 v 5a)	3	3	7	5	4	5	4	8	3	3	(5)	(3)		
1997 vs future with EWA (1 v 5a)	8	3	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(10)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			7	549	47	27	1	0	0	0	0	0	632	5
today vs future with EWA (3 v 5a)			8	626	44	16	2	1	0	0	0	0	696	5
1997 vs future with EWA (1 v 5a)			(1)	(349)	(39)	73	(6)	(2)	0	0	0	0	(324)	(2)
1997														
Loss Number			1638	4	0	407	107						2156	W
today vs future no EWA (2 v 4a)	4	4	6	5	6	8	2	1	(2)	3	(6)	(10)		
today vs future with EWA (3 v 5a)	3	3	7	5	4	5	4	8	3	3	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	3	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(10)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			105	0	0	34	7	0	0	0	0	0	146	7
today vs future with EWA (3 v 5a)			115	0	0	19	16	0	0	0	0	0	151	7
1997 vs future with EWA (1 v 5a)			(23)	(0)	(0)	88	(47)	0	0	0	0	0	17	1

Table A7: continued

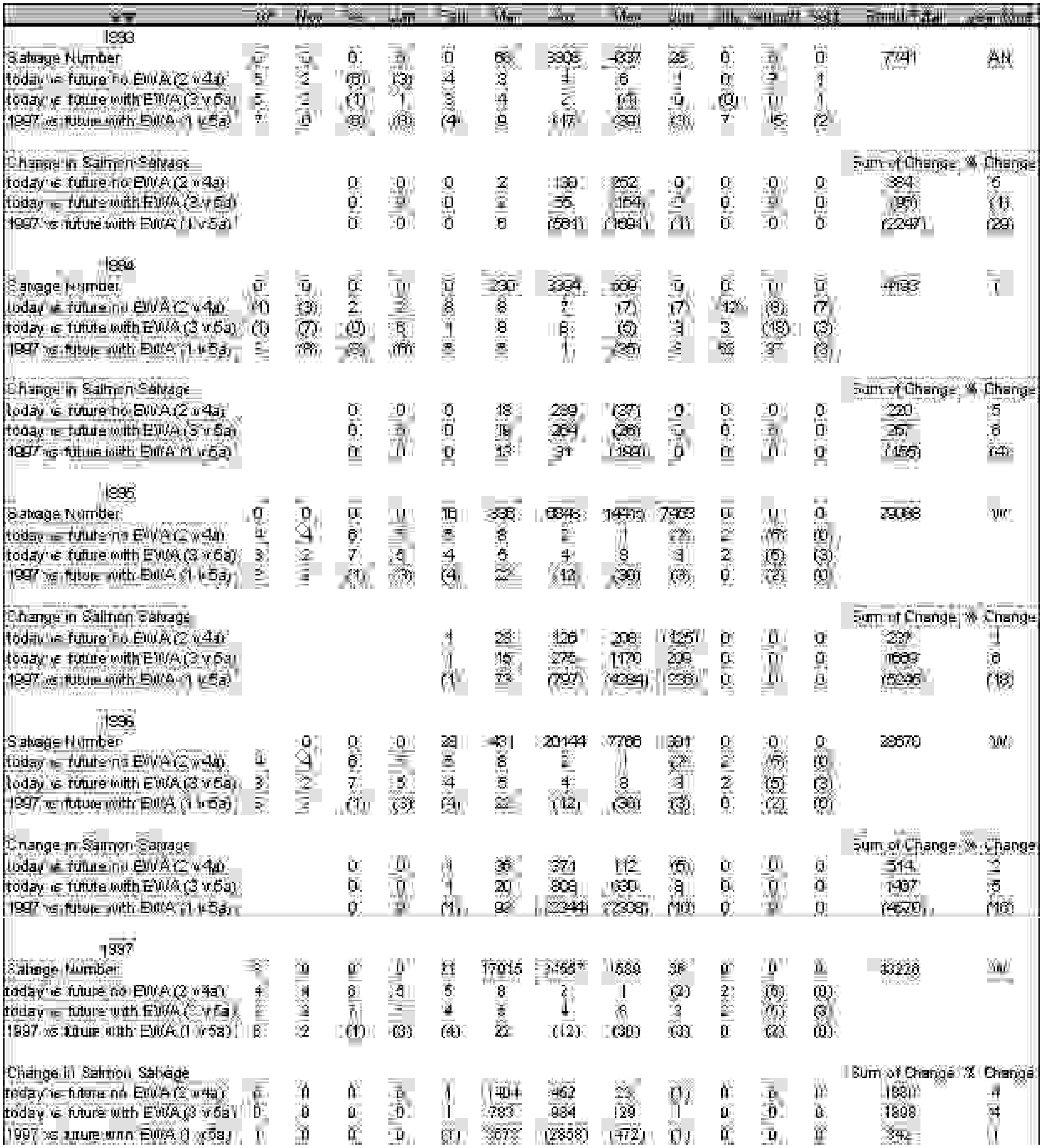


Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Grand Total	WY
1998														
Loss Number:			19	1009	77	180	9						1290	W
today vs future no EWA(2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA(3 v 5a)	3	2	7	5	4	6	4	8	3	2	(6)	(3)		
1997 vs future with EWA(1 v 5a)	8	2	(1)	(3)	(0)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)			1	47	3	15	0	0	0	0	0	0	66	5
today vs future with EWA(3 v 5a)			1	53	3	9	0	0	0	0	0	0	66	5
1997 vs future with EWA(1 v 5a)			(0)	(30)	(3)	39	(1)	0	0	0	0	0	4	0
1999														
Loss Number:			31	68	59	2483	1544						4185	W
today vs future no EWA(2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA(3 v 5a)	3	2	7	5	4	6	4	8	3	2	(6)	(3)		
1997 vs future with EWA(1 v 5a)	8	2	(1)	(3)	(0)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)			2	3	3	205	38	0	0	0	0	0	241	8
today vs future with EWA(3 v 5a)			2	4	3	114	62	0	0	0	0	0	184	4
1997 vs future with EWA(1 v 5a)			(0)	(2)	(2)	538	(180)	0	0	0	0	0	352	8
2000														
Loss Number:			384	2606	3829	1590	249						8659	AN
today vs future no EWA(2 v 4a)	5	2	(6)	(3)	4	3	4	6	1	0	3	1		
today vs future with EWA(3 v 5a)	6	2	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA(1 v 5a)	2	0	(6)	(8)	(0)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)			(21)	(70)	162	43	10	0	0	0	0	0	124	1
today vs future with EWA(3 v 5a)			(4)	19	111	56	4	0	0	0	0	0	186	2
1997 vs future with EWA(1 v 5a)			(23)	(221)	(167)	148	(42)	0	0	0	0	0	(304)	(4)
2001														
Loss Number:			1688	1297	6013	15403	259						24660	D
today vs future no EWA(2 v 4a)	(0)	(2)	2	2	(7)	(1)	4	(3)	(7)	(3)	(6)	(4)		
today vs future with EWA(3 v 5a)	(1)	1	5	8	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA(1 v 5a)	2	(6)	(2)	(7)	3	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)			51	34	(99)	(225)	9	0	0	0	0	0	(230)	(1)
today vs future with EWA(3 v 5a)			38	23	165	391	4	0	0	0	0	0	721	3
1997 vs future with EWA(1 v 5a)			(36)	(38)	148	(344)	(30)	0	0	0	0	0	(340)	(1)
2002														
Loss Number:			2500	4835	1222	2056	265						10877	D
today vs future no EWA(2 v 4a)	(0)	(2)	2	2	(7)	(1)	4	(3)	(7)	(3)	(6)	(4)		
today vs future with EWA(3 v 5a)	(1)	1	5	8	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA(1 v 5a)	2	(6)	(2)	(7)	3	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)			75	127	(20)	(30)	9	0	0	0	0	0	161	1
today vs future with EWA(3 v 5a)			100	374	24	52	4	0	0	0	0	0	493	5
1997 vs future with EWA(1 v 5a)			(64)	(328)	30	(96)	(21)	0	0	0	0	0	(418)	(4)
2003														
Loss Number:			513	20442	3287	3106	198	23	8				27578	AN
today vs future no EWA(2 v 4a)	5	2	(6)	(3)	4	3	4	6	1	0	3	1		
today vs future with EWA(3 v 5a)	6	2	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA(1 v 5a)	2	0	(6)	(8)	(0)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)			(28)	(645)	139	84	8	1	0	0	0	0	(341)	(1)
today vs future with EWA(3 v 5a)			(0)	149	95	199	5	1	0	0	0	0	248	1
1997 vs future with EWA(1 v 5a)			(20)	(1729)	(143)	239	(34)	(9)	(0)	0	0	0	(1656)	(6)

Table A7: Note

This table presents the combined loss numbers for winter-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the salvage numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in salvage numbers.

Table A8: Salvage Projections for Spring-run Chinook Salmon



Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Annual Total	Year Type
1993														
Salvage Number	0	0	0	0	0	66	3306	4337	25	0	0	0	7741	AN
today vs future no EWA (2 v 4a)	5	2	(6)	(3)	4	3	4	6	1	0	2	1		
today vs future with EWA (3 v 5a)	5	2	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(6)	(8)	(4)	9	(17)	(39)	(3)	7	(5)	(2)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			0	0	0	2	130	252	0	0	0	0	384	5
today vs future with EWA (3 v 5a)			0	0	0	4	55	(154)	0	0	0	0	(95)	(1)
1997 vs future with EWA (1 v 5a)			0	0	0	6	(581)	(1694)	(1)	0	0	0	(2247)	(29)
1994														
Salvage Number	0	0	0	0	0	230	3394	569	0	0	0	0	4193	[illegible]
today vs future no EWA (2 v 4a)	(1)	(3)	2	2	8	8	7	(7)	(7)	12	(8)	(7)		
today vs future with EWA (3 v 5a)	(1)	(7)	(0)	5	1	8	8	(5)	3	3	(18)	(3)		
1997 vs future with EWA (1 v 5a)	5	(8)	(3)	(6)	8	8	1	(35)	3	52	37	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			0	0	0	18	239	(37)	0	0	0	0	220	5
today vs future with EWA (3 v 5a)			0	0	0	19	264	(26)	0	0	0	0	257	6
1997 vs future with EWA (1 v 5a)			0	0	0	13	31	(199)	0	0	0	0	(155)	(4)
1995														
Salvage Number	0	0	0	0	16	336	6846	14495	7963	0	0	0	29656	W
today vs future no EWA (2 v 4a)	4	4	6	3	8	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA (3 v 5a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v 5a)	5	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)					4	28	126	208	(125)	0	0	0	237	1
today vs future with EWA (3 v 5a)					1	15	275	1170	209	0	0	0	1669	6
1997 vs future with EWA (1 v 5a)					(1)	73	(797)	(4284)	(236)	0	0	0	(5245)	(18)
1996														
Salvage Number		0	0	0	28	431	20144	7766	301	0	0	0	28670	W
today vs future no EWA (2 v 4a)	4	4	6	3	8	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA (3 v 5a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v 5a)	5	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			0	0	1	35	371	112	(5)	0	0	0	514	2
today vs future with EWA (3 v 5a)			0	0	1	20	808	630	8	0	0	0	1467	5
1997 vs future with EWA (1 v 5a)			0	0	(1)	92	(2244)	(2308)	(10)	0	0	0	(4471)	(16)
1997														
Salvage Number	3	0	0	0	11	17015	24567	1589	36	0	0	0	43228	W
today vs future no EWA (2 v 4a)	4	4	6	4	5	8	2	1	(2)	2	(6)	(0)		
today vs future with EWA (3 v 5a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	1	1404	462	23	(1)	0	0	0	1889	4
today vs future with EWA (3 v 5a)	0	0	0	0	1	783	984	129	1	0	0	0	1898	4
1997 vs future with EWA (1 v 5a)	1	0	0	0	(1)	3673	(2858)	(472)	(1)	0	0	0	342	1

Table A8: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	August	Sept	Annual Total	Year Type
1998														
Salvage Number	0	0	0	0	12	7288	10508	16707	564	0	0	0	35079	W
today vs future no EWA (2 v 4a)	4	3	6	5	7	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA (3 v 5a)	3	3	7	5	4	5	4	8	3	2	(6)	(3)		
1997 vs future with EWA (1 v 5a)	8	5	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	1	603	201	234	(9)	0	0	0	1030	3
today vs future with EWA (3 v 5a)	0	0	0	0	1	335	421	1315	16	0	0	0	2088	6
1997 vs future with EWA (1 v 5a)	0	0	0	0	(0)	1573	(1223)	(4816)	(18)	0	0	0	(4484)	(13)
1999														
Salvage Number	0	0	0	0	74	3177	40469	12087	24	0	0	0	55831	W
today vs future no EWA (2 v 4a)	4	3	6	5	5	8	2	1	(2)	2	(6)	(0)		
today vs future with EWA (3 v 5a)	3	3	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v 5a)	8	5	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	3	262	744	176	(1)	0	0	0	1184	2
today vs future with EWA (3 v 5a)	0	0	0	0	3	146	1622	981	1	0	0	0	2753	5
1997 vs future with EWA (1 v 5a)	0	0	0	0	(3)	688	(4710)	(3592)	(1)	0	0	0	(7619)	(14)
2000														
Salvage Number	0	0	0	0	136	3082	39347	2158	16	0	0	6	44745	AN
today vs future no EWA (2 v 4a)	6	3	(6)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v 5a)	5	3	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(6)	(9)	(4)	9	(17)	(39)	(3)	7	16	(2)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	6	93	1550	126	0	0	0	0	1775	4
today vs future with EWA (3 v 5a)	0	0	0	0	4	108	659	(76)	0	0	0	0	695	2
1997 vs future with EWA (1 v 5a)	0	0	0	0	(6)	287	(6679)	(840)	(1)	0	0	(0)	(7239)	(16)
2001														
Salvage Number	0	0	0	0	0	2698	14128	1380	0	0	0	0	18206	D
today vs future no EWA (2 v 4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(2)	(6)	(4)		
today vs future with EWA (3 v 5a)	(1)	1	5	6	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA (1 v 5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	0	(38)	501	(35)	0	0	0	0	428	2
today vs future with EWA (3 v 5a)	0	0	0	0	0	68	195	56	0	0	0	0	319	2
1997 vs future with EWA (1 v 5a)	0	0	0	0	0	(60)	(1112)	(545)	0	0	0	0	(1717)	(9)
2002														
Salvage Number				36	12	1121	9043	695	24	0	0		10931	D
today vs future no EWA (2 v 4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(5)	(4)		
today vs future with EWA (3 v 5a)	(1)	1	5	6	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA (1 v 5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	1	(0)	(16)	320	(18)	(2)	0	0	0	286	3
today vs future with EWA (3 v 5a)	0	0	0	2	0	28	125	28	(2)	0	0	0	182	2
1997 vs future with EWA (1 v 5a)	0	0	0	(2)	0	(25)	(712)	(275)	(3)	0	0	0	(1017)	(9)
2003														
Salvage Number	0	0	0	46	24	5208	10382	914	0	0	0	0	16574	AN
today vs future no EWA (2 v 4a)	6	3	(6)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v 5a)	5	3	(1)	1	3	4	2	(4)	0	(0)	0	1		
1997 vs future with EWA (1 v 5a)	7	0	(6)	(9)	(4)	9	(17)	(39)	(3)	7	16	(2)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	(1)	1	141	405	55	0	0	0	0	603	4
today vs future with EWA (3 v 5a)	0	0	0	0	1	182	174	(32)	0	0	0	0	325	2
1997 vs future with EWA (1 v 5a)	0	0	0	(4)	(1)	485	(1762)	(356)	0	0	0	0	(1638)	(10)

Table A8: Note

This table presents the combined salvage numbers for spring-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the salvage numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in salvage numbers.

