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).

[illegible]													
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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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. <u>Long-term Contracts</u>

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. <u>Sacramento River Winter-run Chinook Salmon</u>

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. <u>Central Valley Spring-run Chinook Salmon</u>

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. <u>Sacramento River winter-run Chinook salmon</u>

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 °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 °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 °F 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 °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.

XIII. LITERATURE CITED

Aceituno, M.E. 1993. The relationship between instream flow and physical habitat availability for Chinook salmon in the Stanislaus River, California. FWS Ecological Services, Sacramento Field Office. 71 pages.

Adams, B.L., W.S. Zaugg, and L.R. McLain. 1973. Temperature effect on parr-smolt transformation in steelhead trout (*Salmo gairdneri*) as measured by gill sodium-potassium stimulated adenosine triphosphatase. Comparative Biology and Physiology 44A:1333-1339.

Alderdice, D.F. and F.P.J. Velsen. 1978. Relation between temperature and incubation time for eggs of Chinook salmon (*Oncorhynchus tshawytscha*). Journal of the Fisheries Research Board of Canada 35.

Allen, M.A., and T.J. Hassler. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates. (Pacific Southwest), Chinook salmon. U.S. Fish and Wildlife Report 82 (11.49). April 1986.

Alley, D.W. 2000. Comparisons of juvenile steelhead densities, population estimates, and habitat conditions for the San Lorenzo River, Santa Cruz County, California, 1995-1999; with an index of adult returns. Prepared for the City of Santa Cruz Water Dept., Santa Cruz County Environmental Planning, and the San Lorenzo Valley Water District. Project No. 150-03. June 2000.

Ayers and Associates, 2001. Two-dimensional modeling and analysis of spawning bed mobilization, Lower American River. Prepared for the U.S. Army Corps of Engineers, Sacramento District Office.

Azevedo, R.L., and Z.E. Parkhurst. 1958. The upper Sacramento River salmon and steelhead maintenance program, 1949-1956. FWS Office Report. 96 pages.

Bailey, E.D. 1954. Time pattern of 1953-1954 migration of salmon and steelhead into the upper Sacramento River. California Department of Fish and Game, unpublished report. 4 pages.

Baker, P.F., T.P. Speed, and F.K. Ligon. 1995. Estimating the influence of temperature on the survival of Chinook salmon smolts (*Oncorhynchus tshawytscha*) migrating through the Sacramento-San Joaquin River Delta of California. Canadian Journal of Fisheries and Aquatic Sciences 52:855-863.

Baker, P.F., and J.E. Morhardt. 2001. Survival of Chinook salmon smolts in the Sacramento-San Joaquin Delta and Pacific Ocean. Pages 163-183 *in* R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids. Volume 2. California Department of Fish and Game, Fish Bulletin 179.

Barnhart, R.A. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest), steelhead. U.S. Fish and Wildlife Service, Biological Report 82 (11.60), 21 pages.

Beacham, T.D., and C.B. Murray. 1990. Temperature, egg size, and development of embryos and alevins of one species of Pacific salmon: a comparative analysis. Transactions of the American Fisheries Society 119:927-945.

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6. 275 pages.

Bell, M.C. 1973. Fisheries handbook of engineering requirements and biological criteria. U.S. Amy Corps of Engineers, Portland, OR.

Bell, M.C. 1986. Fisheries handbook of engineering requirements and biological criteria (second edition). U.S. Army Corps of Engineers, Portland, OR.

Bell, M.C. 1991. Fisheries handbook of engineering requirements and biological criteria (third edition). U.S. Army Corps of Engineers, Portland, OR.

Berejikian, B.A., E.P. Tezak, S.L. Schroder, T.A. Flagg, and C.M. Knudsen. 1999. Competitive differences between newly emerged offspring of captive-reared and wild coho salmon. Transaction of the American Fisheries Society 128:832-839.

Bilby R.E. 1984. Removal of woody debris may affect stream channel stability. Journal of Forestry 82:609-613.

Bjornn T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. American Fisheries Society Special Publication 19:83-138.

Boles, G. 1988. Water temperature effects on Chinook salmon (*Oncorhynchus tshawytscha*) with emphasis on the Sacramento River: a literature review. Report to the California Department of Water Resources, Northern District. 43 pages.

Bolton, S. and J. Shellberg. 2001. Ecological issues in floodplains and riparian corridors. Submitted to the Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. 144 pages.

Botsford, L.W. 1994. Extinction probabilities and delisting criteria for Pacific salmonids. *In*: Past and Present Status of Central Valley Chinook Salmon. Conservation Biology 8:873-875.

Botsford, L.W., and J.G. Brittnacher. 1998. Viability of Sacramento River winter-run Chinook salmon. Conservation Biology 12:65-79.

Boussu, M.F. 1954. Relationship between trout populations and cover in a small stream. Journal of Wildlife Management 18:229-239.

Bovee, K.D. 1978. Probability of use criteria for the Family Salmonidae (Instream Flow Information Paper No. 4, FWS/OBS-78-07). Washington D.C., U.S. Fish and Wildlife Service, Division of Biological Services, Western Energy and Land Use Team. 79 pages.

Brandes, P. 2004. Conceptual model for evaluating benefits of the Environmental Water Account. Prepared for the CALFED EWA Review Panel. 4 pages.

Brandes P., K. Perry, E. Chappell, J. McLain, S. Greene, R. Sitts, D. McEwan, and M. Chotkowski. 2000. Delta Salmon Project Work Team: Delta Juvenile Salmon Monitoring Program Review. Prepared for the Interagency Ecological Program. 150 pages.

Brandes, P.L. and J.S. McLain. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin Estuary. Pages 39-138 *in* R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids. California Department of Fish and Game, Fish Bulletin 179, Volume 2.

Brett, J.R. 1952. Temperature tolerance of young Pacific salmon, genus *Oncorhynchus*. Journal of the Fisheries Research Board of Canada 9:265-323.

Brown, L.R, and P.B. Moyle. 1991. Status of coho salmon in California. Prepared for the National Marine Fisheries Service , Environmental and Technical Services Division, Portland, OR. 114 pages.

Brown, L.R., P.B. Moyle, and R.M. Yoshiyama. 1994. Historical decline and current status of coho salmon in California. North American Journal of Fisheries Management 14:237-261.

Brown, R., and W. Kimmerer. 2003. Interpretive Summary of the 2003 EWA Chinook Salmon Workshop. Prepared by the EWA Science Advisors for Sam Luoma, Lead Scientist, California Bay-Delta Authority. September 2003. 23 pages.