Table A9: Loss Projections for Spring-run Chinook Salmon

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	WY
1993	0	0	0			103	5618	7538	40				13299	AN
Loss Number	5	2	(8)	(3)	4	3	4	5	1	0	7	1		
today vs future no EWA (2 v 4a)	5	2	(1)	1	2	4	2	(4)	0	(0)	0	1		
today vs future with EWA (3 v 5a)	3	0	(5)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
1997 vs future with EWA (1 v 5a)														
													Sum of Change	% Change
Change in Salmon Loss			0	0	0	3	221	438	0	0	0	0	662	5
today vs future no EWA (2 v 4a)			0	0	0	4	94	(257)	0	0	0	[illegible]	(159)	(1)
today vs future with EWA (3 v 5a)			0	0	(1)	(10)	(954)	(2930)	(1)	0	0	0	(3884)	(29)
1997 vs future with EWA (1 v 5a)														
1994	0	0				204	3407	1140					4748	C
Loss Number	(1)	(3)	2	2	5	8	[illegible]	(7)	(7)	(12)	(8)	(7)		
today vs future no EWA (2 v 4a)	(1)	(7)	(0)	6	1	8	8	(5)	3	3	(18)	(3)		
today vs future with EWA (3 v 5a)	3	(8)	(3)	(6)	6	5	1	(35)	8	52	37	(3)		
1997 vs future with EWA (1 v 5a)														
													Sum of Change	
Change in Salmon Loss			0	0	0	16	240	(75)	0	0	0	0	181	4
today vs future no EWA (2 v 4a)			0	0	0	16	255	(52)	0	0	0	[illegible]	230	5
today vs future with EWA (3 v 5a)			0	0	(1)	11	31	(308)	0	0	0	0	(356)	(7)
1997 vs future with EWA (1 v 5a)														
1995	0				24	237	4900	18590	15092				38862	W
Loss Number	4	4	6	5	5	8	2	1	(2)	2	(6)	(0)		
today vs future no EWA (2 v 4a)	2	1	7	5	4	5	4	2	3	2	(5)	(3)		
today vs future with EWA (3 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
1997 vs future with EWA (1 v 5a)														
													Sum of Change	
Change in Salmon Loss			0	0	1	20	90	259	(254)	0	0	0	126	0
today vs future no EWA (2 v 4a)			0	0	1	11	197	1509	425	0	0	[illegible]	2141	8
today vs future with EWA (3 v 5a)			0	0	(1)	51	(571)	(5527)	(478)	0	0	0	(6526)	(17)
1997 vs future with EWA (1 v 5a)														
1996		0	0	0	30	1555	22535	14113	747				38981	W
Loss Number	4	4	6	5	5	8	2	1	(2)	2	(6)	(0)		
today vs future no EWA (2 v 4a)	2	1	7	5	4	5	4	2	3	2	(5)	(3)		
today vs future with EWA (3 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
1997 vs future with EWA (1 v 5a)														
													Sum of Change	
Change in Salmon Loss			0	0	1	128	415	304	(13)	0	0	0	735	2
today vs future no EWA (2 v 4a)			0	0	1	72	903	1145	21	0	0	[illegible]	2142	5
today vs future with EWA (3 v 5a)			0	0	(1)	336	(2623)	(4194)	(24)	0	0	0	(6506)	(17)
1997 vs future with EWA (1 v 5a)														
1997	39	0	0	0	45	15225	36773	3191	23	0	0	0	55299	W
Loss Number	4	4	6	5	5	8	1	1	(2)	2	(5)	(0)		
today vs future no EWA (2 v 4a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
today vs future with EWA (3 v 5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
1997 vs future with EWA (1 v 5a)														
													Sum of Change	
Change in Salmon Loss	2	0	0	0	2	1257	676	46	(0)	0	0	0	1982	4
today vs future no EWA (2 v 4a)	1	9	0	0	2	700	1474	259	1	0	0	0	2437	4
today vs future with EWA (3 v 5a)	2	3	0	0	(2)	3287	(4279)	948	(1)	0	0	[illegible]	(1940)	(4)
1997 vs future with EWA (1 v 5a)														

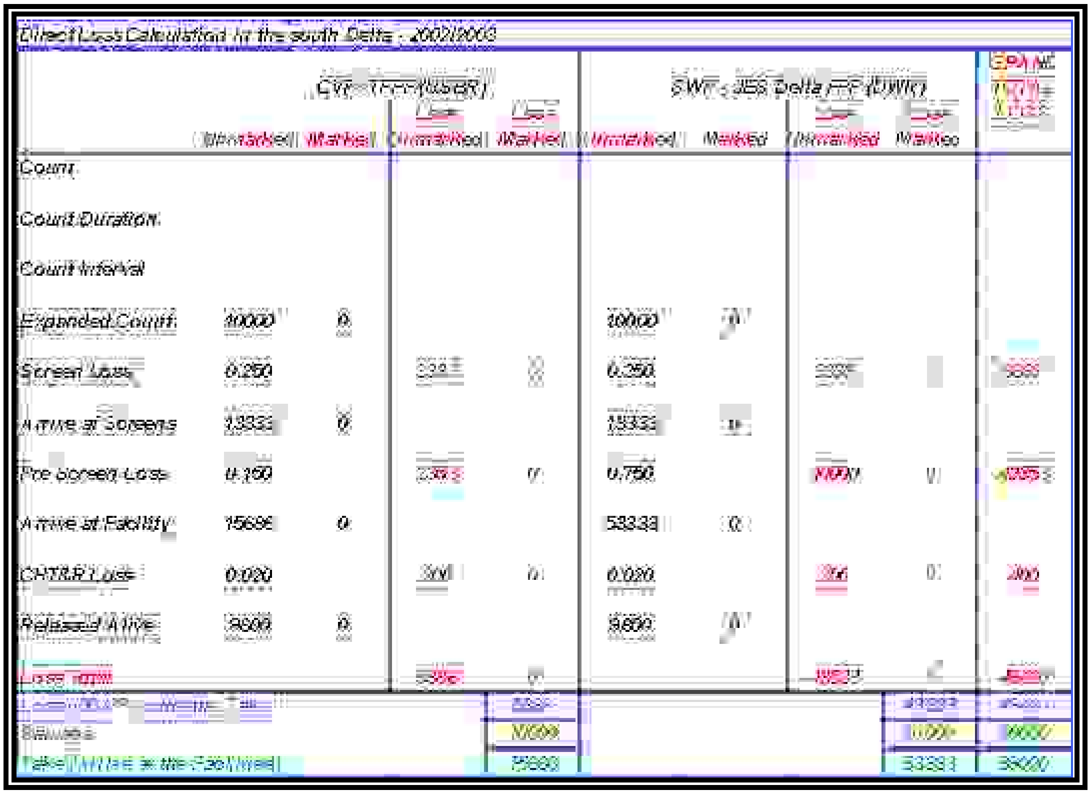
Table A9: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Sum/Total	WY
1998														
Loss Number:	0	0	0	0	8	4800	3110	4219	1092				13229	W
today vs future no EWA(2 v 4a)	4	4	8	5	6	8	2	1	(7)	2	(5)	(0)		
today vs future with EWA(3 v 5a)	3	2	7	3	4	5	4	8	3	2	(6)	(0)		
1997 vs future with EWA(1 v 5a)	5	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)	0	0	0	0	0	396	149	205	(18)	0	0	0	733	3
today vs future with EWA(3 v 5a)	0	0	0	0	0	271	325	1154	21	0	0	0	1731	6
1997 vs future with EWA(1 v 5a)	0	0	0	0	(0)	1086	(944)	(4226)	(35)	0	0	0	(4168)	(15)
1999														
Loss Number:	0	0	0		44	3195	9227	2592	18				13173	W
today vs future no EWA(2 v 4a)	3	4	8	5	5	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA(3 v 5a)	3	2	7	3	4	5	4	8	3	2	(6)	(0)		
1997 vs future with EWA(1 v 5a)	5	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)	0	0	0	0	4	264	1697	471	(0)	0	0	0	2435	2
today vs future with EWA(3 v 5a)	0	0	0	0	4	147	1689	2645	1	0	0	0	4486	5
1997 vs future with EWA(1 v 5a)	0	0	0	0	(3)	690	(10738)	(9686)	(1)	0	0	0	(19738)	(15)
2000														
Loss Number:	0	0	0		264	7293	8400	7182	84			28	[illegible]	AN
today vs future no EWA(2 v 4a)	5	2	(5)	(3)	4	3	4	6	1	0	1	1		
today vs future with EWA(3 v 5a)	3	2	(1)	1	5	4	2	(4)	0	(0)	(1)	1		
1997 vs future with EWA(1 v 5a)	7	0	(6)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)	0	0	0	0	11	497	3310	444	1	0	0	0	3933	4
today vs future with EWA(3 v 5a)	0	0	0	0	8	365	1408	(263)	0	0	0	0	1415	1
1997 vs future with EWA(1 v 5a)	0	0	0	0	(11)	679	(14258)	(2790)	(3)	0	0	(0)	(16378)	(17)
2001														
Loss Number:	0	0	0			7435	28758	5204	9				41394	D
today vs future no EWA(2 v 4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(5)	(4)		
today vs future with EWA(3 v 5a)	(1)	1	5	6	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA(1 v 5a)	3	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(8)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)	0	0	0	0	0	(108)	1019	(132)	0	0	0	0	779	2
today vs future with EWA(3 v 5a)	0	0	0	0	0	189	397	210	0	0	0	0	795	2
1997 vs future with EWA(1 v 5a)	0	0	0	0	0	(166)	(2263)	(2057)	0	0	0	0	(4486)	(11)
2002														
Loss Number:				21	8	1245	10825	2463	18				14579	D
today vs future no EWA(2 v 4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(5)	(4)		
today vs future with EWA(3 v 5a)	(1)	1	6	5	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA(1 v 5a)	3	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(8)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)	0	0	0	1	(0)	18	384	(82)	(1)	0	0	0	302	2
today vs future with EWA(3 v 5a)	0	0	0	1	0	32	149	99	(1)	0	0	0	280	2
1997 vs future with EWA(1 v 5a)	0	0	0	(1)	0	(38)	(852)	(974)	(2)	0	(0)	0	(1867)	(13)
2003														
Loss Number:	0	0	0	46	57	2257	2797	2573					[illegible]	AN
today vs future no EWA(2 v 4a)	5	2	(6)	(3)	4	3	4	6	1	0	2	1		
today vs future with EWA(3 v 5a)	3	2	(1)	1	5	4	2	(4)	0	(0)	(0)	1		
1997 vs future with EWA(1 v 5a)	7	0	(6)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v 4a)	0	0	0	(1)	2	331	1102	150	0	0	0	0	1584	4
today vs future with EWA(3 v 5a)	0	0	0	0	2	429	459	(81)	0	0	0	0	809	2
1997 vs future with EWA(1 v 5a)	0	0	0	(4)	(2)	1141	(4788)	(1003)	0	0	0	0	(4617)	(11)

Table A9: Note
This table presents the combined loss numbers for spring-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the loss numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in loss numbers.

Table A10: Simple Through-Delta Loss Model

This simple model is based on the projected loss of fish entrained at the south Delta export facilities. It includes losses due to pre-screen mortality, trucking and handling, and screening efficiency (top table). The number of fish that arrive at the facilities to support the number of fish counted in the expanded count (*e.g.*10,000 fish) is then further expanded by the two survival factors, 5% survival and 66% survival, (Low and High). This expanded number is the projected number of fish that would have to arrive at the northern Delta to support the 10,000 fish salvaged in the expanded salvage count.

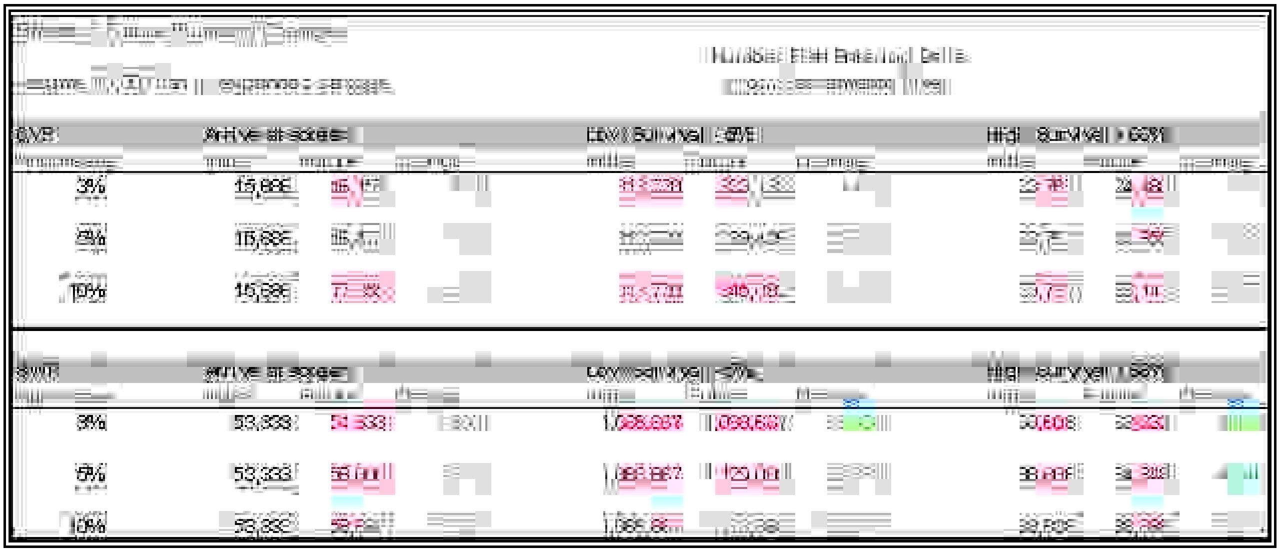


Direct Loss Calculation in the south Delta - 2002/2003

	CVP - [illegible] (USBR)		Loss		SWP - [illegible] Delta [illegible] (DWR)		Loss		[illegible]
	Unmarked	Marked	Unmarked	Marked	Unmarked	Marked	Unmarked	Marked	
Count									
Count Duration									
Count Interval									
Expanded Count	10000	0			10000	0			
Screen Loss	0.250		3333	0	0.250		[illegible]	[illegible]	[illegible]
Arrive at Screens	13333	0			13333	0			
Pre Screen Loss	0.150		2353	0	0.750		[illegible]	0	[illegible]
Arrive at Facility	15686	0			53333	0			
CHT&R Loss	0.020		[illegible]	0	0.020		[illegible]	0	[illegible]
Released Alive	9800	0			9800	0			
Loss Total			[illegible]	0			[illegible]	[illegible]	[illegible]
[illegible]			[illegible]				[illegible]		[illegible]
Salvage			10000				10000		[illegible]
Take [illegible] at the Facilities			[illegible]				53333		[illegible]

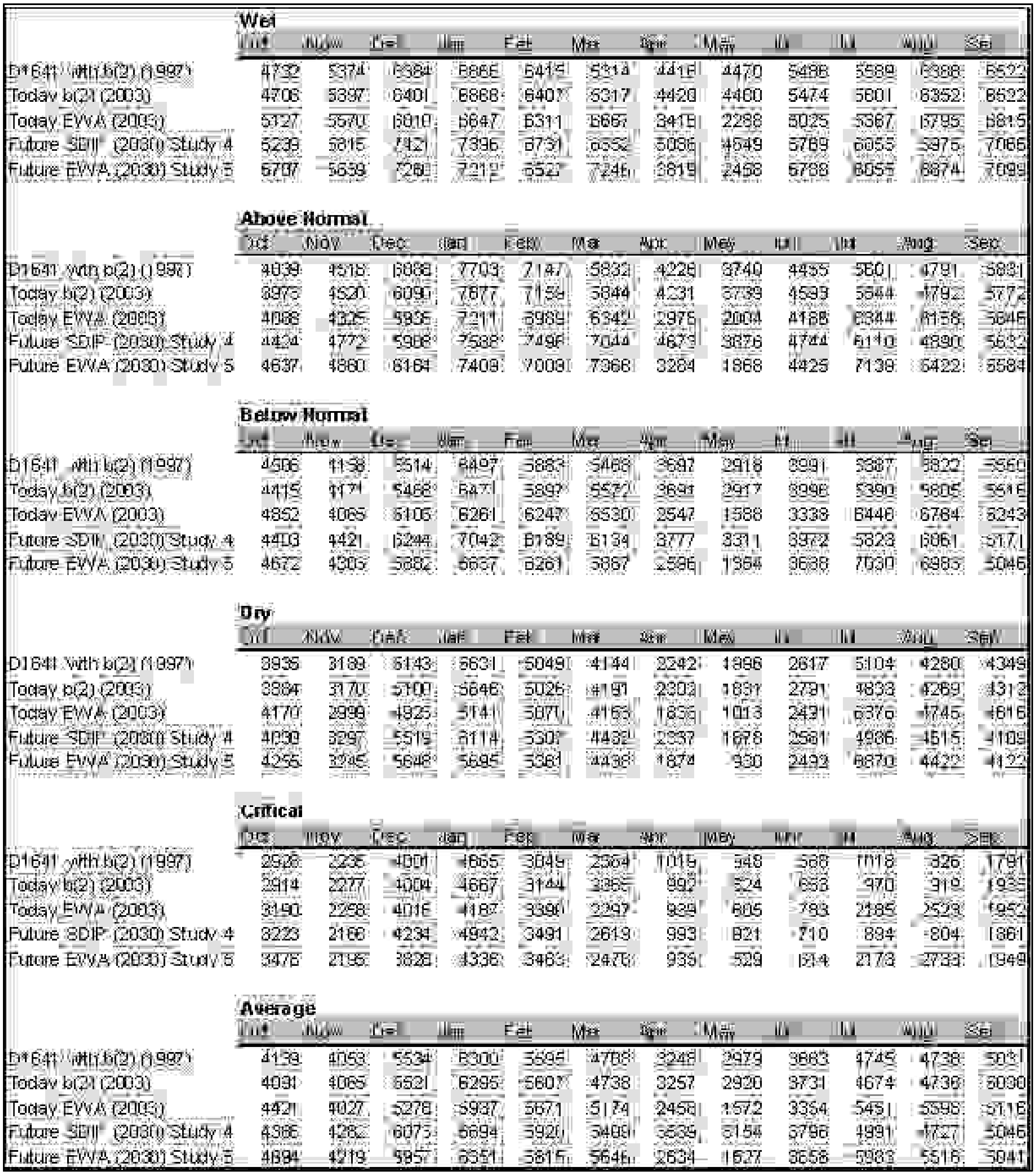
[illegible]	% Survival	CVP	SWP	Total
Low	0.05	[illegible]	[illegible]	[illegible]
High	0.66	[illegible]	[illegible]	[illegible]

Table A10: Simple Model for Through-Delta Expansion - part 2



This table represents a Simple Model for the expansion of the number of fish arriving at the export facilities utilizing a typical range of pumping increases observed in the CALSIM II modeling for studies 4a and 5a. The through-Delta expansion is then calculated for the values derived in the future pumping conditions. Finally, the changes in the number of additional fish needed to support the different percentages of pumping rate increases are determined from the expanded values.

Table A11: CALSIM II Modeling for Studies 4 and 5 at the SWP



Wet

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	4732	5374	6384	6865	6415	5314	4416	4470	5486	5589	6388	6522
Today b(2) (2003)	4706	5397	6401	6868	6407	5317	4420	4460	5474	5601	6352	6522
Today EWA (2003)	5127	5570	6010	6647	6311	6667	3418	2288	5025	5367	6795	6815
Future SDIP (2030) Study 4	5239	5815	7421	7396	6731	6552	5086	4549	5769	6055	5975	7066
Future EWA (2030) Study 5	5707	5639	7280	7212	6527	7246	3819	2458	5788	6055	6874	7099

Above Normal

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	4039	4518	6088	7703	7147	5832	4228	3740	4455	5601	4791	5831
Today b(2) (2003)	3973	4520	6090	7677	7158	5844	4231	3739	4593	5544	4792	5772
Today EWA (2003)	4088	4325	5935	7211	6989	6342	2976	2004	4188	6344	6158	5646
Future SDIP (2030) Study 4	4424	4772	5988	7588	7498	7044	4673	3876	4744	6110	4890	5632
Future EWA (2030) Study 5	4637	4880	6164	7409	7008	7368	3284	1868	4425	7139	6422	5584

Below Normal

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	4506	4138	5514	6497	5883	5468	3697	2918	3991	5387	5822	5560
Today b(2) (2003)	4415	4171	5468	6471	5897	5572	3691	2917	3998	5390	5805	5616
Today EWA (2003)	4852	4065	6106	6261	6247	5530	2547	1588	3338	6446	6784	6243
Future SDIP (2030) Study 4	4403	4421	6244	7042	6189	6134	3777	3311	3972	5823	6061	5171
Future EWA (2030) Study 5	4672	4305	5882	6637	6261	5867	2596	1364	3638	7030	6985	5046

Dry

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	3935	3189	6143	5631	5049	4144	2242	1896	2617	5104	4280	4349
Today b(2) (2003)	3884	3170	5100	5646	5026	4191	2302	1831	2791	4833	4269	4312
Today EWA (2003)	4170	2999	4825	5141	5070	4163	1856	1013	2431	6376	4745	4616
Future SDIP (2030) Study 4	4030	3297	5519	6114	5307	4432	2337	1678	2581	4936	4515	4109
Future EWA (2030) Study 5	4255	3245	5648	5695	5381	4438	1874	930	2493	6870	4422	4122

Critical

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	2926	2235	4001	4665	3049	2364	1015	548	588	1018	826	1791
Today b(2) (2003)	2914	2277	4004	4667	3144	2365	992	524	653	970	819	1935
Today EWA (2003)	3190	2258	4016	4187	3390	2297	939	605	783	2185	2523	1952
Future SDIP (2030) Study 4	3223	2166	4234	4942	3491	2619	993	821	710	894	804	1861
Future EWA (2030) Study 5	3476	2195	3828	4336	3463	2476	935	529	614	2173	2733	1949

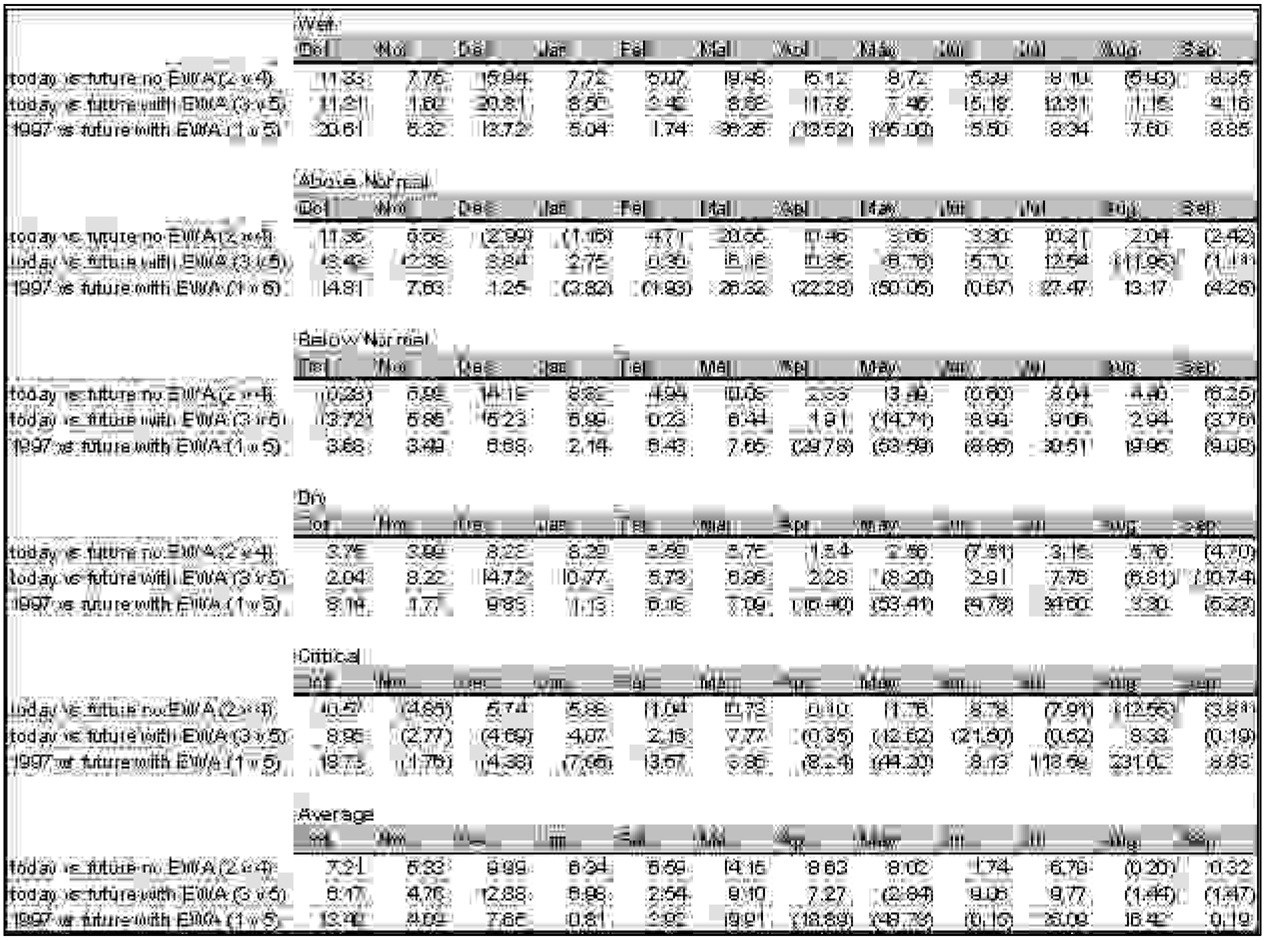
Average

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	4139	4053	5534	6300	5595	4788	3248	2979	3883	4745	4738	5031
Today b(2) (2003)	4091	4065	5521	6295	5607	4738	3257	2920	3731	4674	4736	5030
Today EWA (2003)	4421	4027	5278	5937	5671	5174	2456	1572	3354	5451	5598	5116
Future SDIP (2030) Study 4	4386	4282	6075	6694	5920	5409	3539	3154	3798	4991	4727	5046
Future EWA (2030) Study 5	4894	4219	5957	6351	5815	5646	2634	1627	3658	5983	5516	5041

Table A11: Note

CALSIM II modeling values for the studies 1 through 3 and studies 4 and 5 at the SWP export facilities. Values are in cubic feet per second (cfs). The CALSIM II modeling runs used data from 72 years of historical hydrological records. Modeling runs are divided into hydrological year types and are an average of those years falling into a particular water year classification.

Table A12: Percentage Changes in Pumping Rates at the SWP for Studies 4 and 5

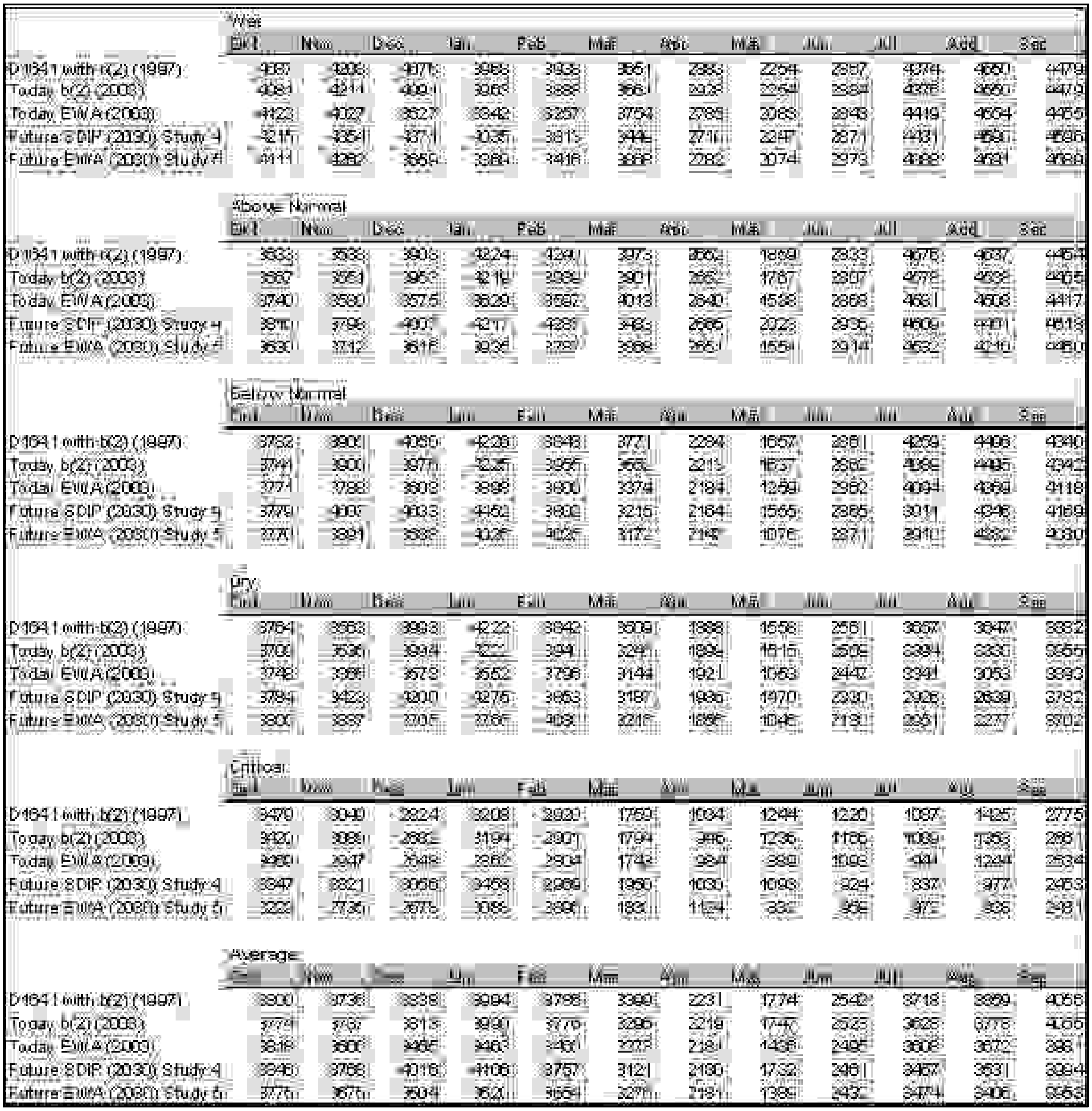


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
today vs future no EWA (2 v 4)	11.33	7.75	15.94	7.72	5.07	19.48	15.12	8.72	5.39	8.10	(5.93)	8.35
today vs future with EWA (3 v 5)	11.21	1.62	20.81	8.50	2.42	8.82	11.78	7.46	15.18	12.81	1.15	4.16
1997 vs future with EWA (1 v 5)	20.61	5.32	13.72	5.04	1.74	38.35	(13.52)	(45.00)	5.50	8.34	7.60	8.85
Above Normal												
today vs future no EWA (2 v 4)	11.36	6.58	(2.99)	(1.16)	4.71	20.66	10.46	3.66	3.30	10.21	2.04	(2.42)
today vs future with EWA (3 v 5)	8.42	12.38	3.84	2.75	0.35	16.16	10.35	(6.76)	5.70	12.54	(11.95)	(1.18)
1997 vs future with EWA (1 v 5)	14.81	7.63	1.25	(3.82)	(1.93)	26.32	(22.28)	(50.05)	(0.67)	27.47	13.17	(4.26)
Below Normal												
today vs future no EWA (2 v 4)	(0.28)	6.95	14.15	8.82	4.94	10.05	2.55	13.49	(0.60)	8.04	4.40	(6.25)
today vs future with EWA (3 v 5)	(3.72)	6.85	15.23	5.99	0.23	6.44	1.91	(14.71)	8.99	9.06	2.94	(3.76)
1997 vs future with EWA (1 v 5)	3.68	3.49	6.88	2.14	8.43	7.65	(29.78)	(53.59)	(8.85)	30.51	19.95	(9.08)
Dry												
today vs future no EWA (2 v 4)	3.75	3.89	8.22	6.29	5.59	5.75	1.54	2.56	(7.51)	3.15	5.76	(4.70)
today vs future with EWA (3 v 5)	2.04	8.22	14.72	10.77	5.73	6.86	2.28	(8.20)	2.91	7.76	(6.81)	(10.74)
1997 vs future with EWA (1 v 5)	8.14	1.77	9.85	1.13	6.16	7.09	(10.40)	(53.41)	(4.78)	34.60	3.30	(5.23)
Critical												
today vs future no EWA (2 v 4)	10.57	(4.85)	5.74	5.88	(1.04)	11.73	0.10	(1.76)	8.78	(7.91)	(12.56)	(3.81)
today vs future with EWA (3 v 5)	8.95	(2.77)	(4.69)	4.07	2.16	7.77	(0.35)	(12.62)	(21.50)	(0.62)	8.33	(0.19)
1997 vs future with EWA (1 v 5)	18.73	(1.76)	(4.38)	(7.66)	13.57	5.85	(8.24)	(44.20)	8.13	118.58	231.02	8.83
Average												
today vs future no EWA (2 v 4)	7.21	6.33	9.99	6.34	5.59	14.15	8.63	8.02	1.74	6.79	(0.20)	0.32
today vs future with EWA (3 v 5)	6.17	4.76	12.88	5.98	2.54	9.10	7.27	(2.84)	9.06	9.77	(1.44)	(1.47)
1997 vs future with EWA (1 v 5)	13.42	8.09	7.65	0.81	2.92	19.91	(18.89)	(48.79)	(0.15)	26.09	16.42	0.19

Table A12:

Percentage changes in the pumping rates between study 4 and 2, and study 5 and studies 1 and 3 at the SWP export facilities. Numbers in parenthesis indicate that the future condition is less than the current baseline condition.

Table A13: CALSIM II Modeling for Studies 4 and 5 at the CVP



Wet	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	4067	4206	4071	3958	3938	3651	2383	2254	2857	4374	4650	4479
Today b(2) (2003)	4084	4211	4091	3969	3888	3661	2328	2254	2884	4376	4650	4479
Today EWA (2003)	4123	4027	3627	3342	3257	3754	2785	2083	2848	4419	4654	4455
Future SDIP (2030) Study 4	4216	4354	4371	4035	3813	3446	2716	2247	2871	4431	4590	4596
Future EWA (2030) Study 4	4111	4282	3659	3384	3416	3688	2282	2074	2973	4388	4581	4589

Above Normal	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	3633	3538	3906	4224	4290	3973	2562	1869	2833	4676	4637	4454
Today b(2) (2003)	3567	3551	3957	4219	3989	3901	2562	1787	2807	4678	4638	4465
Today EWA (2003)	3740	3580	3575	3629	3592	4013	2640	1538	2868	4631	4608	4417
Future SDIP (2030) Study 4	3810	3796	4007	4217	4287	3463	2685	2023	2935	4609	4401	4518
Future EWA (2030) Study 4	3630	3712	3616	3936	3782	3368	2651	1554	2914	4532	4210	4480

Below Normal	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	3782	3905	4050	4228	3848	3771	2294	1657	2811	4259	4496	4340
Today b(2) (2003)	3744	3900	3977	4225	3955	3652	2215	1637	2862	4099	4495	4342
Today EWA (2003)	3771	3788	3603	3898	3800	3374	2184	1259	2862	4094	4369	4118
Future SDIP (2030) Study 5	3779	4007	4033	4452	3892	3215	2164	1565	2865	3011	4346	4169
Future EWA (2030) Study 5	3770	3891	3532	4025	4025	3172	2142	1076	2871	3910	4382	4030

Dry	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	3764	3563	3993	4222	3842	3509	1888	1556	2561	3657	3647	3832
Today b(2) (2003)	3709	3536	3934	4222	3941	3291	1894	1615	2509	3394	3330	3955
Today EWA (2003)	3748	3361	3573	3552	3796	3144	1921	1063	2447	3341	3053	3393
Future SDIP (2030) Study 5	3784	3423	3800	4275	3853	3187	1986	1470	2330	2926	2839	3782
Future EWA (2030) Study 5	3806	3397	3705	3786	4031	3216	1885	1046	2130	2951	2277	3702

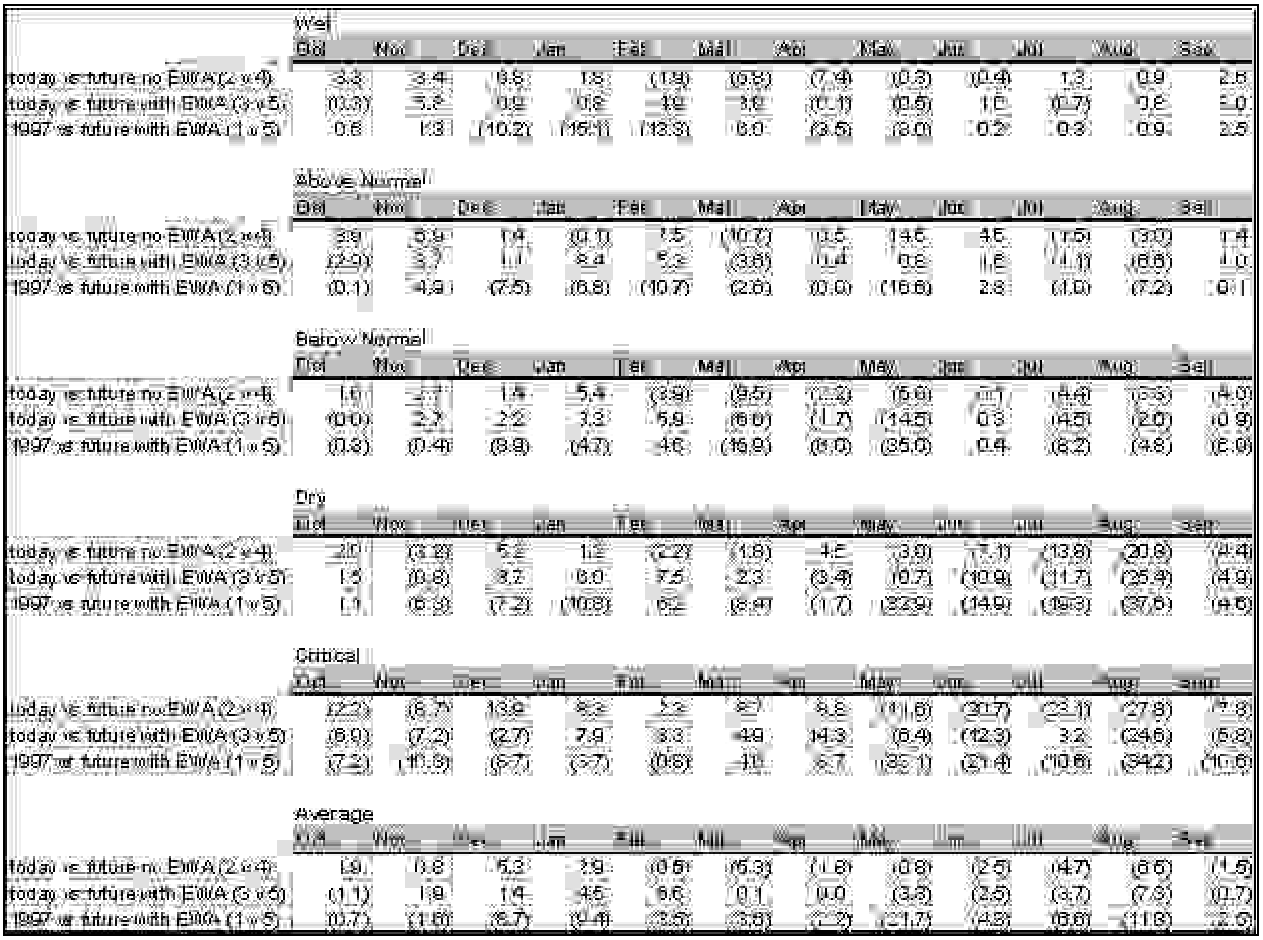
Critical	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	3470	3040	2824	3208	2920	1759	1034	1244	1220	1087	1425	2775
Today b(2) (2003)	3420	3089	2832	3194	2901	1794	995	1235	1166	1089	1353	2861
Today EWA (2003)	3350	2947	2548	2862	2904	1743	984	889	1093	944	1244	2534
Future SDIP (2030) Study 4	3347	2821	3056	3458	2969	1960	1030	1098	924	837	977	2453
Future EWA (2030) Study 5	3222	2735	2675	3082	2896	1831	1124	832	956	973	835	2481

Average	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
D1641 with b(2) (1997)	3900	3736	3838	3994	3798	3399	2231	1774	2542	3718	3859	4056
Today b(2) (2003)	3774	3737	3813	3990	3776	3296	2219	1746	2523	3625	3778	4065
Today EWA (2003)	3818	3606	3465	3463	3480	3277	2181	1436	2495	3608	3672	3931
Future SDIP (2030) Study 4	3846	3769	4016	4106	3757	3121	2130	1732	2461	3467	3531	3994
Future EWA (2030) Study 5	3776	3676	3504	3621	3654	3270	2181	1389	2432	3474	3406	3953

Table A13: Note

CALSIM II modeling values for the studies 1 through 3 and studies 4 and 5 at the CVP export facilities. Values are in cubic feet per second (cfs). The CALSIM II modeling runs used data from 72 years of historical hydrological records. Modeling runs are divided into hydrological year types and are an average of those years falling into a particular water year classification.