Busby, P.J., T.C. Wainright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz and, I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon and California. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-27. 261 p.

CALFED Bay-Delta Program. 1999. Ecosystem Restoration Program Plan, Volumes I and II. Technical Appendix to Draft PEIS/EIR. June 1999.

CALFED Bay-Delta Program. 2000. Programmatic Record of Decision. August 28, 2000. 82 pages plus appendices and attachments.

CALFED Bay-Delta Program. 2003. Annual review of the 2002-2003 Environmental Water Account. Presented by the independent EWA Review Panel, October 15-17, 2003 at the Grand Plaza Ballroom, Sacramento, CA. 19 pages.

CALFED Bay-Delta Program. 2004. Environmental Water Account Implementation 2001-2003. Draft report prepared for the re-initiation of consultation on portions of the CALFED Bay-Delta Program by the management agencies. April 26, 2004. Sacramento, CA. 30 pages.

California Advisory Committee on Salmon and Steelhead. 1988. Restoring the balance. California Department of Fish and Game. Sacramento.

California Department of Boating and Waterways. 2000. Biological assessment for Egeria Densa Control Program and two-year Komeen research trials. May 15, 2000. 137 pages.

California Department of Fish and Game. 1965. California Fish and Wildlife Plan, Volume I: Summary. 110 pages.; Volume II: Fish and Wildlife Plans, 216 pages; Volume III: Supporting Data, 1802 pages.

California Department of Fish and Game. 1994. Petition to the California Board of Forestry to list coho salmon (*Oncorhynchus kisutch*) as a sensitive species. California Department of Fish and Game Report, 35 pages plus appendices. *In* Weitkamp *et al.* (1995).

California Department of Fish and Game. 1995. Letter to M. Schiewe for the Endangered Species Act Administrative Record for west coast steelhead, dated 30 March 1995, 10 pages plus attachments.

California Department of Fish and Game. 1998. Report to the Fish and Game Commission. A status review of the spring-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River Drainage. Candidate species status report 98-01.

California Department of Fish and Game. 1999. Central Valley Salmon and Steelhead Harvest Monitoring Project: Angler Survey for 1998. Funded by FWS, Comprehensive Assessment and Monitoring Program (CAMP) pursuant to the CVPIA PL-102-575.

California Department of Fish and Game. 2000a. Natural versus hatchery proportions of juvenile salmonids migrating through the Klamath River estuary and monitor natural and hatchery juvenile salmonid emigration from the Klamath River basin. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Project Number F-51-R-6. Project No. 17. Job No. 1&2.

California Department of Fish and Game. 2000b. Central Valley Salmon and Steelhead Harvest Monitoring Project: Angler Survey for 1999. Funded by FWS, Comprehensive Assessment and Monitoring Program (CAMP) pursuant to the CVPIA PL-102-575.

California Department of Fish and Game. 2000c. Spring-run Chinook salmon annual report. Prepared for the California Fish and Game Commission. Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento. 19 pages.

California Department of Fish and Game. 2001a. Re: Stanislaus River, Goodwin Dam New Melones Dam historical blockage.

California Department of Fish and Game. 2001b. Natural versus hatchery proportions of juvenile salmonids migrating through the Klamath River estuary and monitor natural and hatchery juvenile salmonid emigration from the Klamath River basin. Annual Performance Report. Federal Aid in Sport Fish Restoration Act. Project Number F-51-R-6. Project No. 17. Job No. 1&2.

California Department of Fish and Game. 2001c. Draft Fishery Management and Evaluation Plan.

California Department of Fish and Game. 2001d. Central Valley Salmon and Steelhead Harvest Monitoring Project: Angler Survey for 2000. Funded by FWS, Comprehensive Assessment and Monitoring Program (CAMP) pursuant to the CVPIA PL-102-575.

California Department of Fish and Game. 2002a. Spring-run Chinook salmon annual report. Prepared for the California Fish and Game Commission. Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento.

California Department of Fish and Game. 2002b. Status review of California coho salmon north of San Francisco. Prepared for the California Fish and Game Commission. Candidate species status review report 2002-3. Sacramento. 232pp.

California Department of Fish and Game. 2002c. Sacramento River winter-run Chinook Salmon biennial report 2000-2001. Prepared for the California State Fish and Game Commission. Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento. 25 pages.

California Department of Fish and Game. 2002d. Pre-screening evaluation of salmonid entrainment in Ruddle Ditch. A small riparian diversion on the Merced River. San Joaquin Valley Southern Sierra Region, La Gange Field Office. 3 pages.

California Department of Fish and Game. 2003a. Memorandum to Madelyn Martinez (NOAA Fisheries) regarding steelhead populations in the San Joaquin River basin. 4 pages.

California Department of Fish and Game. 2003b. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. Species Recovery Plan Report 2003-1.

California Department of Fish and Game. 2004a. Freshwater Sport Fishing Regulations 2004-2006. California Fish and Commission and Department of Fish and Game, Sacramento.

California Department of Fish and Game. 2004b. Status of the Fish Passage Assessment Program. March 2004. Sacramento. 4 pages

California Department of Fish and Game. 2004c. Sacramento River spring-run Chinook salmon 2002-2003 biennial report. Prepared for the California Fish and Game Commission. Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento. 35 pages.

California Department of Fish and Game. 2004d. Sacramento River winter-run Chinook salmon 2002-2003 biennial report. Prepared for the California Fish and Game Commission. Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento. 22 pages.

California Department of Fish and Game. 2004e. Sacramento River winter-run Chinook salmon escapement survey, April-September 2003. Salmon and Steelhead Assessment Project Technical Report No. 04-1. 36 pages with appendices.

California Department of Fish and Game and National Marine Fisheries Service. 2001. Final report on anadromous salmonid fish hatcheries in California. Joint Hatchery Review Committee. December 2001.

California Department of Water Resources. 1986. Clear Creek Fishery Study. Northern District. Red Bluff.

California Department of Water Resources. 1993a. Sacramento-San Joaquin Delta Atlas. 121 pages.

California Department of Water Resources. 1993b. Upper Sacramento River habitat modeling progress report, end of phase 1. Northern District. Technical Information Report, TIR ND-93-01. 66 pages.

California Department of Water Resources. 1999a. Feather River study, Chinook salmon emigration survey, March - June 1996. Draft report. June 1999.