Table A14: Percentage Pumping Changes at the CVP for Studies 4 and 5



Wet	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
today vs future no EWA (2 v 4)	3.3	3.4	6.6	1.6	(1.9)	(6.8)	(7.4)	(0.3)	(0.4)	1.3	0.9	2.6
today vs future with EWA (3 v 5)	(0.3)	5.2	0.9	0.8	4.9	3.9	(0.1)	(0.5)	1.0	(0.7)	0.6	5.0
1997 vs future with EWA (1 v 5)	0.6	1.3	(10.2)	(15.1)	(13.3)	6.0	(3.5)	(3.0)	0.2	0.3	0.9	2.5

Above Normal	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
today vs future no EWA (2 v 4)	3.9	5.9	1.4	(0.1)	7.5	(10.7)	0.5	14.6	4.6	(1.5)	(3.0)	1.4
today vs future with EWA (3 v 5)	(2.9)	3.7	1.1	8.4	5.2	(3.6)	1.4	0.8	1.6	(1.1)	(6.6)	1.0
1997 vs future with EWA (1 v 5)	(0.1)	4.9	(7.5)	(6.8)	(10.7)	(2.6)	(0.0)	(16.6)	2.8	(1.0)	(7.2)	0.1

Below Normal	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
today vs future no EWA (2 v 4)	1.0	2.7	1.5	5.4	(3.9)	(9.5)	(1.2)	(5.6)	[illegible]	(4.4)	(3.3)	(4.0)
today vs future with EWA (3 v 5)	(0.0)	2.2	2.2	3.3	5.9	(6.0)	(1.7)	(14.5)	0.3	(4.5)	(2.0)	(0.9)
1997 vs future with EWA (1 v 5)	(0.3)	(0.4)	(8.9)	(4.7)	4.6	(15.9)	(6.0)	(35.0)	0.4	(8.2)	(4.8)	(6.0)

Dry	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
today vs future no EWA (2 v 4)	2.0	(3.2)	5.2	1.2	(2.2)	(1.8)	4.5	(3.0)	(7.1)	(13.8)	(20.8)	(4.4)
today vs future with EWA (3 v 5)	1.5	(0.8)	3.7	0.0	7.5	2.3	(3.4)	(0.7)	(10.9)	(11.7)	(25.4)	(4.9)
1997 vs future with EWA (1 v 5)	1.1	(6.3)	(7.2)	(10.8)	6.2	(8.4)	(1.7)	(22.9)	(14.9)	(19.3)	(37.6)	(4.6)

Critical	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
today vs future no EWA (2 v 4)	(2.2)	(6.7)	13.9	8.2	2.2	8.7	8.8	(11.6)	(30.7)	(23.1)	(27.8)	(7.8)
today vs future with EWA (3 v 5)	(6.9)	(7.2)	(2.7)	7.9	3.3	4.9	14.3	(6.4)	(12.3)	3.2	(24.6)	(5.8)
1997 vs future with EWA (1 v 5)	(7.2)	(10.9)	(6.7)	(3.7)	(0.6)	4.1	6.7	(35.1)	(21.4)	(10.6)	(34.2)	(10.6)

Average	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
today vs future no EWA (2 v 4)	1.9	0.8	5.3	2.9	(0.6)	(6.3)	(1.6)	(0.8)	(2.5)	(4.7)	(6.6)	(1.5)
today vs future with EWA (3 v 5)	(1.1)	1.9	1.4	4.5	6.6	0.1	0.0	(3.3)	(2.5)	(3.7)	(7.3)	(0.7)
1997 vs future with EWA (1 v 5)	(0.7)	(1.6)	(6.7)	(9.4)	(3.5)	(3.6)	(1.2)	(21.7)	(4.3)	(6.6)	(11.3)	(2.5)

Table A14: Note

Percentage changes in the pumping rates between study 4 and 2, and study 5 and studies 1 and 3 at the CVP export facilities. Numbers in parenthesis indicate that the future condition is less than the current baseline condition.

Table A15: Salvage Projections for winter-run Chinook salmon under Studies 4 and 5

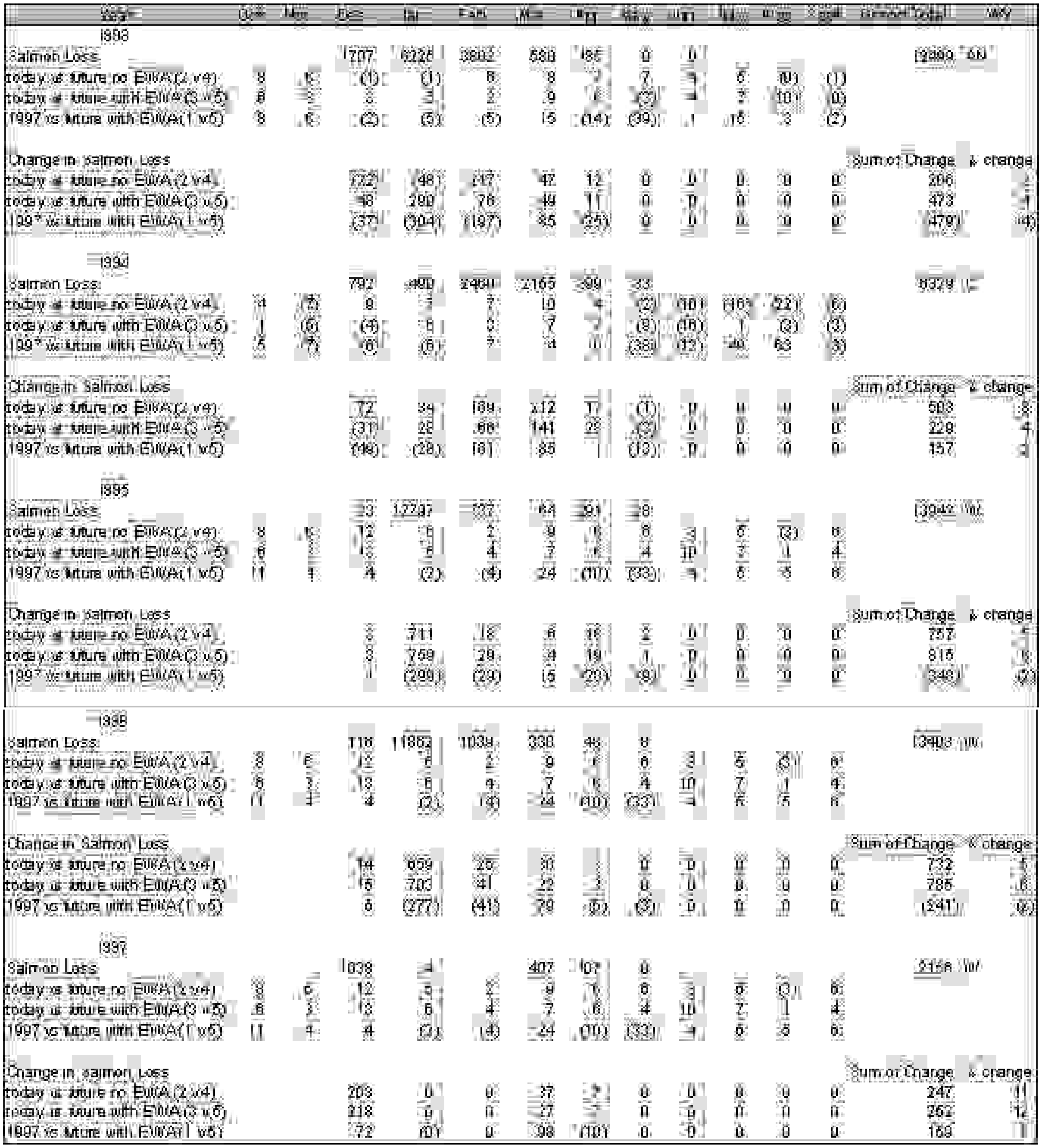
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	[illegible]	[illegible]
1993														
Salvage number			510	1470	1125	344	33	0	0				3638	AN
today vs future no EWA (2 v4)	5	6	(1)	(1)	8	8	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	2	9	6	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	5	6	(2)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			(7)	(11)	64	28	5	0	0				79	2
today vs future with EWA (3 v5)			15	68	22	29	5	0	0				139	4
1997 vs future with EWA (1 v5)			(11)	(72)	(58)	50	(11)	0	0				(103)	(3)
1994														
Salvage Number			338	215	2941	1625	332	6	0				5457	[illegible]
today vs future no EWA (2 v4)	4	(7)	9	7	7	10	4	(2)	(10)	(16)	(22)	(8)		
today vs future with EWA (3 v5)	1	(5)	(4)	6	3	7	7	(9)	(16)	1	(3)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(5)	(6)	7	4	0	(38)	(32)	49	62	(7)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			22	15	202	160	19	(0)	0				417	8
today vs future with EWA (3 v5)			(9)	12	79	106	31	(1)	0				218	4
1997 vs future with EWA (1 v5)			(16)	(13)	182	64	1	(2)	0				228	4
1995														
Salvage Number			33	4082	362	34	394	16	0				4920	W
today vs future no EWA (2 v4)	8	6	12	6	2	9	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			4	222	8	3	24	1	0				265	6
today vs future with EWA (3 v5)			5	245	11	2	25	1	0				285	6
1997 vs future with EWA (1 v5)			2	(95)	(11)	8	(37)	(5)	0				(138)	(3)
1996														
Salvage Number			36	3281	386	23	40	12	0				3828	W
today vs future no EWA (2 v4)	8	6	12	6	2	9	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			4	182	9	7	2	1	0				206	5
today vs future with EWA (3 v5)			5	191	15	2	2	0	0				220	6
1997 vs future with EWA (1 v5)			2	(77)	(16)	17	(4)	(4)	0				(81)	(2)
1997														
Salvage Number			520	1	0	337	23	0	0				881	W
today vs future no EWA (2 v4)	5	6	12	6	2	9	6	6	3	5	(3)	5		
today vs future with EWA (3 v5)	6	3	13	8	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			64	0	0	31	1	0	0				97	11
today vs future with EWA (3 v5)			68	0	0	22	1	0	0				93	11
1997 vs future with EWA (1 v5)			22	(0)	0	81	(2)	0	0				101	12

Table A15: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Annual Total	WY
1988														
Salvage Number			4	400	108	196	12	0	0				720	W
today vs future no EWA (2 v4)	8	6	13	6	2	8	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	6	[illegible]	12	[illegible]	4	7	[illegible]	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			0	22	2	18	1	0	0				44	6
today vs future with EWA (3 v5)			1	24	4	13	1	0	0				42	6
1997 vs future with EWA (1 v5)			0	(9)	(4)	47	(1)	0	0				33	5
1999														
Salvage Number			48	56	85	1108	435	0	0				1732	W
today vs future no EWA (2 v4)	8	6	12	[illegible]	2	9	[illegible]	6	[illegible]	5	(2)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			6	3	2	102	27	0	0				139	8
today vs future with EWA (3 v5)			6	[illegible]	[illegible]	71	28	0	0				115	7
1997 vs future with EWA (1 v5)			2	(4)	(3)	266	(42)	0	0				221	13
2000														
Salvage Number			128	975	1145	596	166	0	0				3008	AN
today vs future no EWA (2 v4)	8	8	(11)	(1)	6	8	1	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	[illegible]	9	[illegible]	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	8	8	(21)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			(3)	(7)	65	47	(1)	0	0				114	4
today vs future with EWA (3 v5)			4	45	22	60	9	0	0				131	4
1997 vs future with EWA (1 v5)			(3)	(98)	(39)	80	(23)	0	0				(46)	(2)
2001														
Salvage Number			604	589	2261	3881	138	0	0				7273	D
today vs future no EWA (2 v4)	3	0	7	5	2	2	3	0	(7)	(4)	(6)	(5)		
today vs future with EWA (3 v5)	2	0	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	6	0	(10)	(44)	(10)	12	(15)	(5)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			35	27	49	95	1	0	0				209	3
today vs future with EWA (3 v5)			51	45	146	189	(1)	0	0				430	6
1997 vs future with EWA (1 v5)			17	(20)	140	0	(13)	0	0				119	2
2002														
Salvage Number			850	1623	379	1067	138	0	0				4047	D
today vs future no EWA (2 v4)	3	0	7	5	2	2	3	0	(7)	(4)	(6)	(5)		
today vs future with EWA (3 v5)	2	3	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	6	0	(10)	(44)	(10)	14	(15)	(5)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			58	36	8	26	4	0	0				182	5
today vs future with EWA (3 v5)			86	143	25	52	(1)	0	0				304	8
1997 vs future with EWA (1 v5)			20	(65)	23	0	(13)	0	0				34	(1)
2003														
Salvage Number			1210	6830	1120	1128	64	24	12				9368	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	6	8	1	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	2	9	6	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	14	(14)	(29)	1	15	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			(3)	(62)	64	91	1	2	0				106	1
today vs future with EWA (3 v5)			6	318	22	95	4	(1)	0				445	5
1997 vs future with EWA (1 v5)			(5)	(384)	(68)	185	(9)	(9)	0				(250)	(3)

Table A15: Note
This table presents the combined salvage numbers for winter-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the salvage numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in salvage numbers.