California Department of Water Resources. 1999b. Feather River study, Chinook salmon emigration survey, October - December 1996. Draft report. June 1999.

California Department of Water Resources. 1999c. Feather River study, Chinook salmon emigration survey, December 1997 - June 1998. Draft report. June 1999.

California Department of Water Resources. 1999d. John Skinner South Delta Fish Salvage Facility mitten crab exclusion and control experimental guidance/barrier wall research project, August- November 1999. Filed with State Clearinghouse on June 10, 1999. Notice of Exemption prepared by Environmental Services Office, Sacramento.

California Department of Water Resources. 1999e. John Skinner South Delta Fish Salvage Facility mitten crab experimental exclusion barrier grizzly bar rack research project, August- November 1999. Filed with State Clearinghouse on June 23, 1999. Notice of Exemption prepared by Environmental Services Office, Sacramento.

California Department of Water Resources. 1999f. Fall and spring Chinook young-of-year loss estimates based on Central Valley adult escapement estimates 1994-1998. Office Memo from Erin Chappell to Steve Ford and Sheila Greene. Environmental Services Office, Sacramento.

California Department of Water Resources. 2000. Study Plan: steelhead and spring-run salmon redd dewatering and juvenile stranding in the Lower Feather River. August 7, 2000. Environmental Services Office, Sacramento. 12 pages.

California Department of Water Resources. 2001. Initial information package for the relicensing of the Oroville Facilities, FERC No. 2100.

California Department of Water Resources. 2002a. Suisun Marsh Salinity Control Gates salmon passage evaluation report. Environmental Services Office, Sacramento. 19 pages.

California Department of Water Resources. 2002b. Redd de-watering and juvenile steelhead and spring-run salmon stranding in the Lower Feather River, 2000- 2001. Annual Report prepared in compliance with the 2000 OCAP biological opinion. Environmental Services Office, Sacramento. 8 pages.

California Department of Water Resources. 2002c. Emigration of juvenile Chinook salmon in the Feather River, 1998-2001. July 2002.

California Department of Water Resources. 2003a. RE: Size-length criteria at Delta Fish Facilities.

California Department of Water Resources. 2003b. 2003 Lower Feather River steelhead (*Oncorhynchus mykiss*) redd survey. SP F-10 Task 2B Report. Oroville Facilities Relicensing, FERC No. 2100.

California Department of Water Resources. 2003c. Fall and spring Chinook young-of-year loss estimates based on Central Valley adult escapement estimates 1994-2002. Office Memo from Erin Chappell to Sheila Greene. Environmental Services Office, Sacramento.

California Department of Water Resources. 2004a. Evaluation of project effects on instream flows and fish habitat. SP-F-16 Phase 2 Report. Oroville Facilities Relicensing, FERC No. 2100.

California Department of Water Resources. 2004b. Preliminary juvenile salmonid related results from instream flow studies on the Lower Feather River. Oroville Facilities Relicensing, FERC No. 2100.

California Department of Water Resources. 2004c. 2002/2003 winter-run Chinook incidental take and monitoring program annual data report. Summary of the incidental take of winter-run Chinook at the State and Federal Fish Facilities, and monitoring in the lower Delta, Sacramento River, Chipps Island and the Suisun Marsh Salinity Control Structure Operations required for the 1993 winter-run biological opinion. Environmental Services Office, Sacramento.

California Department of Water Resources and California Department of Fish Game. 2004. Suisun Marsh Salinity Control Gates salmon passage evaluation report, 2003. May 2004. 6 pages.

California Department of Water Resources and U.S. Bureau of Reclamation. 1999. Biological Assessment: Effects of the Central Valley Project and State Water Project operations, from October 1998 through March 2000, on steelhead and spring-run Chinook salmon. 211 pages.

California Department of Water Resources and U.S. Bureau of Reclamation. 2000. Biological Assessment: Effects of the Central Valley Project and State Water Project on steelhead and spring-run Chinook salmon. 200 pages.

California Regional Water Quality Control Board-Central Valley Region. 1998. Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins, fourth edition. Available: http://www.swrcb.ca.gov/~rwqcb5/home.html

California Regional Water Quality Control Board-Central Valley Region. 2001. Draft staff report on recommended changes to California's Clean Water Act, section 303(d) list. Available: http://www.swrcb.ca.gov/rwqcb5/html/

California Resources Agency. 1989. Upper Sacramento River fisheries and riparian management plan. Prepared by an Advisory Council established by SB1086, authored by State Senator Jim Nielson. 157 pages.

Calkins, R.D., W.F. Durand, and W.H. Rich. 1940. Report of the Board of Consultants on the fish problem of the upper Sacramento River. Stanford University. 34 pages.

Carl Mesick Consultants. 2002. Knights Ferry Gravel Replenishment Project. Final Report. Project #97-N21. Produced for CALFED Bay-Delta Program. El Dorado, California. 13 pages.

Cavallo, B., R. Kurth, J. Kindopp, A. Seeholtz, and M. Perrone. 2003. Distribution and habitat use of steelhead and other fishes in the Lower Feather River, 1999-2001. Interim report prepared by the California Department of Water Resources. January 22, 2003.

Cech, J. and C.A. Myrick. 1999. Steelhead and Chinook bioenergetics: temperature, ration, and genetic effects. Dept. of Wildlife, Fish, and Conservation Biology. University of California at Davis. Technical Report UCAL-WRC-W-885.

CH2MHill. 2001. Fish passage improvement project at the Red Bluff Diversion Dam. Interim Draft EIS/EIR. Prepared for Tehama-Colusa Canal Authority and the U.S. Bureau of Reclamation.

Chamberlain, C.D. 2003. Trinity River Fish Stranding Evaluation, May to June 2002. Draft report prepared for DFG Coastal California Salmon Recovery Program. Agreement No. P0010331, FWS, Arcata, CA. 19 pages.

Chambers, J. 1956. Fish passage development and evaluation program. Progress Report No. 5. U.S. Army Corps of Engineers, North Pacific Division, Portland, OR.

Chapman, D.W., and T.C. Bjornn. 1969. Distribution of salmon in streams, with special reference to food and feeding. Pages 153-176 *in:* T. G. Northcote, editor. Symposium on salmon and trout in streams. University of British Columbia. Vancouver.

Chilcote, M.W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (*Oncorhynchus mykiss*). Canadian Journal of Fisheries Aquatic Sciences 60:1057-1067.

Chilcote, M.W., S.A. Leider and J.J. Loch. 1986. Differential reproductive success of hatchery and wild summer-run steelhead under natural conditions. Transactions of the American Fisheries Society 115:726-735.