Table A16: Projected losses for winter-run Chinook salmon under Studies 4 and 5



Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Annual Total	WY
1993														
Salmon Loss			1707	6226	3602	580	185	0	0				12499	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	8	8	7	7	3	6	(0)	(1)		
today vs future with EWA (3 v5)	8	3	3	3	2	9	6	(3)	[illegible]	7	(10)	(0)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			(22)	(48)	217	47	12	0	0	0	0	0	206	2
today vs future with EWA (3 v5)			48	290	76	49	11	0	0	0	0	0	473	4
1997 vs future with EWA (1 v5)			(37)	(304)	(197)	85	(25)	0	0	0	0	0	(479)	(4)
1994														
Salmon Loss			792	490	2460	2165	399	33					6329	C
today vs future no EWA (2 v4)	4	(7)	8	3	7	10	4	(2)	(10)	(16)	(22)	(6)		
today vs future with EWA (3 v5)	1	(6)	(4)	5	0	7	7	(8)	(16)	1	(2)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(6)	(6)	7	4	(1)	(38)	(12)	40	63	(3)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			72	34	169	212	17	(1)	0	0	0	0	503	8
today vs future with EWA (3 v5)			(31)	28	66	141	28	(3)	0	0	0	0	229	4
1997 vs future with EWA (1 v5)			(49)	(28)	161	85	1	(13)	0	0	0	0	157	2
1995														
Salmon Loss			23	12797	137	64	91	28					13942	W
today vs future no EWA (2 v4)	8	6	12	6	2	9	6	8	3	6	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	6	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			3	711	18	6	16	2	0	0	0	0	757	5
today vs future with EWA (3 v5)			3	759	29	4	19	1	0	0	0	0	815	6
1997 vs future with EWA (1 v5)			1	(299)	(29)	15	(29)	(9)	0	0	0	0	(348)	(2)
1996														
Salmon Loss			118	11862	1039	338	46	8					13403	W
today vs future no EWA (2 v4)	8	6	12	6	2	9	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			14	659	25	30	[illegible]	0	0	0	0	0	732	5
today vs future with EWA (3 v5)			15	703	41	22	3	0	0	0	0	0	785	6
1997 vs future with EWA (1 v5)			6	(277)	(41)	79	(5)	(3)	0	0	0	0	(241)	(2)
1997														
Salmon Loss			1038	4		407	107	0					2156	W
today vs future no EWA (2 v4)	8	6	12	5	2	9	6	6	3	6	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	(6)	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	6	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			203	0	0	37	7	0	0	0	0	0	247	11
today vs future with EWA (3 v5)			218	0	0	27	7	0	0	0	0	0	252	12
1997 vs future with EWA (1 v5)			72	(0)	0	98	(10)	0	0	0	0	0	159	7

Table A16: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Annual Total	WY
1998														
Salmon loss			19	1009	77	180	9						1293	W
today vs future no EWA (2 v4)	8	6	12	8	2	9	8	5	3	5	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	8	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	1	4	(2)	(4)	24	(10)	(33)	4	5	6	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			2	58	2	12	1	0	0	0	0	0	77	6
today vs future with EWA (3 v5)			2	50	3	12	1	0	0	0	0	0	78	6
1997 vs future with EWA (1 v5)			1	(24)	(3)	43	(1)	0	0	0	0	0	17	1
1999														
Salmon loss			81	58	59	2485	1544						4195	W
today vs future no EWA (2 v4)	8	6	12	8	2	9	8	5	3	5	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	8	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	6	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			4	4	1	222	95	0	0	0	0	0	332	8
today vs future with EWA (3 v5)			4	4	2	165	100	0	0	0	0	0	275	7
1997 vs future with EWA (1 v5)			1	(2)	(2)	595	(148)	0	0	0	0	0	446	11
2000														
Salmon loss			384	2608	3829	1591	248						8659	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	6	8	7	3	4	5	(10)	(1)		
today vs future with EWA (3 v5)	6	8	1	5	2	9	6	(3)	4	7	(10)	(1)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	16	(14)	(39)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			(5)	(20)	213	128	18	0	0	0	0	0	337	4
today vs future with EWA (3 v5)			1	121	76	136	14	0	0	0	0	0	358	4
1997 vs future with EWA (1 v5)			(8)	(127)	(199)	232	(34)	0	0	0	0	0	(137)	(2)
2001														
Salmon loss			1638	1297	6013	15403	258						24660	D
today vs future no EWA (2 v4)	3	0	7	5	3	2	3	0	(7)	(4)	(6)	(5)		
today vs future with EWA (3 v5)	2	3	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	6	0	(10)	(44)	(10)	12	(15)	(5)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			116	68	130	378	7	0	0	0	0	0	700	3
today vs future with EWA (3 v5)			170	115	389	752	(2)	0	0	0	0	0	1426	6
1997 vs future with EWA (1 v5)			40	(52)	372	1	(25)	0	0	0	0	0	337	1
2002														
Salmon loss			2500	4835	1222	2056	265						10877	D
today vs future no EWA (2 v4)	3	0	7	6	2	2	3	0	(7)	(4)	(6)	(6)		
today vs future with EWA (3 v5)	2	3	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	6	0	(10)	(44)	(10)	12	(15)	(5)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			172	255	26	50	8	0	0	0	0	0	512	5
today vs future with EWA (3 v5)			253	427	79	101	(2)	0	0	0	0	0	857	8
1997 vs future with EWA (1 v5)			60	(193)	76	0	(26)	0	0	0	0	0	(83)	(1)
2003														
Salmon loss			516	10442	7237	3102	198	23	8				21678	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	6	8	7	3	4	5	(10)	(1)		
today vs future with EWA (3 v5)	6	8	2	5	2	9	6	(3)	4	7	(10)	(1)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			(7)	(158)	187	250	13	1	0	0	0	0	289	1
today vs future with EWA (3 v5)			14	951	66	264	11	(1)	0	0	0	0	1306	6
1997 vs future with EWA (1 v5)			(11)	(989)	(171)	463	(27)	(9)	0	0	0	0	(754)	(3)

Table A16: Note

This table presents the combined loss numbers for winter-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the loss numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in loss numbers.

Table A17: Projected Salvage for spring-run Chinook salmon under studies 4 and 5

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Total	% change
1993														
Salvage Number	0	0	0	0	0	68	3308	4337	28	0	0	0	7741	[illegible]
today vs future no EWA (2 v4)	8	[illegible]	(1)	(1)	6	8	7	7	4	[illegible]	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	2	4	6	(3)	4	[illegible]	(10)	(0)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	0	6	219	309	1	0	0	0	534	[illegible]
today vs future with EWA (3 v5)			0	0	0	[illegible]	188	(151)	1	0	0	0	44	1
1997 vs future with EWA (1 v5)			0	0	0	[illegible]	(453)	(1689)	0	0	0	0	(2132)	(28)
1994														
Salvage Number	0	0	230	3394	569	0	0	0	0	0	0	0	4192	[illegible]
today vs future no EWA (2 v4)	4	(7)	9	7	7	10	4	(2)	(10)	(16)	(22)	(6)		
today vs future with EWA (3 v5)	1	(6)	(4)	6	3	[illegible]	7	(9)	(16)	1	(3)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(8)	(6)	7	4	0	(38)	(12)	49	63	(3)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			21	233	38	0	0	0	0	0	0	0	292	[illegible]
today vs future with EWA (3 v5)			(3)	191	15	0	0	0	0	0	0	0	198	5
1997 vs future with EWA (1 v5)			(14)	(194)	37	0	0	0	0	0	0	0	(171)	(4)
1995														
Salvage Number	0	16	336	6848	14415	7453	0	0	0	0	0	0	29068	[illegible]
today vs future no EWA (2 v4)	8	[illegible]	12	6	2	[illegible]	6	6	[illegible]	[illegible]	(3)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	1	4	(2)	(4)	24	(10)	(33)	4	[illegible]	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			42	381	349	684	0	0	0	0	0	0	1455	[illegible]
today vs future with EWA (3 v5)			45	406	564	496	0	0	0	0	0	0	1511	[illegible]
1997 vs future with EWA (1 v5)			15	(160)	(571)	1787	0	0	0	0	0	0	1070	4
1996														
Salvage Number	[illegible]	0	0	0	28	431	20144	7760	301	0	0	0	28670	[illegible]
today vs future no EWA (2 v4)	8	[illegible]	12	6	2	9	6	6	3	[illegible]	(3)	6		
today vs future with EWA (3 v5)	6	[illegible]	13	6	4	[illegible]	6	4	10	[illegible]	1	4		
1997 vs future with EWA (1 v5)	11	1	4	(2)	(4)	24	(10)	(33)	4	[illegible]	6	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	1	340	1235	441	10	0	0	0	1726	6
today vs future with EWA (3 v5)			0	0	1	29	1300	286	30	0	0	0	1646	[illegible]
1997 vs future with EWA (1 v5)			0	0	(1)	103	(1926)	(2532)	11	0	0	0	(4244)	(15)
1997														
Salvage Number	0	0	0	0	21	17015	24557	1589	36	0	0	0	43220	[illegible]
today vs future no EWA (2 v4)	8	6	12	6	2	[illegible]	6	6	3	[illegible]	(3)	6		
today vs future with EWA (3 v5)	6	[illegible]	13	6	4	[illegible]	6	4	10	[illegible]	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	6	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	1	0	0	0	1	1561	1505	80	1	0	0	0	3159	[illegible]
today vs future with EWA (3 v5)	0	0	0	0	1	1131	1585	58	4	0	0	0	2780	6
1997 vs future with EWA (1 v5)	1	0	0	0	(1)	4093	(2348)	(518)	1	0	0	0	1714	[illegible]

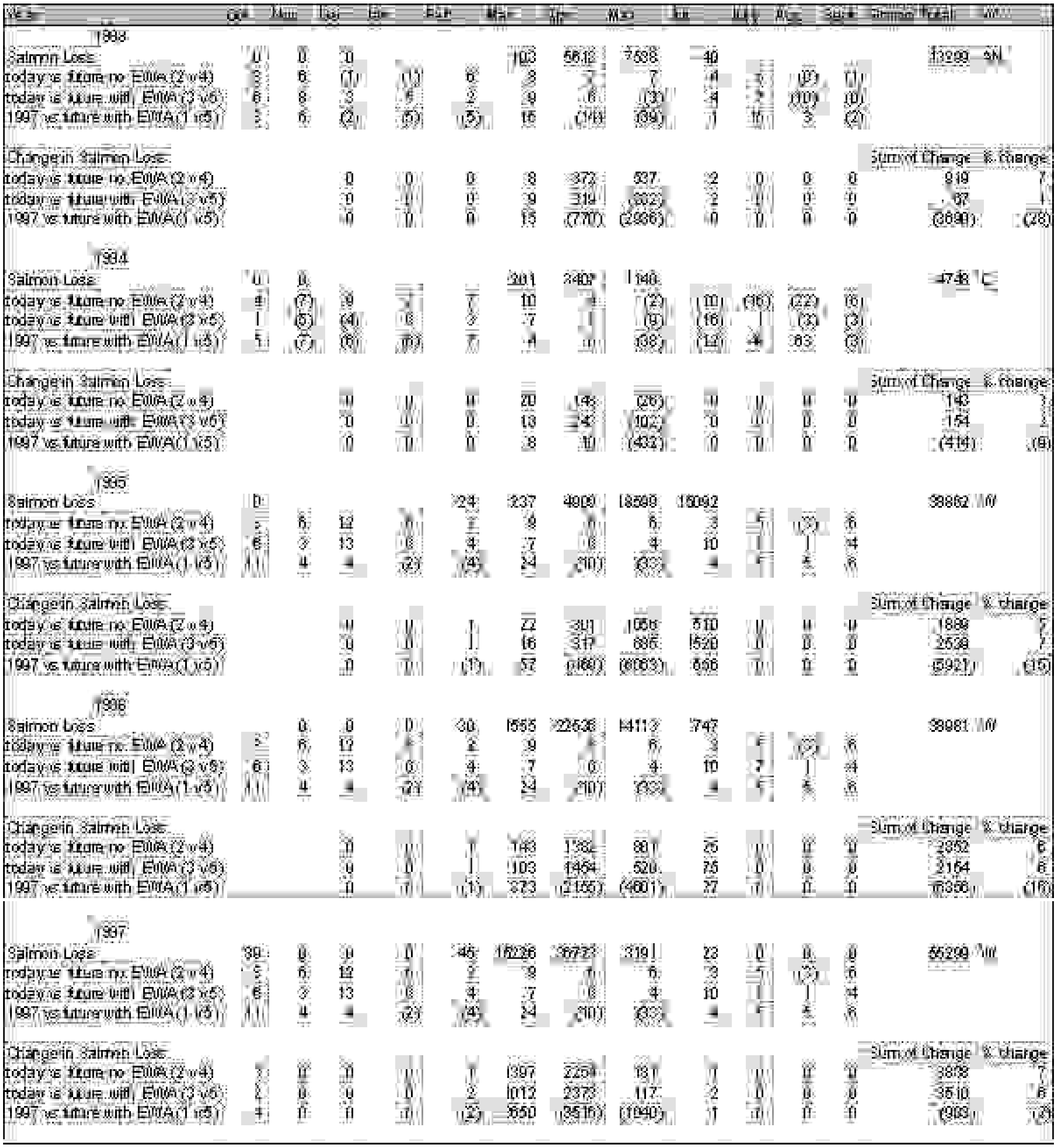
Table A17: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Total	[illegible]
1998														
Salvage Number	0	0	0	0	12	7238	10508	16207	564	0	0	0	34579	[illegible]
today vs future no EWA (2 v4)	8	6	12	6	2	9	6	6	3	[illegible]	(3)	6		
today vs future with EWA (3 v5)	6	8	13	6	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(37)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	0	669	644	920	19	0	0	0	2260	2
today vs future with EWA (3 v5)	0	0	0	0	0	485	678	597	57	0	0	0	1817	5
1997 vs future with EWA (1 v5)	0	0	0	0	(0)	1747	(1005)	(5284)	23	0	0	0	(4521)	(13)
1999														
Salvage Number	0	0	0	0	74	3177	40469	12087	24	0	0	0	55831	[illegible]
today vs future no EWA (2 v4)	8	8	12	6	2	9	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	6	8	13	6	4	7	6	4	16	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(33)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	2	292	2481	686	1	0	0	0	3461	6
today vs future with EWA (3 v5)	0	0	0	0	3	211	2612	445	2	0	0	0	3273	6
1997 vs future with EWA (1 v5)	0	0	0	0	(3)	762	(3809)	(3940)	1	0	0	0	(7050)	(13)
2000														
Salvage Number	0	0	0	0	136	3082	39347	2166	18	0	0	6	44745	AN
today vs future no EWA (2 v4)	6	6	(1)	(1)	6	8	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	2	9	8	(3)	4	7	(18)	(0)		
1997 vs future with EWA (1 v5)	6	6	(2)	(5)	(6)	15	(14)	(39)	1	15	2	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	8	247	2604	154	1	0	0	(0)	3014	7
today vs future with EWA (3 v5)	0	0	0	0	3	262	2234	(75)	1	0	0	(0)	2425	5
1997 vs future with EWA (1 v5)	0	0	0	0	(7)	460	(5383)	(840)	0	0	0	(0)	(5790)	(13)
2001														
Salvage Number	0	0	0	0	0	2696	14128	1380	0	0	0	0	18204	0
today vs future no EWA (2 v4)	3	0	7	6	2	2	3	0	(7)	(4)	(6)	(6)		
today vs future with EWA (3 v5)	2	3	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	6	0	(10)	(44)	(10)	12	(15)	(6)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	0	66	409	1	0	0	0	0	476	3
today vs future with EWA (3 v5)	0	0	0	0	0	132	(89)	(60)	0	0	0	0	(17)	(0)
1997 vs future with EWA (1 v5)	0	0	0	0	0	0	(1369)	(613)	0	0	0	0	(1982)	(11)
2002														
Salvage Number				6	15	1121	9043	695	24	6	0		10931	0
today vs future no EWA (2 v4)	3	0	7	5	2	2	3	0	(7)	(4)	(6)	(5)		
today vs future with EWA (3 v5)	2	3	10	5	6	5	(1)	(1)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	6	0	(10)	(44)	(10)	12	(15)	(6)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	0	28	262	0	(0)	0	0	0	292	3
today vs future with EWA (3 v5)	0	0	0	3	1	55	(57)	(30)	(1)	0	0	0	(29)	(0)
1997 vs future with EWA (1 v5)	0	0	0	(1)	(1)	0	(876)	(309)	(2)	0	0	0	(1188)	(11)
2003														
Salvage Number	0	0	0	42	24	5208	10382	914	0	0	0	0	16570	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	6	8	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	2	9	8	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(6)	15	(14)	(39)	1	15	2	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	(0)	1	418	687	65	0	0	0	0	1172	7
today vs future with EWA (3 v5)	0	0	0	2	0	443	590	(32)	0	0	0	0	1003	6
1997 vs future with EWA (1 v5)	0	0	0	(2)	(1)	760	(1423)	(356)	0	0	0	0	(1022)	(6)

Table A17: Note

This table presents the combined salvage numbers for spring-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the salvage numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in salvage numbers.

Table A18: Projected Loss numbers for spring-run Chinook salmon under studies 4 and 5



Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Salmon Total	WY
1993														
Salmon Loss	0	0	0			103	5612	7538	40				13299	AN
today vs future no EWA (2 v4)	3	6	(1)	(1)	6	8	7	7	4	[illegible]	(2)	(1)		
today vs future with EWA (3 v5)	6	8	3	6	2	9	6	(3)	4	[illegible]	(10)	(0)		
1997 vs future with EWA (1 v5)	5	6	(2)	(5)	(5)	15	(14)	(39)	1	16	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	0	8	372	537	2	0	0	0	949	7
today vs future with EWA (3 v5)			0	[illegible]	0	9	319	(302)	2	[illegible]	0	0	67	1
1997 vs future with EWA (1 v5)			0	0	0	15	(770)	(2936)	0	0	0	0	(3690)	(28)
1994														
Salmon Loss	0	0				201	3407	1140					4748	C
today vs future no EWA (2 v4)	4	(7)	9	[illegible]	7	10	[illegible]	(2)	(10)	(16)	(22)	(6)		
today vs future with EWA (3 v5)	1	(5)	(4)	6	2	7	1	(9)	(16)	1	(3)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(6)	(6)	7	4	[illegible]	(38)	(12)	4	63	(3)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	0	20	148	(26)	0	0	0	0	143	3
today vs future with EWA (3 v5)			0	0	0	13	243	(102)	0	0	0	0	154	3
1997 vs future with EWA (1 v5)			0	0	0	8	10	(432)	0	0	0	0	(414)	(9)
1995														
Salmon Loss	0				24	237	4909	18599	15092				38862	W
today vs future no EWA (2 v4)	5	6	12	6	2	9	0	6	3	5	(2)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	1	1	4		
1997 vs future with EWA (1 v5)	[illegible]	4	4	(2)	(4)	24	(10)	(33)	4	[illegible]	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	1	22	301	1056	510	0	0	0	1889	7
today vs future with EWA (3 v5)			0	0	1	16	317	685	1520	0	0	0	2538	7
1997 vs future with EWA (1 v5)			0	0	(1)	57	(180)	(6063)	656	0	0	0	(5921)	(15)
1996														
Salmon Loss		0	0	0	30	1555	22538	14113	747				38981	W
today vs future no EWA (2 v4)	5	6	12	4	2	9	4	6	3	5	(2)	6		
today vs future with EWA (3 v5)	6	3	13	0	4	7	0	4	10	7	1	4		
1997 vs future with EWA (1 v5)	[illegible]	4	4	(2)	(4)	24	(10)	(33)	4	[illegible]	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	1	143	1382	801	25	0	0	0	2352	6
today vs future with EWA (3 v5)			0	0	1	103	1454	520	75	0	0	0	2154	6
1997 vs future with EWA (1 v5)			0	0	(1)	373	(2155)	(4601)	27	0	0	0	(6356)	(16)
1997														
Salmon Loss	39	0	0	0	45	16226	36723	3191	23	0	0	0	56299	W
today vs future no EWA (2 v4)	5	6	12	0	2	9	0	6	3	5	(2)	6		
today vs future with EWA (3 v5)	6	3	13	6	4	7	6	4	10	1	1	4		
1997 vs future with EWA (1 v5)	[illegible]	4	4	(2)	(4)	24	(10)	(33)	4	[illegible]	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	2	0	0	0	1	1397	2254	181	7	0	0	0	3838	7
today vs future with EWA (3 v5)	2	0	0	0	2	1012	2373	117	2	0	0	0	3510	6
1997 vs future with EWA (1 v5)	4	0	0	0	(2)	650	(3516)	(1940)	1	0	0	0	(903)	(2)