Chu, A. 2004. Particle Tracking Model results on the South Delta Improvement Alternatives produced from the CALSIM II model for statewide monthly operations. California Department of Water Resources. Presented to the Fish Agencies March 23, 2004. CD Diskette.

City of Fairfield. 2003. Green Valley Creek Project, Ninth Year Summary. Fisheries habitat mapping and species summary (1995-2003) prepared by ECORP Consulting, Inc. June 19, 2003. 4 pages.

Clark, G.H. 1929. Sacramento-San Joaquin salmon (*Oncorhynchus tshawytscha*) fishery of California. California Division of Fish and Game, Fish Bulletin No.17:73.

Coble, D.W. 1961. Influence of water exchange and dissolved oxygen in redds on survival of steelhead trout embryos. Transactions of the American Fisheries Society 90:469-474.

Cordone, A.J. and D.W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. California Fish and Game 47:89-228.

Cramer, F.K., and D.F. Hammack. 1952. Salmon research at Deer Creek, California. U.S. Fish and Wildlife Service, Spec. Sci. Report 67. 16 pages.

Cramer, S.P. 2000. Fisheries Newsletter, July 2000. Available: www.spcramer.com

Cramer, S.P. 2004. Conceptual framework for an integrated life cycle model of winter-run Chinook salmon in the Sacramento River. Step 1 Report. Presentation to the Winter-run Satellite Project Work Team. Funded by the California Urban Water Users.

Cramer, S.P., and D.B. Demko. 1997. The status of late-fall and spring Chinook salmon in the Sacramento River Basin regarding the Endangered Species Act.

Davis, G.E., J. Foster, C.E. Warren, and P. Doudoroff. 1963. The influence of oxygen concentration on the swimming performance of juvenile Pacific salmon at various temperatures. Transactions of the American Fisheries Society 92:111-124.

Decato, R.J. 1978. Evaluation of the Glenn-Colusa Irrigation District fish screen. California Department of Fish and Game, Anadromous Fisheries Branch Administrative Report No. 78-20.

Demko, D. 2004. Stanislaus River Weir Updates 2003-2004. From S.P. Cramer and Associates. Available: www.stanislausriver.com

Demko, D.B., C. Gemperle, A. Phillips, and S.P. Cramer. 2000. Outmigrant trapping of juvenile salmonids in the Lower Stanislaus River, Caswell State Park site, 1999. Prepared for U.S. Fish and Wildlife Service. S.P. Cramer and Associates, Inc. Gresham, OR. 146 pages plus appendices.

Dunford, W.E. 1975. Space and food utilization by salmonids in marsh habitats in the Fraser River Estuary. M.S. Thesis. University of British Colombia. Vancouver. 81 pages.

East Bay Municipal Utility District. 2004. Lower Mokelumne River Salmon and Steelhead Workshop, April 8, 2004. Interagency meeting.

Edwards, G.W., K.A.F. Urquhart, and T.L. Tillman. 1996. Adult salmon migration monitoring, Suisun Marsh Salinity Control Gates, September-November 1994. Technical Report 50. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. 27 pages.

Ekman, E.G. 1987. Adult spring-run salmon surveys, 1986 and 1987. Office memo, November 17, 1987. U.S. Forest Service, Lassen National Forest.

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in West coast estuaries, Volume II: species life history summaries. ELMR Report No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 329 pages.

Everest, F.H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Commission. Fishery Research Report 7. 48 pages.

Everest, F.H., and D.W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fishery Research Board of Canada 29:91-100.

Fisher, F.W. 1994. Past and present status of Central Valley Chinook salmon. Conservation Biology 8:870-873.

Fisher, J.P., W.G. Pearcy, and A.W. Chung. 1984. Studies of juvenile salmonids off the Oregon and Washington coast, 1983. Oreg. State Univ. Coll. Oceanogr. Cruise Rep. 84-2; Oreg. State Univ. Sea Grant Coll. Program. ORESU-T-85-004:29 pages. *In:* Sandercock (1991).

Fleming, I.A., and M.R. Gross. 1993. Breeding success of hatchery and wild coho salmon (*Oncorhynchus kisutch*) in competition. Ecological Applications 3:230-245.

Folmar, L.C., and W.W. Dickhoff. 1980. The parr-smolt transformation (smoltification) and seawater adaptation in salmonids: a review of selected literature. Aquaculture 21:1-37.

Foott, J.S., K. Nichols and R. Harmon. 2000. Lack of experimental evidence for IHN virus transmission from infected hatchery salmon to natural salmon in the Sacramento River. FY 2000 Investigation Report. FWS, California-Nevada Fish Health Center, Anderson, CA.

Fry, D.H. 1961. King salmon spawning stocks of the California Central Valley, 1940-1959. California Fish and Game 47:55-71.

Gaines, P.D. and C.D. Martin. 2001. Abundance and seasonal, spatial and diel distribution patterns of juvenile salmonids passing the Red Bluff Diversion Dam, Sacramento River. Red Bluff Research Pumping Plant Report Series, Volume 14. U.S. Fish and Wildlife Service, Red Bluff, CA.

Garcia, A. 1989. The impacts of squawfish predation on juvenile Chinook salmon at Red Bluff Diversion Dam and other locations in the Sacramento River. U.S. Fish and Wildlife Service Report No. AFF/FAO-89-05.

Gingras, M. 1997. Mark/recapture experiments at Clifton Court Forebay to estimate pre-screen loss of juvenile fishes:1976-1993. Interagency Ecological Program Technical Report No. 55.

Goals Project. 1999. Baylands ecosystem habitat goals: a report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco. San Francisco Bay Regional Water Quality Control Board. Oakland, CA.

Godfrey, H. 1965. Coho salmon. Int. North Pac. Fish. Comm. Bull. 16. 39 pages.

Goyer, R.A. 1996. Toxic effects of metals. Pages 691-736 *in*: C.D. Klassen, editor. Casarett & Doull's toxicology: the basic science of poisons, fifth edition. McGraw Hill. New York, NY.

Grant, W.S., editor. 1997. Genetic effects of straying of non-native fish hatchery fish into natural populations: proceedings of the workshop. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-30. 130 pages.

Hallock, R.J. 1987. Sacramento River system salmon and steelhead problems and enhancement opportunities: A report to the California Advisory Committee on Salmon and Steelhead Trout. June 22, 1987.

Hallock, R.J. 1989. Upper Sacramento River steelhead (*Oncorhynchus mykiss)* 1952-1988. Prepared for the U.S. Fish and Wildlife Service. California Department of Fish and Game, Sacramento.

Hallock, R.J. and F.W. Fisher. 1985. Status of winter-run Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento River. Report to the California Department of Fish and Game, Anadromous Fisheries Branch, Sacramento, CA.

Hallock, R.J., D.A. Vogel, and R.R. Reisenbichler. 1982. The effect of Red Bluff Diversion Dam on the migration of adult Chinook salmon, as indicated by radio tagged fish. California Department of Fish and Game, Anadromous Fisheries Branch, Admin. Report No. 82-8.

Hallock, R.J., R.F. Elwell, and D.H. Fry, Jr. 1970. Migrations of adult king salmon, *Oncorhynchus tshawytscha*, in the San Joaquin Delta. California Fish and Game 151. Sacramento. 92 p.

Hallock, R.J., W.F. Van Woert, and L. Shapavalov. 1961. An evaluation of stocking hatchery-reared steelhead rainbow trout (*Salmo gairdneri gairdneri*) in the Sacramento River system. California Fish and Game 114:73.

Hannon, J., M. Healey, and B. Deason. 2003. American River steelhead (*Oncorhynchus mykiss*) spawning 2001-2002. U.S. Bureau of Reclamation. Sacramento, CA. 36 pages.

Hannon, J., M. Healey, and B. Deason. 2004. American River steelhead (*Oncorhynchus mykiss*) spawning 2001-2003. US Bureau of Reclamation. Sacramento, CA. 36 pages.

Hanson, C. 2001. Adult and juvenile steelhead occurrence within Suisun Creek. Memo to City of Vallejo. Prepared by Hanson Environmental, Inc. July 2001. 10 pages.

Hare, S.R., N.J. Mantua, and R.C. Francis. 1999. Inverse productions regimes: Alaska and west coast Pacific salmon. Fisheries 24(1):6-14.

Hartman, G., J.C. Scrivener, L.B. Holtby, and L. Powell. 1987. Some effects of different streamside treatments on physical conditions and fish population processes in Carnation Creek, a coastal rainforest stream in British Columbia. Pages 330-372 *in* Salo and Cundy (1987).

Hassler, T.J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)–coho salmon. U.S. Fish and Wildlife Service Biol. Rep. 82 (11.70) 19 pages.

Hatchery Scientific Review Group. 2004. Hatchery reform: Principles and recommendations of the HSRG. April 2004. Seattle, WA. Available: www.hatcheryreform.org

Healey, M.C. 1980. Utilization of the Nanaimo River estuary by juvenile Chinook salmon (*Oncorhynchus tshawytscha*). Fishery Bulletin 77:653-668.

Healey, M.C. 1982. Juvenile pacific salmon in estuaries: the life support system. Pages 315-341 *in* V.S. Kennedy, editor. Estuarine Comparisons. Academic Press. New York, N.Y.

Healey, M.C. 1991. Life history of Chinook salmon. Pages 213-393 *in* C. Groot and L. Margolis, editors. Pacific Salmon Life Histories. University of British Columbia Press. Vancouver.

Hedrick, R.P., and S. Yun. 2003. A report on the susceptibility of selected salmonids to infectious hematopoietic necrosis virus (IHNV). Department of Medicine and Epidemiology, School of Veterinary Medicine. University of California, Davis.

Heifetz, J., M.L. Murphy, and K.V. Koski. 1986. Effects of logging on winter habitat of juvenile salmonids in Alaska streams. North American Journal of Fisheries Management 6:52-58.

Herren, J.R., and S.S. Kawasaki. 2001. Inventory of water diversions in four geographic areas in California's Central Valley. Pages 343-355 *in*: R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids, Volume 2. California Fish and Game, Fish Bulletin 179.

Hinz, J.A. 1959. Annual report, Nimbus Salmon and Steelhead Hatchery, fiscal year 1957-58. California Department of Fish and Game, Inland Fisheries Admin. Report No. 59-4.

Hoar, W.S. 1976. Smolt transformation: evolution, behavior, and physiology. Journal of the Fisheries Research Board of Canada 33:1233-1252.

Horn, M.J., and A. Blake. 2004. Acoustic tracking of juvenile Chinook salmon movement in the vicinity of the Delta Cross Channel, 2001 study results. U.S. Department of the Interior. Technical Memorandum No. 8220-04-04.

Ingersoll, C.G. 1995. Sediment tests. Pages 231-255 *in*: G.M. Rand, editor. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Taylor and Francis. Bristol, Pennsylvania.

Interagency Ecological Program Steelhead Project Work Team. 1999. Monitoring, assessment, and research on Central Valley steelhead: Status of knowledge, review existing programs, and assessment needs. *In* Comprehensive Monitoring, Assessment, and Research Program Plan, Tech. App. VII-11.

Israel, J.A., and K.S. Williamson. 2003. Investigation of anadromous fish genetics in the Klamath hydroelectric project area. Draft report. Klamath Hydroelectric Project FERC Project 2082, contract no. 3000021859.

Johnson, C. 2000. Discussion paper: Differences between critical habitat and the standards of section 7 of the Endangered Species Act of 1973, as amended. National Marine Fisheries Service, Silver Spring, MD. 12 pages.

Joint Hatchery Review Committee. 2001. Final report on anadromous salmonid fish hatcheries in California. Prepared by the California Department of Fish and Game and National Marine Fisheries Service. December 2001.

Jones and Stokes Associates, Inc. 1993. Strategies, potential sites, and site evaluation criteria for restoration of Sacramento River fish and wildlife habitats, Red Bluff to the Feather River. Prepared for the U.S. Army Corps of Engineers, Sacramento, CA. 30 pages.

Jones and Stokes Associates. 2002. DAYOPS - Daily operations and protections. Gaming simulations of water years 1995-2001, with historical daily inflows meeting the 1995 WQCP Objectives (D-1641) for 8500 pumping at Banks and evaluation of Environmental Water Account. July 17, 2002.

Jones and Stokes Associates. 2003. Summary of September 2003 EWA Gaming Graphs from Daily Delta Modeling of 1999-2003.

Jones and Stokes Associates. 2004. Freeport Regional Water Project. Biological assessment for ESA section 7(a)(2) consultation. Prepared for the U.S. Bureau of Reclamation and the Freeport Regional Water Authority. Sacramento, CA. 124 pages with appendices

Katopodis, C. 1992. Introduction to Fishway Design. Working Document. Freshwater Institute, Department of Fisheries and Oceans, Winnipeg, Canada.