Table A18: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Annual Total	WY
1998														
Salmon Loss	0	0	0		3	4200	9110	14219	992				28220	W
today vs future no EWA (2 v4)	8	6	12	8	2	9	6	6	3	5	(3)	8		
today vs future with EWA (3 v5)	6	3	13	8	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	(1)	4	4	(2)	(6)	24	(10)	(33)	4	5	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	0	440	497	806	37	0	0	0	1782	6
today vs future with EWA (3 v5)	0	0	0	0	0	319	528	565	110	0	0	0	1478	5
1997 vs future with EWA (1 v5)	0	0	0	0	(0)	1151	(775)	(4635)	40	0	0	0	(4220)	(15)
1999														
Salmon Loss	0	0	1		94	3195	92779	2522	18				128172	W
today vs future no EWA (2 v4)	8	6	12	8	2	9	6	6	3	5	(3)	8		
today vs future with EWA (3 v5)	6	3	13	8	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	(1)	4	4	(2)	(4)	24	(10)	(33)	4	5	5	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	3	293	5657	1861	1	0	0	0	7804	6
today vs future with EWA (3 v5)	0	0	0	0	4	212	5655	1200	2	0	0	0	7373	6
1997 vs future with EWA (1 v5)	0	0	0	0	(4)	766	(8822)	(10025)	1	0	0	0	(18684)	(15)
2000														
Salmon Loss	0	0	0		264	7295	84002	7132	84			16	98801	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	6	8	7	1	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	1	9	6	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	16	586	5660	308	3	0	0	(0)	6672	7
today vs future with EWA (3 v5)	0	0	0	0	5	620	4770	(248)	3	0	0	(0)	5161	5
1997 vs future with EWA (1 v5)	0	0	0	0	(14)	1064	(11513)	(2777)	1	0	0	(1)	(13240)	(13)
2001														
Salmon Loss	0	0	0			7435	28756	5204	0				41394	D
today vs future no EWA (2 v4)	3	0	1	6	4	2	3	0	(7)	(4)	(6)	(8)		
today vs future with EWA (3 v5)	2	3	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	5	0	(10)	(44)	(10)	12	(15)	(5)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	0	182	833	3	0	0	0	0	1018	2
today vs future with EWA (3 v5)	0	0	0	0	0	364	(180)	(228)	0	0	0	0	(45)	(0)
1997 vs future with EWA (1 v5)	0	0	0	0	0	1	(2787)	(2311)	0	0	0	0	(5098)	(12)
2002														
Salmon Loss				21	3	1285	10825	2465	18				14579	D
today vs future no EWA (2 v4)	3	0	1	5	2	2	3	0	(7)	(4)	(6)	(8)		
today vs future with EWA (3 v5)	2	3	10	9	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	5	0	(10)	(44)	(10)	12	(15)	(5)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	1	0	31	313	1	(1)	0	0	0	345	2
today vs future with EWA (3 v5)	0	0	0	2	0	61	(68)	(109)	(1)	0	0	0	(113)	(1)
1997 vs future with EWA (1 v5)	0	0	0	(1)	0	0	(1049)	(1094)	(2)	0	0	0	(2145)	(15)
2003														
Salmon Loss	0	0	0	46	67	12257	27971	2572					42903	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	0	8	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	8	3	5	1	9	6	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	8	6	(2)	(5)	(5)	15	(14)	(39)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	(0)	3	984	1851	183	0	0	0	0	3022	7
today vs future with EWA (3 v5)	0	0	0	2	1	1042	1688	(89)	0	0	0	0	2544	6

Table A18:

This table presents the combined loss numbers for spring-run Chinook salmon recovered at the SWP and CVP export facilities for the eleven year period between 1993 and 2003 according to the Bureau of Reclamation data set. Future changes in the loss numbers are calculated by multiplying the historical salvage value by the percentage of pumping rate change between the baseline value and the future condition in the first block to derive the number of additional fish or reduction in fish projected to occur in the second block. Numbers in parenthesis indicate a reduction in loss numbers.

APPENDIX B - ADDITIONAL FIGURES

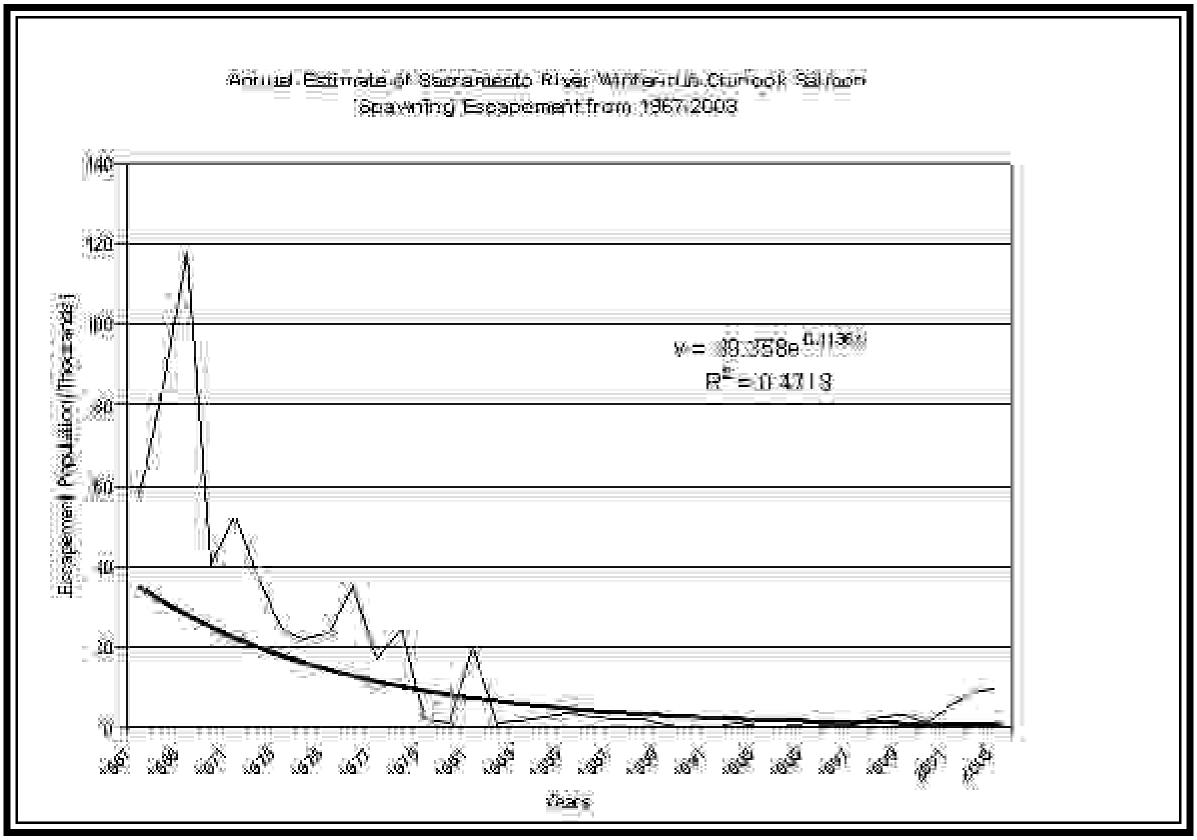


Figure B1:
Annual estimated Sacramento River winter-run Chinook salmon escapement population.
Sources: PFMC 2002, DFG 2004, NOAA Fisheries 1997
Trendline for figure B1 is an exponential function: $Y=39.358\ e^{-0.1136x}$, $R^2=0.4713$.

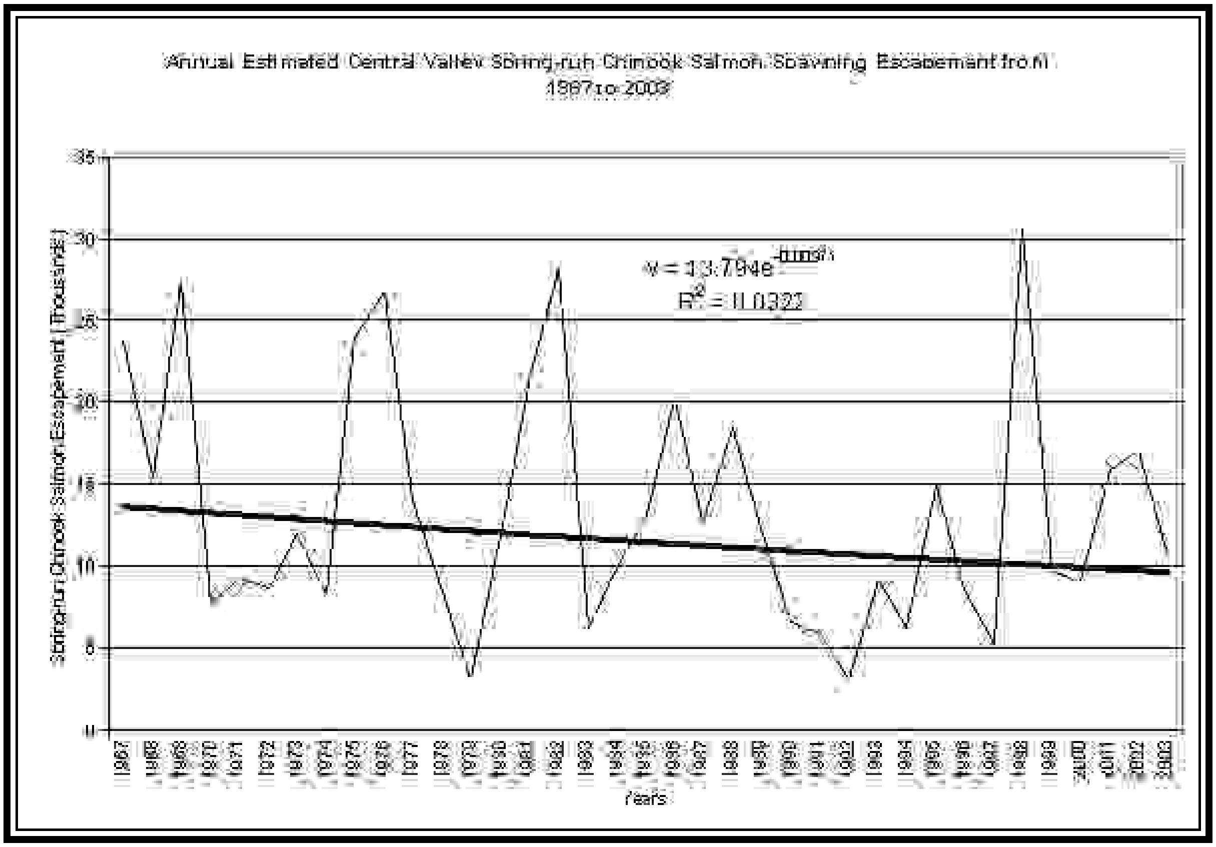
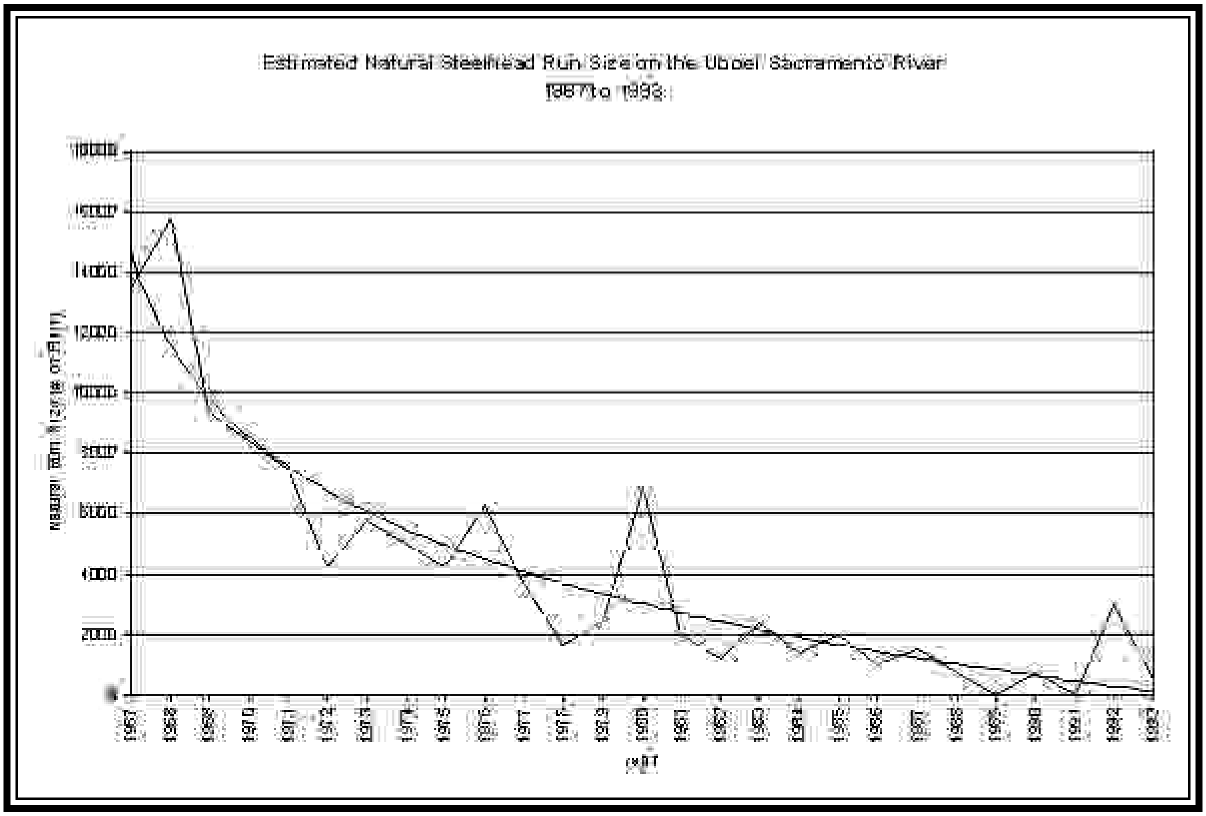


Figure B2:
Annual estimated Central Valley spring-run Chinook salmon escapement population for the Sacramento River watershed for years 1967 through 2003.
Sources: PFMC 2002, DFG 2004, Yoshiyama 1998.
Trendline for figure B2 is an exponential function: $Y=13.794\ e^{-0.0097}$, $R^2 = 0.0322$.



Note: Steelhead escapement surveys at RBDD ended in 1993

Figure B3:
Estimated Central Valley natural steelhead escapement population in the upper SacramentoRiver based on RBDD counts.
Source: McEwan and Jackson 1996.
Trendline for Figure B3 is a logarithmic function: Y= -4419 Ln(x) + 14690 R^2= 0.8574

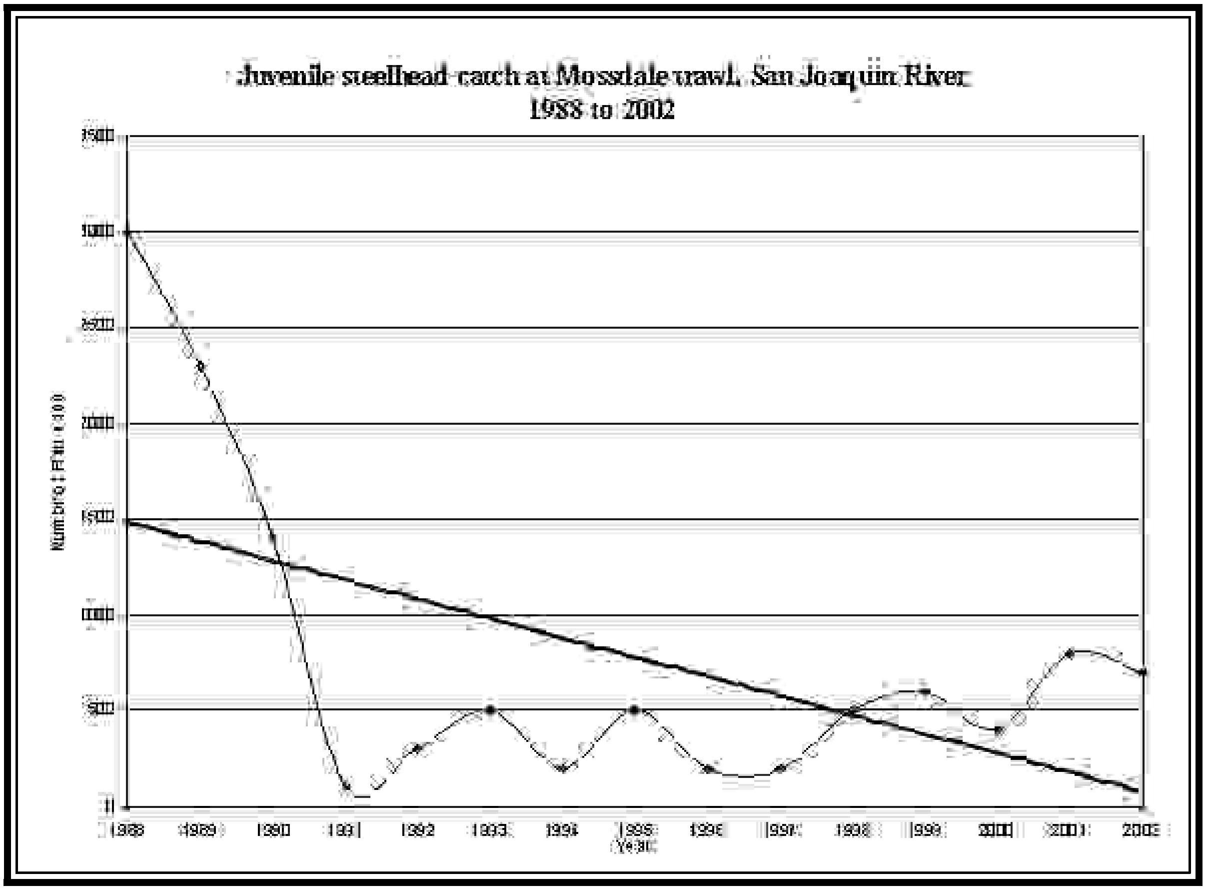


Figure B4:
Estimated number of juvenile Central Valley steelhead derived from the Mossdale trawl surveys on the San Joaquin River from 1988 to 2002.
Source: Marston (DFG), 2003.

Enclosure 2

NOAA FISHERIES - ESSENTIAL FISH HABITAT CONSULTATION

Long-Term Central Valley Project and State Water Project Operations Criteria and Plan (OCAP)

Pursuant to section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens), Federal agencies are required to consult with the Secretary of Commerce (delegated to NOAA Fisheries) with respect to "any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act." In addition, the Magnuson-Stevens Act also provides that the Secretary of Commerce "shall coordinate with and provide information to other Federal agencies to further the conservation and enhancement of essential fish habitat[1]."

This essential fish habitat (EFH) Consultation is based on information received from the Bureau of Reclamation (Reclamation) in a section 7 Biological Assessment (BA) on the OCAP project, and the EFH Assessment (included as Chapter 14), dated June 30, 2004. A description of the project is provided in the BA as Chapter 2.

This consultation involves the EFH of species managed under three different fishery management plans (FMP) and discusses them in the following order: 1) the Pacific Groundfish FMP, 2) the Coastal Pelagic Species FMP, and 3) the Pacific Salmon FMP. With regards to the Pacific salmon FMP, because the accompanying OCAP Biological Opinion provides habitat protection for winter and spring-run Chinook salmon, this EFH consultation pertains only to fall and late-fall run Chinook salmon. In addition, because steelhead are not managed by the Pacific Fishery Management Council (the Council), EFH has not been designated for this species.

1.0 Pacific Groundfish Fishery Management Plan

Starry flounder (*Platichthys stellatus*) are managed under this FMP and were consulted upon by Reclamation because of their interaction with the Delta pumps. Because of the high numbers of fish taken at the pumps, NOAA Fisheries believes that the proposed project will affect the EFH of starry flounder.

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[1] 16 U.S.C. § 1855(b)(1)(D).

EFH Conservation Recommendation:

> NOAA Fisheries recommends that Reclamation should insure that screening and salvage operations are developed that minimize the take of starry flounder. NOAA Fisheries believes that efforts to improve screening and salvaging efforts for fall/late-fall Chinook salmon (which are described further below) recommended will also benefit starry flounder.

2.0 Coastal Pelagic Species Fishery Management Plan

Northern anchovy (*Engraulis mordax*) is the only species managed under this FMP that occurs in the project area. NOAA Fisheries concurs with Reclamation that the proposed project will not affect the EFH of northern anchovy.

3.0 Pacific Salmon Fishery Management Plan

Chinook salmon (*Oncorhynchus tshawytscha*) are the largest of the Pacific salmon. Chinook salmon are highly prized by commercial, sport, and subsistence fishers. The fisheries of healthy Pacific coast chinook salmon stocks are managed by the Council under the Pacific Salmon Fishery Management Plan. Approximately, 80 percent of the California catch comes from the Central Valley as opposed to the Klammath River system (Dan Viele, personal communication). These stocks include fall and late-fall run Chinook salmon from the Klammath and Central Valley systems. In 2003, preliminary estimates of California coastal community and state personal income impacts of the troll and recreational salmon fishery collectively for the Fort Bragg, and San Francisco/Monterey port areas was $27.0 million and $10.7 million, respectively[2].

As noted by the Council, Chinook salmon eggs, alevins, and juveniles in freshwater streams provide an important nutrient input and food source for aquatic invertebrates, other fishes, birds, and small mammals. The carcasses of Chinook adults can also be an important nutrient input in their natal watersheds, as well as providing food sources for terrestrial mammals such as bears, otters, minks, and birds such as gulls, eagles, and ravens. Because of their relatively low abundance in coastal and oceanic waters, Chinook salmon in the marine environment are typically only an incidental food item in the diet of other fishes, marine mammals, and coastal sea birds.

In 1999, the Council identified EFH for Central Valley Chinook stocks to include the Sacramento and San Joaquin rivers and their tributaries as EFH[3]. Freshwater EFH for Chinook salmon consists of four major habitat functions: 1) spawning and incubation; 2) juvenile rearing; 3)

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[2] PFMC. 2004. Review of 2003 ocean salmon fisheries. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, Portland OR, Table IV-16.

juvenile migration corridors; and 4) adult migration corridors and adult holding habitat.[3] Projected impacts associated with the proposed project are expected to eliminate, diminish, and/or disrupt these EFH habitat functions for fall and late-fall run Chinook salmon at many sites within the project area. As concluded in the EFH Assessment prepared by Reclamation, CVP and SWP operations will adversely affects the EFH of fall and late-fall run Chinook salmon.

In developing its EFH Conservation Recommendations, NOAA Fisheries recognized that all appropriate and practicable steps to avoid adverse effects to EFH and measures to minimize remaining adverse affects are constrained due to the existing operational conditions in the Central Valley that have transpired over the lifetime of managing water in the Central Valley. Consequently, available opportunities to avoid and minimize adverse effects may be limited. In addition, the agency's highest priority is to fulfill its conservation mandates for protecting winter and spring-run Chinook salmon, coho salmon and steelhead listed under the Endangered Species Acts (see OCAP Biological Opinion). In some instances, this priority may take precedent over protecting the EFH of fall and late-fall run Chinook salmon for particular locations.

Due to these limitations to avoid and minimize EFH impacts, NOAA Fisheries believes that available conservation measures may be insufficient to offset the expected further deterioration of EFH habitat functions in parts of the project area. Consequently, the agency included EFH Conservation Recommendations that advise Reclamation to consider compensatory mitigation as part of this consultation. As stated in the EFH regulations, the EFH Conservation Recommendations provided by NOAA Fisheries "...may include measures to avoid, minimize, mitigate, or other otherwise offset adverse effects on EFH from actions or proposed actions authorized, funded, or undertaken[4]..." by the Federal action agency. Consequently, the agency believes that in order to provide meaningful EFH Conservation Recommendations for conserving and enhancing EFH, it needs to look beyond options for avoiding and minimizing adverse affects and also include compensatory mitigation for conserving and enhancing Chinook salmon EFH. The use of compensatory mitigation is also consistent with NOAA Fisheries Southwest Region's habitat protection policy.[5]

For this EFH consultation, compensatory mitigation is defined as activities used to offset unavoidable adverse impacts on stream miles and associated habitat functions and values by restoring, enhancing or creating Chinook salmon habitat in other locations. In examining mitigation options, the agency recognizes that the proposed project action occurs within the context of other water dependent operations that can also affect water quality and quantity. Because all aspects of Central Valley water usage are interrelated and interdependent, the agency believes that reasonable opportunities for compensatory mitigation should look beyond the scope

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[3] PFMC. 1999. Identification and description of essential fish habitat, adverse impacts and recommended conservation measures for salmon. Amendment 14 to the Pacific Coast Salmon Plan. PFMC, Portland, OR.

[4] EFH regulations, 50 CFR §600.905 (b)

[5] http://swr.nmfs.noaa.gov/hcd/habitpro.pdf

of the OCAP proposed actions and consider opportunities related to other water dependent operations. That is, in order to properly mitigate, NOAA Fisheries recognizes that Reclamation may need to look beyond its own operations in order to improve the functions and values of Chinook salmon EFH by combining suggested mitigation efforts with other government programs and initiatives as well as with non-regulatory initiatives and partnerships.

The following EFH Conservation Recommendations are divided into two sections. The first deals with specific measures that Reclamation and the California Department of Water Resources (DWR) should consider to avoid and minimize adverse effects. The second section deals with conservation measures that Reclamation and DWR should consider to offset unavoidable impacts.

3.1 EFH Conservation Recommendations to Avoid and Minimize Adverse Effects:

3.1.1 Trinity River

To date restoration projects involving physically altering the riparian berms along the upper 40 miles of the Trinity River have not taken place, yet the corresponding flow increases have been implemented and will increase in the future. Fall-run Chinook salmon have experienced stranding and isolation as a result of the increased flows for the Trinity ROD.

EFH Conservation Recommendations:

3.1.1.1 NOAA Fisheries recommends that the Trinity River Mainstem Fishery Restoration Program as described in the Trinity River SEIS/EIR along with the Trinity River Record of Decision (ROD) flows be implemented. Implementing the restoration program will reduce stranding and isolation of juvenile fall-run Chinook salmon through improvements to EFH.

3.1.2 Upper Sacramento River

Fall/late fall-run Chinook salmon adults migrate up the Sacramento River in late summer through late winter(August -December). Fall-run spawn heavily in the main stem of the Sacramento River, primarily upstream of Red Bluff although a few do spawn just downstream of the Red Bluff Diversion Dam (RBDD). RBDD gates are raised during the majority of the fall-run Chinook salmon migration but some are blocked or delayed prior to September 15 when the gates are raised. The highest density spawning area occurs from the city of Anderson upstream to the first riffle downstream of Keswick Dam.

Fall/late fall-run Chinook salmon spawning the upper Sacramento River is adversely affected in all years when flows are kept high for agricultural demand (i.e., rice decomposition) and then decreased in the fall to conserve water in Shasta Reservoir. Large numbers of fall-run Chinook salmon redds have been dewatered in the upper Sacramento River when flows are lowered after the rice decomposition program is completed and Shasta Dam releases decrease. Consequently, it is anticipated that some redd dewatering will continue in the future condition. Outmigrating Chinook salmon juveniles are also subjected to potential entrainment from several unscreened or substandard screened water diversions located along the river. These diversions adversely affect EFH by disrupting migration and rearing functions from operating properly.

EFH Conservation Recommendations:

3.1.2.1 NOAA Fisheries recommends that Reclamation, working through the appropriate CalFed program, investigate alternatives to the rice decomposition program (i.e., baling rice straw, mulching, etc.), and recommend ways of stabilizing, or increasing flows after September 30, to reduce redd dewatering.

3.1.2.2 NOAA Fisheries recommends that Reclamation encourage the Sacramento River Temperature Control Task Group efforts for managing water temperature throughout the summer in the upper Sacramento River relative to fish habitat conditions and coldwater pool storage in Shasta Reservoir to also consider the habitat needs of fall/late-fall-run Chinook salmon.

3.1.2.3 NOAA Fisheries recommends that Reclamation continue to investigate options to improve passage for all runs of chinook salmon at RBDD above that which is achieved with the current operations of gates open between May 15 and September 15.

3.1.2.4 NOAA Fisheries recommends that Reclamation facilitate the Central Valley Project Improvement Act, Anadromous Fish Screening Program, to expeditiously complete the following projects:

- the Bella Vista Water District screening system should be reviewed for efficacy;
- the unscreened water diversion for the City of Redding Municipal Water Intake;
- the unscreened pumping plants for Sutter Mutual Water Company’s Tisdale, State Ranch Bend Pumping Plant and the Portugese Bend Pumping Plant;
- the Natomas Mutual Water Company’s five pumping plants; and
- the Reclamation District 108 facilities at El Dorado Bend, Steiner Bend, and Rough and Ready plant.

3.1.3 Feather River

Fall-run Chinook salmon compose the largest population of salmonids in the Feather River. Unlike spring–run Chinook salmon, there is a distinct and substantial amount of in-channel spawning and rearing among fall–run Chinook salmon in the Feather River. Spawning activity begins in the low flow channel (LFC) and then gradually intensifies downstream. Typically the peak of spawning occurs about one month earlier in the LFC than in the river below Thermalito Outlet. Approximately two-thirds of the total fall–run Chinook salmon spawning occurs in the

LFC, while roughly one-third occurs below Thermalito Outlet. Due to the success of the Feather River Hatchery (FRH), large numbers of fall–run Chinook salmon spawn in the LFC of the Feather River, often over utilizing the habitat available for spawning. The significant shift in the distribution of Chinook salmon spawning in the Feather River to the upper reach of the LFC may be a major factor affecting any in-channel production of spring-run Chinook salmon resulting from redd superimposition mortality. This results in competition for spawning area in the lower Feather River. Superimposition on spring-run Chinook salmon redds by fall-run Chinook salmon is well documented (DWR 2003). Since fall-run Chinook salmon spawn later in the fall, they may destroy a significant proportion of the redds of earlier spawning spring-run Chinook salmon. This competition, and resulting superimposition of fall–run Chinook salmon redds, is most intense in the LFC where flows are predicted to remain at 600 cfs, and where the highest density of spawning occurs.

The operation of the Oroville Complex has also changed water temperatures in the Feather River. Compared to historical levels, mean monthly water temperatures in the LFC at Oroville are 2^0 to 7^0 F warmer during November through April. Release from the broad, shallow Thermalito Afterbay reservoir probably create warmer conditions than historical levels for at least part of the spring and summer. For the proposed project, water temperatures below Thermalito will be too warm for adult fall run Chinook salmon holding and spawning habitat.

Beside high water temperatures, late migrating juvenile fall run Chinook salmon may be exposed to higher predation rates due to introduced exotics (e.g. striped bass, large-mouth bass, and American Shad).

EFH Conservation Recommendations:

3.1.3.1 NOAA Fisheries recognizes the importance of providing more favorable temperature conditions below the Thermalito outlet for spawning fall-run Chinook salmon. NOAA Fisheries is currently engaged in the FERC licensing process to address temperature, flow, passage, and hybridization issues in this system. Consequently, the agency is deferring its EFH recommendations for mitigating and minimizing those effects to the FERC proceedings rather than present recommendations here that could unnecessarily limit those discussions.

3.1.3.2 DWR should consider EFH conservation by reestablishing endemic trees and other appropriate native vegetation in riparian areas; restoring natural bottom characteristics; removing unsuitable material; adding gravel to promote spawning. All of these activities should be undertaken during appropriate seasons.

3.1.4 American River

Adult fall-run Chinook salmon enter the American River in August and peak migration occurs in October although a few may show up as early as May. Spawning generally begins in late

October or early November and continues through December with a few later fish still spawning in January. Most spawning occurs in the upper 3 miles of river from Goethe Park upstream to Nimbus Dam.

The greatest EFH impact to the America River will result in loss of habitat functions from increased water temperatures and ensuing increases in water demands. Actual water deliveries will more than double from a total of 217,185 TAF to 475,000 TAF by year 2020. Future flows would be lower than under present conditions throughout much of the year due to increased diversions upstream of Folsom. The increased diversions have the potential to adversely impact the spawning habitat of fall-run Chinook salmon. Chinook salmon spawning occurs at water depths greater than 6 inches and flows need to be maintained near or above the level at which spawning occurred in order to maximize survival from egg to fry. River flow levels dropping below the level at which spawning occurs may cause stranding of redds and juvenile Chinook salmon from the initiation of spawning at about the beginning of November until juveniles have emigrated from the river, generally by end of June. While flows are expected to be adequate for fall-run Chinook salmon spawning in normal water conditions, they are projected to provide less than optimal spawning habitat during dry conditions. In fact, reductions could be as great as 700 cfs in February with the Environmental Water Account (EWA) in place, and would result in significantly less rearing habitat available in dry years, affecting juvenile fall-run Chinook salmon much more than juvenile steelhead. Concerns for flow fluctuations causing stranding of redds and juvenile fall-run Chinook salmon from the initiation of spawning to about the beginning of November is noted.

Flow fluctuations during peak spawning periods can significantly decrease egg and fish survival. Under reduce flow conditions in the upper 3 miles (where most of spawning occurs), fish tend to spawn in overlapping areas rather than extending spawning distribution downstream, resulting in redd superimposition. In order to maximize survival from egg to fry, flows need to be maintained near or above the level at which spawning occurred.

It is estimated that 1000 cfs provides 275 areas of spawning habitat; flows of 1,000 cfs or below would occur during October-November in about 20-25 percent of years. Flows in the future would be lower than under present conditions through much of the year due to increased diversion upstream of Folsom. Flows in the river could potentially be as low as 300 cfs in May under driest conditions, however, most juvenile Chinook salmon have left river by May.

Temperatures lower than 60^0 F are considered suitable for Chinook salmon spawning and egg incubation in the American River with preferred temperature being $<56^0$ F. A temperature of 56^0 F or below is best for survival of incubating eggs. Early spawning success is low if water temperature in early November is above 60^0 F. Chinook salmon fry generally emerge from the gravel starting in late December, peaking in February and continuing up through March. Nearly all leave the river as young-of-the-year before the end of June. The preferred water temperature for juvenile Chinook is 53^0 F to 57.5^0 F. Water temperatures generally exceed this range starting in April in over 50 percent of years. Fry do not spend time rearing in the river and juveniles have emigrated from the river, generally by the end of June. Emigrating Chinook salmon are nearly all are pre-smolts suggesting that the smolting process continues downstream of lower American River into the Delta and estuary.

Increased water temperatures will certainly reduced the habitat quality for incubating and rearing fall-run Chinook salmon. The Chinook salmon egg mortality model results indicate that egg to fry water temperature-related mortality will reach or exceed 15 percent in all water years.

EFH Conservation Recommendations:

3.1.4.1 NOAA Fisheries supports efforts to adopt a more prescriptive minimum flow standard in the lower American River. The agency advises that:

a) discussions currently underway between Reclamation, members of the Water Forum, and Management Agencies for modifying Reclamation's water rights permits to effect an increase to minimum flows in the lower American Rivers be ardently pursued; and

b) flows for spawning and rearing fall-run Chinook salmon be optimized considering the needs of steelhead and other aquatic species.

3.1.4.2 NOAA Fisheries recognizes that meeting temperature objectives for steelhead during the summer and for fall-run Chinook salmon in the fall may be problematic. Conflicting demands between whether to use more cool water during the summer for steelhead rearing or holding some to increase the spawning success of Chinook in the fall will need to be reconciled. However, a temperate control management strategy/plan should be developed for extending the effectiveness of cold water management in the lower river that balances the cold water needs of steelhead during the summer months with cold water needs for returning and spawning (eggs to fry water temperature related mortalities are expected to increase) fall-run Chinook salmon during the fall months. Coordinated efforts such as temperature curtains in Lake Natomas, temperature shutters at Folsom Dam, and a new water intake for El Dorado Irrigation District to conserve the cold water pool at Folsom Dam should be vigorously pursued.

3.1.5 Stanislaus River

The Stanislaus River is the northernmost tributary in the San Joaquin River basin used by Chinook salmon. The river now supports fall-run Chinook salmon and small populations of late-fall-run Chinook salmon.

Flows are projected to be adequate for fall-run Chinook salmon spawning in nearly all years but temperatures will be warm in the lower part of the river during the early part of the adult immigration period. Under dry conditions, flows may be less than desirable for optimal outmigration prior to the VAMP period.

EFH Conservation Recommendations:

3.1.5.1 Reclamation should continue funding the development of a water temperature model for identifying optimization strategies for cold water releases from the New Melones Reservoir with consideration to fall-run Chinook salmon as well as steelhead.