Keller, E.A., and F.J. Swanson. 1979. Effects of large organic material on channel form and fluvial processes. Earth Surface Processes 4:361-380.

Kennedy, T. and T. Cannon. 2002. Stanislaus River Salmonid Density and Distribution Survey Report (2000-2001). Final Draft. Prepared for the U.S. Fish and Wildlife Service, CVPIA by Fishery Foundation of California. December 2002. 36 pages.

Kimmerer, W., B. Mitchell, and A. Hamilton. 2001. Building Models and Gathering Data: Can We Do This Better? Pages 305-317 *in* R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids, Volume 2. California Department of Fish and Game, Fish Bulletin 179.

Kimmerer, W.J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco Estuary. Estuaries 25:6B:1275-12-90.

Kjelson, M.A., and P.L. Brandes. 1989. The use of smolt survival estimates to quantify the effects of habitat changes on salmonid stocks in the Sacramento-San Joaquin Rivers, California. Canadian Special Publication on Fisheries Aquatic Science 105:100-115.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1981. Influences of freshwater inflow on Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento-San Joaquin Estuary. Pages 88-108 *in* R.D. Cross and D.L. Williams, editors. Proceedings of the National Symposium on Freshwater Inflow to Estuaries. U.S. Fish and Wildlife Service, FWS/OBS-81-04.

Kjelson, M.A., P.F. Raquel, and F.W. Fisher. 1982. Life history of fall-run juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento-San Joaquin estuary, California. Pages 393-411 *in* V.S. Kennedy, editor. Estuarine comparisons. Academic Press. New York, NY.

Lee, G.F., and A.J. Lee. 2003. Impacts of San Joaquin River Deep Water Ship Channel watershed and South Delta flow manipulations on the low-DO problem in the Deep Water Ship Channel. Report prepared for the CALFED Bay-Delta Program. G. Fred Lee and Associates. El Macero, CA. 18 pages.

Lee, G.F., and A.J. Lee. 2004. Excerpts from an overview of Sacramento-San Joaquin River Delta water quality issues. Report prepared the for CALFED Bay-Delta Program. G. Fred Lee and Associates. El Macero, CA. 18 pages.

Leidy, R.A. 1997. Estuary Report June 1997. U.S. Environmental Protection Agency. San Francisco Estuary Project.

Leidy, R.A., and S. Li. 1987. Analysis of river flows necessary to provide water temperature requirements of anadromous fishery resources of the Lower American River. EDF V. EBMUD, Exhibit No. 69-A. Prepared by McDonough, Holland, and Allen. Sacramento, CA.

Levings, C.D. 1982. Short term use of low-tide refugia in a sand flat by juvenile Chinook, (*Oncorhynchus tshawytscha*), Fraser River estuary. Can. Tech. Rpt. Fish and Aquat. Sci. 1111. 7 pages.

Levings, C.D., C.D. McAllister, and B.D. Chang. 1986. Differential use of the Campbell River estuary, British Columbia, by wild and hatchery-reared juvenile Chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 43:1386-1397.

Levy, D.A., and T.G. Northcote. 1982. Juvenile salmon residency in a marsh area of the Fraser River estuary. Canadian Journal of Fisheries and Aquatic Sciences 39:270-276.

Lindley, S.T., R. Schick, B.P. May, J.J. Anderson, S. Greene, C. Hanson, A. Low, D. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2004. Population structure of threatened and endangered Chinook salmon ESUs in California's Central Valley basin. Public review draft. NOAA Fisheries Southwest Science Center. Santa Cruz, CA.

Lindley, S.T., and K.B. Newman. 2001. Draft, state-space models for winter-run Chinook salmon. Unpublished. NOAA Fisheries Southwest Science Center. Santa Cruz, CA.

Lindsay, R.B., R.K. Schroeder, K.R. Kenaston, R.N. Toman, and M.A. Buckman. 2004. Hooking mortality by anatomical location and its use in estimating mortality of spring-run salmon caught in a river sport fishery. North American Journal of Fisheries Management 24:367-378.

Low, A.F. 2004. Delta Cross Channel gate analysis. Presented to the EWA Science Review Panel, October 2003. Technical report to CALFED. California Department of Fish and Game, Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento.

MacFarlane, B.R. and E.C. Norton. 2002. Physiological ecology of juvenile Chinook salmon at the southern end of their distribution, the San Francisco Estuary and Gulf of Farallones, California. California Department of Fish and Game, Fish Bulletin 100:244-257.

Mantua, N.J., and S.R. Hare. 2002. The Pacific Decadal Oscillation. Journal of Oceanography 58:35-44.

Martin, C.D., P.D. Gaines, and R.R. Johnson. 2001. Estimating the abundance of Sacramento River juvenile winter Chinook salmon with comparisons to adult escapement. Red Bluff Research Pumping Plant Report Series, Volume 5. U.S. Fish and Wildlife Service. Red Bluff, CA..

Mahoney, J. 1958. 1957 king salmon spawning population estimates for the Sacramento-San Joaquin River systems. California Department of Fish and Game, Marine Resource Branch. 18 pages.

Mahoney, J. 1960. 1959 king salmon spawning population estimates for the Sacramento-San Joaquin River systems. California Department of Fish and Game, Marine Resource Branch. 14 pages.

Marcotte, B.D. 1984. Life history, status, and habitat requirements of spring-run Chinook salmon in California. U.S. Forest Service. Unpublished report, Lassen National Forest. Chester. 34 pages.

Maslin, P., M Lennox, W. McKinney. 1997. Intermittent streams as rearing habitat for Sacramento River Chinook salmon (*Oncorhynchus tshawytscha*). California State University, Chico, Department of Biological Sciences. 89 pages.

McBain, S., W. Trush and G. Mathews. 1999. Lower Clear Creek bedload transport measurements. Technical memo for Water Year 1998.

McBain, S. and W. Trush. 2001. Geomorphic evaluation of Lower Clear Creek downstream of Whiskeytown Dam, CA. McBain, Trush and Associates. Arcata..

McDonald, J. 1960. The behavior of Pacific salmon fry during the downstream migration to freshwater and saltwater nursery areas. Journal of the Fisheries Research Board of Canada 17:655-676.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations (VSPs) and the recovery of evolutionary significant units. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-42, 156 pages.