3.1.6 Delta Ecosystem

Juvenile fall and late-run Chinook salmon normally migrate down from the Sacramento and San Joaquin River basins through the rich feeding grounds of the Delta, to the San Francisco Estuary and into the towards the Pacific Ocean. The suitability of the Delta migration corridor as part of juvenile salmon rearing EFH is reduced by various aspects of the proposed project. Adverse impacts to EFH may complicate normal habitat functions by extending migration routes (*i.e.*, complex channel configurations make it difficult for salmon to find their way to the ocean), increasing water temperatures, increasing susceptibility to predators, and adding direct mortality from salvage and entrainment operations.

Once juvenile salmon are in the vicinity of the SWP and CVP export water diversion facilities, they are more likely to be drawn into these facilities during water diversion operations. Water transfers would increase Delta exports from 200 TAF-600 TAF in about 80 percent of years and potentially up to 1MAF in some dry and critical years. With exports increasing in the future with the implementation of the project, and assuming that entrainment is directly proportional to the amount of water exported, the potential exist for these diversions to adversely affect the ability of outmigrating late fall/fall-run Chinook salmon to utilize the habitat as they normally would. While screening facilities allow for many fish longer than 38 mm to be salvaged , considerable mortality is believed to occur when fish are less than 38 mm. In addition, smaller fish are not screened effectively.[6,7]

Though there are efforts in place to minimize entrainment, the Tracy Fish Collecting Facility (TFCF) primary louver (screen) panels cannot be cleaned without leaving gaping openings in the screen face. Further, cleaning the secondary channel and louver panels takes the entire facility off-line. Also, during secondary louver screen cleaning operations, and secondary channel dewatering, the entire secondary system is shut down. As a result, all fish salvage is compromised for the duration of the outage. This loss in fish protection allows unscreened water to pass through the facility 25 percent of the time and results in underestimating the loss of Chinook salmon to the pumps. Also, significant delays in routine maintenance and replacement of critical control systems at the TFCF can occur. Finally, the TFCF was designed for a

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[6] Kimmerer, W. J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco Estuary. Estuary 25:1275-1290.

[7] Brown, R., S. Greene, P. Coulston, and S. Barrow. 1996. An evaluation of the effectiveness of fish salvage operations at the intake to the California Aqueduct, 1979-1993. *In* J. T. Hollibaugh (ed.) San Francisco Bay: The Ecosystem. AAAS, San Francisco, CA. Pp. 497-518.

maximum export rate of 4600 cfs, the rated capacity of the Tracy Pumping Plant (TPP).

With regards to the John E. Skinner Fish Facility, there is currently no standard method for reporting problems associated with the operation and maintenance of the facility. Delays in routine maintenance and replacement of critical control systems at the facility are not being reported to NOAA Fisheries, as they are experienced.

A fish barrier at the head of Old River is intended to limit the movement of both water and outmigrant Chinook salmon into Old River. The effect is to increase survival down the San Joaquin River past the Port of Stockton, where they encounter Sacramento River flows to the export facilities in the south Delta. Recent telemetry studies conducted as part of the VAMP confirm the diversion of Chinook salmon outmigrants to the CVP and SWP facilities in the south Delta (Vogel 2004[8]).

In addition, the fish barrier is again placed to improve adult Chinook salmon returns in the San Joaquin River. A recent study has found that the placement of the barrier in the fall improves the dissolved oxygen content in the Stockton ship channel, downstream to the head Old River in the San Joaquin River.[9] Having poor water quality/low dissolved oxygen in the ship channel has become a fish passage problem for returning adult salmon.[10]

The projects are now challenging the need for fish screens, based on cost, without serious consideration of impacts to Chinook salmon. At the present time, fish screening actions that are called for in both State and Federal statutes (CVPIA section 3406 (21)) are falling behind the compliance timetable in the existing CVPIA permits. So is progress to meet the “doubling goal” of the CVPIA Anadromous Fish Restoration Program.

EFH Conservation Recommendations:

Central Valley Project (Reclamation)

Delta Cross-Channel Gates

3.1.6.1 To increase the survival of out-migrating fall/late-fall-run Chinook salmon, NOAA Fisheries recommends that the DCC gates should be closed as early as possible, under an adaptive management program based on monitoring outmigrant movements, but

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[8] Vogel, David A. 2004. Juvenile Chinook Salmon Radio-Telemetry Studies in the Northern and Central Sacramento-San Joaquin Delta 2002-2003. Draft Report. Natural Resource Scientists, Inc. Red Bluff, CA. January 2004.

[9] Hallock, R. J., Elwell, R.F. and D.H. Fry, Jr. 1970. Migrations of adult king salmon, *Oncorhynchus tshawytscha*, in the San Joaquin Delta. California Dept. of Fish and Game Bulletin 151. Sacramento CA. 92 p.

[10] Lee, G. F. 2003. August and September 2003 SJR DWSC Flow and DO. Report submitted to SJR DO TMDL Steering Committee, by G. Fred Lee & Associates, El Macero, CA.

no later than on December 1 of each year, unless NOAA Fisheries approves a later date. The DCC gates should remain closed for the protection of Pacific salmonids until June 15 of each year, unless NOAA Fisheries approves an earlier date. Water quality considerations in the Delta will be one cause for a request to vary from these dates.

Tracy Fish Collection Facility (TFCF)
3.1.6.2 At the TFCF, Reclamation should submit to the NOAA Fisheries for approval, one or more solutions to the problem of Chinook salmon losses associated with cleaning the primary louvers, by no later than 12 months from the date of issuance of this document. In the event that a solution is not be in place within 24 months of the issuance of this document, NOAA Fisheries recommends that export pumping at the Tracy Pumping Plant should cease during louver screen cleaning operations.

3.1.6.3 With regard to the secondary louver screen cleaning and secondary channel dewatering at TFCF, Reclamation should submit to NOAA Fisheries for approval, one or more solutions to this problem no later than 12 months from the date of issuance of this document. Should a solution not be in place within 24 months of the date of issuance of this document, NOAA Fisheries recommends that export pumping at the Tracy Pumping Plant should cease during outages of the secondary system, such as the secondary louver screen cleaning operations, debris removal and predator management programs.

3.1.6.4 Beginning on the first day of the month following the issuance of this document, and monthly thereafter, Reclamation should submit a TFCF Status Report to the NOAA Fisheries Engineering Team Leader. The report should be in a format acceptable to both parties, but should describe the status of each component of the fish salvage system, and should provide a schedule for the correction of each deficiency.

3.1.6.5 NOAA Fisheries staff (scientific and enforcement) should be permitted reasonable access to the TFCF, and its records of (i) operation, (ii) fish salvage, and (iii) fish transportation and release activities, during both announced and unannounced inspection visits. Records of research activities conducted at the TFCF are also included in this recommendation.

3.1.6.6 NOAA Fisheries recommends that Reclamation undertake ways to reduce predation on juvenile fall/late-fall-run Chinook salmon by undertaking predator removal studies at the Tracy facility and also at post-release sites for salvaged juveniles. Loss calculations should be adjusted pending results of these studies.

Tracy Pumping Plant
3.1.6.7 A plan to limit TPP exports to 4600 cfs should be prepared and implemented. This restriction should remain in place until a plan to expand the TFCF capacity is prepared, approved by NOAA Fisheries, and implemented.

3.1.6.8 Reclamation should promptly execute a renewal of the Tracy Pumping Plant Mitigation Agreement between Reclamation and CDFG, to offset unavoidable losses of Chinook salmon at the TFCF. The renewed agreement should provide for: a) An annual payment of $740,000 (adjusted for inflation (1994 to 2004) and for the current level of annual losses), as required in the last amendment of the agreement; b) Annual adjustments for facility improvements implemented by Reclamation; c) Annual adjustments for operation of the TFCF outside the criteria for the facility. Discretion provided in existing permits and agreements (such as D-1630 - Table 2) shall not be used to mask facility inadequacies and operational decisions from this adjustment; and d) NOAA Fisheries shall have review and approval over all future agreements and/or amendments for this term.

State Water Project (DWR)

JE Skinner Delta Fish Facility

3.1.6.9 Beginning on the first day of the month following the issuance of this document, and monthly thereafter, DWR should submit a JE Skinner Delta Fish Facility Status Report to the NOAA Fisheries Engineering Team Leader. The report should be in a format acceptable to both parties, but should describe the status of each component of the fish salvage system, and provide a schedule for correcting each deficiency.

3.1.6.10 NOAA Fisheries staff (scientific and enforcement) should be permitted reasonable access to the JE Skinner Delta Fish Protective Facility and its records of (i) operation, (ii) fish salvage, and (iii) fish transportation and release activities, during both announced and unannounced inspection visits. Records of research activities conducted at the facility are also included in this recommendation.

3.1.6.11 NOAA Fisheries recommends that DWR undertake ways to reduce predation on juvenile fall/late-fall-run Chinook salmon by undertaking predation management studies at post-release sites for salvaged juveniles.

3.1.6.12 NOAA Fisheries recommends that alternatives to reduce “pre-screen” losses (predation) in Clifton Court Forebay be evaluated. At minimum, the proposal to “re-connect the Forebay” downstream of the fish screens, shall be evaluated.

CVP and SWP Fish Hauling Protocols

3.1.6.13 Fish hauling runs for salmonids should be scheduled at least every 12 hours, or more frequently if required by the “Bates Table” calculations (made at each count and recorded on the monthly report).

South Delta Improvement Project

3.1.6.14 For the Head of Old River Barrier (HORB), fish barrier, NOAA Fisheries supports designing a permanent structure as proposed in the project to improve the water quality in the San Joaquin River, which also would benefit year round fish passage of outmigrants and returning adults.

3.1.6.15 For the agricultural barriers and barrier at Old River, NOAA Fisheries recommends that all diversions served from the waterways serviced by these facilities be screened, to protect the fishery from losses caused by these diversions.

Freeport Regional Water Project, Rock Slough Intake and other Fish Screening Projects, including CVPIA-AFSP

3.1.6.16 NOAA Fisheries recommends that Reclamation ensure that the Projects (CVP and SWP) aggressively move to get the CVPIA - Anadromous Fish Screening Program fully engaged, with appropriate funding, and implement the major projects already designed.

3.1.6.17 Until the Rock Slough diversion is screened, pumping at this site should be avoided whenever Chinook salmon are detected in the vicinity of the intake. The Contra Costa Water District (CCWD) should use its two screened diversions (Los Vaqueros-Old River and Mallard Slough), and the storage in the Los Vaqueros Reservoir, to offset this restriction.

A monitoring plan, approved by NOAA Fisheries, shall be implemented, and continued until such time as the use of the unscreened Rock Slough diversion is resolved.

3.2 EFH Conservation Recommendations to Mitigate Unavoidable Impacts

As mentioned in the introductory text, NOAA Fisheries recognizes that many of the expected adverse impacts to fall and late-fall run Chinook salmon EFH cannot be avoided or adequately minimized. Consequently, the agency believes that the proposed project presents a net negative impact to EFH. NOAA Fisheries is recommending several measures that may effectively offset these impacts. They are offered in the context of the general responsibility that Reclamation has to evaluate options for improving fish mitigation.[11]

3.2.1 Water Use Efficiency

The operation of the Central Valley Project and the State Water Project is to divert, store and convey water from the southern portion of the Sacramento-San Joaquin Delta to other parts of the state consistent with applicable law require targeting known water quantities for coordinating operations. There is little doubt that all Reclamation water contracts under the Central Valley Project could benefit from improved measurement, accounting, and compliance. The accuracy of

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[11] "The Secretary of the Interior is further authorized and directed to conduct feasibility investigations of opportunities to mitigate damages to or enhance fish and wildlife as a result of increasing the amount of water available for such purposes because of water conservation efforts on Federal reclamation projects" (16USC12(1)).

water diversion measurement could be improved by employing state of the art technology, as well as sufficient monitoring and calibration checks to guarantee on-going accuracy. NOAA Fisheries recommends building into the contracts incentives through water payment reductions for voluntarily adopting water conservation programs (many Districts already have programs)

EFH Conservation Recommendation:

3.2.1.1 As a means to offset potential adverse affects to EFH, NOAA Fisheries recommends that Reclamation working with appropriate CalFed programs, perform (or commission) an agricultural water-use efficiency study, using existing scientific literature and/or new research as required, to consider (but not limited to) the following questions: a) What are the current spatial and temporal irrigation patterns that dominate Central Valley agriculture?; b) What is the efficacy of current cropping patterns (those specific crops that are currently grown) under irrigated agriculture from a 'water consumption' per 'economic unit output' standpoint?; c) What would be the socio-economic and political impacts of altering Central Valley cropping patterns to promote increased water use efficiency by replacing water intensive crops (e.g.-rice) with more water-efficient crops?; d) Are Central Valley irrigation methods and procedures in accordance with the most modern knowledge and technological capabilities?; e) If new water-saving technologies or methods can be identified, how much time and money would it take to deploy them on a widespread basis in the Central Valley.

3.2.2 Fish Passage

As noted above, opportunities to avoid or minimize adverse affects to EFH in specific project area may be constrained and the potential for substantive habitat gains in these areas is minimal. Yoshiyama et al. (2001)[12] noted that the primary cause in the reduction of instream habitat for Chinook salmon has been the construction of dams and other barriers. Many of the direct adverse impacts to fall and late-fall run EFH or the indirect impacts caused by these runs to the EFH of other Chinook runs could be alleviated if fish passage were provided. In Central Valley watersheds, dams block 95% of historic salmonid spawning habitat. Additionally, non-federal FERC licensed dams account for approximately 40% of all surface water storage in the Central Valley. As a result, Chinook salmon are extirpated from approximately 5,700 miles of their historic habitat in the Central Valley. In most cases the habitat remaining is restricted to the valley floor where it was historically limited to seasonal migration use only. Remnant populations below these dams are now subject to intensive river regulation and to further direct and indirect impacts of hydroelectric operations.

EFH Conservation Recommendation:

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[12] Yoshiyama, R.M., F. W. Fisher and P. B. Moyle. 2001. Historical and present distribution of Chinook salmon in the Central Valley Drainage of California. IN Contributions to the Biology of Central Valley Salmonids, Vol. 1, Randall Brown (ed.).

3.2.2.1 NOAA Fisheries recommends that Reclamation consider evaluating fish passage opportunities for late fall/fall-run Chinook salmon at all CVP dams and consider modified operations at RBDD to minimize delays in upstream migration until a permanent solution at RBDD is in place (Recommendation 3.1.2.3) . Use of Tracy Mitigation funds to restore passage and improve habitat in upstream tributaries as well as improvements in screening efficiency and transportation at the Delta fish collection facilities should be considered.

3.2.3 Increased Water Releases in San Joaquin River

Historically, the upper San Joaquin River supported spawning and rearing habitat for the southernmost stocks of fall run Chinook salmon. Since completion of Friant Dam, most of the water in the river has been diverted for agricultural and other uses, with the exceptions of releases to satisfy riparian water rights upstream of Gravelly Ford and flood releases. As a result, the reach from Gravelly Ford to Mendota Pool is often dry, does not currently support a continuous natural riparian and aquatic ecosystem, and is the reason why Chinook salmon are extirpated from the San Joaquin River above the Mendota Pool. In addition, instream flows in the balance of the San Joaquin River have been inadequate for the downstream sustenance of healthy Chinook salmon populations. One option available for mitigating unavoidable adverse effects is to restore degraded habitat to properly functioning conditions. Consequently, restoring the Upper San Joaquin River ecosystem and simultaneously improving water quality in the San Joaquin River/Delta can mitigate for impacts to fall run and late-fall Chinook salmon in other parts of the Central Valley.

EFH Conservation Recommendation:

3.2.3.1 NOAA Fisheries recommends that Reclamation should seek opportunities to restore adequate instream flows, and any necessary fish passage facilities, to restore fall-run Chinook salmon EFH on the San Joaquin River. NOAA Fisheries recommends that efforts to restore the ecosystem of the Upper San Joaquin River and its water quality should meet the objectives be coordinated within the CALFED Programmatic Environmental Impact Statement /Environmental Impact Report (PEIS/EIR) Record of Decision (ROD), which also recommended evaluating water storage in the upper San Joaquin River basin. Reclamation should take the lead on these efforts and fully coordinate with other entities involved in restoring San Joaquin flows. Reclamation should also coordinate with other efforts and actions underway on the Merced, Tuolumne, Stanislaus, Calaveras, and Mokelumne/Cosumnes rivers (Lower San Joaquin River). NOAA Fisheries finds that the above recommendation will reconnect the Upper San Joaquin River and Lower San Joaquin River, resolve the water quality problems, fish passage issue, and improve fall-run Chinook salmon habitat.

3.2.4 Merced Hatchery

Merced Hatchery was built to help mitigate for the SWP Delta pumping plant and the loss of habitat on the Merced River. There are plans by the State of California to close it.

EFH Conservation Recommendation:

3.2.4.1 If the hatchery is closed, NOAA Fisheries recommends that an equivalent amount of habitat restoration efforts, beneficial to the habitat needs of fall-run and late fall-run Chinook salmon, should be implemented and monitored. Both the habitat restoration plan and the monitoring plan shall be submitted to NOAA Fisheries for approval before implementation.

3.2.5 Monitoring

NOAA Fisheries recognizes the importance of monitoring the status of fall/late-fall-run Chinook salmon for the purpose of adaptively managing Project operations.

EFH Conservation Recommendation:

3.2.5.1 Monitoring of fall/late-fall run Chinook salmon necessary to ensure that project mitigation obligations are being met, and are not causing detrimental effects on remaining populations of aquatic organisms, to include carcass surveys, population estimates, redd surveys, and outmigrant trapping, shall be continued without interruption.

3.2.5.2 Marking of all hatchery origin fish produced for the projects shall be included in this element.

4.0 Responsibilities of Reclamation

As required by section 305(b)(4)(B) of the Magnuson-Stevens Act, Reclamation must provide a detailed response in writing to NOAA Fisheries (and to any Council commenting on the action under section 305(b)(3)) within 30 days after receiving the EFH Conservation Recommendations. The response must include a description of measures proposed by Reclamation for avoiding, mitigating, or offsetting the impact of the project on EFH. In the case that the response is inconsistent with NOAA Fisheries' Conservation Recommendations, Reclamation must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NOAA Fisheries over the anticipated effects of the actions and the measures needed to avoid, minimize, mitigate, or offset such effects.