McEwan, D., and T.A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California. Department of Fish and Game. 234 pages.

McEwan, D. 2001. Central Valley steelhead. Pages 1-44 *in* R .L. Brown, editor. Contributions to the Biology of Central Valley Salmonids, Volume 1. California Department of Fish and Game, Fish Bulletin 179.

McGill, R.R. Jr. 1979. Land use changes in the Sacramento River riparian zone, Redding to Colusa. Department of Water Resources, Northern District. 23 pages.

McGill, R.R. Jr. 1987. Land use changes in the Sacramento River riparian zone, Redding to Colusa. A third update: 1982-1987. Department of Water Resources, Northern District. 19 pages.

Meehan, W.R. and T.C. Bjornn. 1991. Salmonid distributions and life histories. Pages 47-82 *in* W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. Bethesda, MD.

Menchen, R.S. (editor). 1968. King (Chinook) salmon spawning stocks in California=s Central Valley, 1967. California Department of Fish and Game, Marine Resources Branch. Admin. Report No. 69-4. 22 pages.

Mesick, C. 2001. The effects of San Joaquin River flows and delta export rates during October on the number of adult San Joaquin Chinook salmon that stray. Pages 139-161 *in* R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids, Volume 2. California Department of Fish and Game, Fish Bulletin 179.

Michy, F., and M. Hampton. 1984. Sacramento River Chico Landing to Red Bluff project, 1984, Juvenile salmon study. U.S. Fish and Wildlife Service, Division of Ecological Services. Sacramento, CA.

Miller, R.J., and E.L. Brannon. 1982. The origin and development of life-history patterns in Pacific salmon. Pages 296-309 *in* E.L. Brannon and E.O. Salo, editors. Proceedings of the Salmon and Trout Migratory Behavior Symposium. University of Washington Press. Seattle.

Moffett, J.W. 1947. Annual report of fishery investigations in Central Valley and other projects in California–fiscal year 1947. Memorandum report to Elmer Higgins, Division of Fishery Biology, Washington, D.C.

Monroe, M., J. Kelly, and N. Lisowski. 1992. State of the estuary, a report of the conditions and problems in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. June 1992. 269 pages.

Morinaka, J. 2000. Rock Slough and Old River Fish Monitoring Program 1999 summary report. Prepared by the California Department of Fish and Game to meet ESA requirements of Sacramento River winter-run Chinook salmon and delta smelt biological opinions. Central Valley Bay-Delta Branch, Stockton.

Morinaka, J. 2003. Contra Costa fish entrainment sampling. Three-year Summary Report (October 1993-August 1996). Prepared for the U.S. Bureau of Reclamation and Contra Costa Water District by the California Department of Fish and Game, Bay-Delta and Special Water Projects Division, Stockton. 25 pages.

Moyle, P.B., R.A. Daniels, B. Herbold, and D.M. Baltz. 1986. Patterns in distribution and abundance of a non-coevolved assemblage of estuarine fishes in California. Fishery Bulletin 84:105-117.

Moyle, P.B., J.E. Williams, and E.D. Wikramanayake. 1989. Fish species of special concern of California. Final report submitted to State of California Resources Agency. October 1989.

Myers, J.M., R.G. Kope, G.L. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Department Of Commerce, NOAA Tech Memo. NOAA Fisheries-NWFSC-35, 443p.

Myrick C. A. 1998. Temperature, genetic, and ration effects on juvenile rainbow trout (*Oncorhynchus mykiss*) bioenergetics. Ph.D. dissertation. University of California. Davis. 165 pages.

Myrick, C.A, and Cech J.J. 2000. Growth and thermal biology of Feather River steelhead under constant and cyclical temperatures. Department of Wildlife, Fish, and Conservation Biology, University of California. Davis.

Myrick, C.A. and J.J. Cech. 2001. Temperature effects on Chinook salmon and steelhead: A review focusing on California's Central Valley populations. Department of Wildlife, Fish, and Conservation Biology, University of California. Davis.

National Marine Fisheries Service. 1993a. Endangered Species Act - section 7 consultation. Biological Opinion for the Operation of the Federal Central Valley Project and the California State Water Project. Prepared for the U.S. Bureau of Reclamation and California Department of Water Resources. Southwest Region. Issued February 12, 1993. 81 pages.

National Marine Fisheries Service. 1993b. Endangered Species Act - section 7 consultation. Biological Opinion for the Los Vaqueros Project. Prepared for the U.S. Bureau of Reclamation and Contra Costa Water District. Southwest Region. Issued March 18, 1993. 15 pages.

National Marine Fisheries Service. 1996a. Factors for steelhead decline: a supplement to the notice of determination for west coast steelhead under the Endangered Species Act. NOAA Fisheries Protected Species Branch, Portland, OR, and Protected Species Management Division, Long Beach, CA. 83 pages.

National Marine Fisheries Service. 1996b. Making Endangered Species Act determinations of effect for individual or group actions at the watershed scale. Prepared by NOAA Fisheries, Environmental and Technical Services Branch, Habitat Conservation Branch. 31pages.

National Marine Fisheries Service. 1997a. Proposed recovery plan for the Sacramento River winter-run Chinook salmon. Southwest Region. Long Beach, CA. 217 pages with goals and appendices.

National Marine Fisheries Service. 1997b. Status review update for West Coast Steelhead from Washington, Idaho, Oregon, and California. Prepared by the West Coast Steelhead Biological Review Team. July 7, 1997. 71 pages.

National Marine Fisheries Service. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-35. 443 pages.

National Marine Fisheries Service. 1999. The habitat approach. Implementation of section 7 of the Endangered Species Act for actions affecting the habitat of Pacific anadromous salmonids. Northwest Region, Habitat Conservation and Protected Resources Division. 12 pages.

National Marine Fisheries Service. 2000a. Endangered Species Act - section 7 consultation. Biological opinion for Central Valley Project and State Water Project Operations, April 1, 1999 through March 31, 2000 for Central Valley spring-run Chinook salmon and Central Valley steelhead. Southwest Region. Issued September 20, 2002. 106 pages.

National Marine Fisheries Service. 2000b. Endangered Species Act - section 7 consultation. Biological Opinion for the Trinity River Mainstem Fishery Restoration program. Prepared for the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. Southwest Region. Issued October 12, 2000.

National Marine Fisheries Service. 2001a. Endangered Species Act - section 7 consultation. Biological opinion for Central Valley Project and State Water Project Operations, April 1, 2001 through March 31, 2002 for Central Valley spring-run Chinook salmon and Central Valley steelhead. Southwest Region. Issued September 20, 2002. 106 pages.

National Marine Fisheries Service. 2001b. Status review update for coho salmon (*Oncorhynchus kisutch*) from the Central California Coast and the California Portion of the Southern Oregon/Northern California Coast Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz Laboratory. April 12, 2001. 43 pages.

National Marine Fisheries Service. 2001c. Endangered Species Act - section 7 consultation. Biological opinion for the Vernalis Adaptive Management Plan (VAMP) fishery sampling in the Lower San Joaquin River near Jersey Point. Southwest Region.

National Marine Fisheries Service. 2002a. Endangered Species Act - section 7 consultation. Biological opinion for Central Valley Project and State Water Project Operations, April 1, 2002 through March 31, 2004 for Central Valley spring-run Chinook salmon and Central Valley steelhead. Southwest Region. Issued September 20, 2002. 106 pages.

National Marine Fisheries Service. 2002b. Endangered Species Act - section 7 consultation. Biological opinion for Lower Stony Creek Water Management. Prepared for the U.S. Bureau of Reclamation and U.S. Army Corps of Engineers. Southwest Region. Issued March 11, 2002. 74 pages.

National Marine Fisheries Service. 2002c. Letter to Chet Bowling, U.S. Bureau of Reclamation, from Rod McInnis, National Marine Fisheries Servcie, concerning the exceedance of the 2001 take limit for winter-run Chinook salmon at the Delta pumping plants and justification for revising the juvenile production estimate. Southwest Region. Long Beach, CA. 6 pages.

National Marine Fisheries Service. 2003. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. Draft report February 2003. West Coast Salmon Biological Review Team. U.S. Department of Commerce, National Marine Fisheries Service-Northwest Fisheries Science Center.

National Marine Fisheries Service. 2004. Endangered Species Act - section 7 consultation. Supplemental Biological Opinion for Central Valley Project and State Water Project Operations from April 1, 2004 through March 31, 2006. Prepared for the U.S. Bureau of Reclamation and California Department of Water Resources. Southwest Region. Issued February 27, 2004. 47 pages.

National Marine Fisheries Service and California Department of Fish and Game. 2001. Final report on anadromous salmon fish hatcheries in California. Prepared by Joint Hatchery Review Committee. June 27, 2001.

Nehlsen, W., J.E. Williams, and J.A. Lichatowich. 1991. Pacific salmon at the crossroads: Stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16(2):4-21.

Newman, K. 2000. Estimating and modeling absolute survival rates fro juvenile Chinook salmon outmigrating through the lower Sacramento River using paired release data. October 2000. Prepared for California Department of Water Resources.

Newman, K. and J. Rice. 1997. Statistical model for survival of Chinook salmon smolts out-migrating through the lower Sacramento-San Joaquin system. Interagency Ecological Program, Technical Report No. 59. California Department of Water Resources. Sacramento, California.

Nickelson, T.E., J.W. Nicholas, A.M. McGie, R.B. Lindsay, D.L. Bottom, R.J. Kaiser, and S.E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Oreg. Dep. Fish. Wildl., Res. Develop. Sect. and Ocean Salmon Manage. 83 pages

Nielsen, J.L., S. Pavey, T. Wiacek, G.K. Sage, and I. Williams. 2003. Genetic analyses of Central Valley trout populations 1999-2003. Final Report. USGS Alaska Science Center. Final technical report, submitted to the California Department of Fish and Game, Sacramento, and the U.S. Fish and Wildlife Service, Red Bluff. December 8, 2003.

Nobriga, M., and P. Cadrett. 2003. Differences among hatchery and wild steelhead: evidence from Delta fish monitoring programs. Interagency Ecological Program for the San Francisco Estuary Newsletter 14:3:30-38.

Orange Cove Irrigation District. 1999. Mill Creek Anadromous Fish Adaptive Management Enhancement Plan. Draft EA/IS Appendix II. August 1999.

Orsi, J. 1967. Predation study report, 1966-1967. California Department of Fish and Game.

Pacific Fishery Management Council. 2004. Review of 2003 Ocean Salmon Fisheries. February 2004. Available: www.pcouncil.org

Philipp, D.P., and J.E. Claussen. 1994. Loss of genetic diversity among managed populations. Pages 7-8 *in* G. Farris, editor. Our Living Resources. National Biological Survey. Washington, D.C.

Phillips, R.W., and H.J. Campbell. 1961. The embryonic survival of coho salmon and steelhead trout as influenced by some environmental conditions in gravel beds. Annual Report to Pac. Mar. Fish. Comm. 14:60-73.

Pickard, A., A. Grover, and F. Hall. 1982. An evaluation of predator composition at three locations on the Sacramento River. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report No. 2. 20 pages..

Pimm, S.L., H.L. Jones, and J. Diamond. 1988. On the risk of extinction. American Naturalist. 132:757-785.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1979. Methods for evaluating stream, riparian, and biotic conditions. USDA Gen. Tech. Report INT-138. Ogden, Utah. 78 pages.

Puckett, L.K., and R.N. Hinton. 1974. Some measurements of the relationship between streamflow and king salmon spawning gravel in the main Eel and South Fork Eel rivers. California Department of Fish and Game, Environmental Services Branch Admin. Report No. 74-1.

Rand, G.M., P.G. Wells, and L.S. McCarty. 1995. Introduction to aquatic toxicology. Pages 3-66 *in* G.M. Rand, editor. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Taylor and Francis. Bristol, Pennsylvania.

Reeves, G.H., F.H. Everest and T.E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in Western Oregon and Washington. U.S. Forest Service Gen. Tech. Rep. PNW-GTR-245.

Reiser, D.W., and T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. *In* W.R. Meehan, editor. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in the Western United States and Canada.. USDA, Forest Service General Technical Report PNW-96.

Resources Agency, State of California. 1989. Upper Sacramento River Fisheries and Riparian Management Plan. Prepared by an Advisory Council established by SB 1086, authored by State Senator Jim Nielson. 157 pages.

Reynolds, F., T. Mills, R. Benthin, and A. Low. 1993. Central Valley anadromous fisheries and associated riparian and wetlands areas protection and action plan, draft. California Department of Fish and Game, Inland Fisheries Division. Sacramento.

Rich, A.A. 1997. Testimony of Alice A. Rich, Ph.D., regarding water rights applications for the Delta Wetlands Project, proposed by Delta Wetlands Properties for Water Storage on Webb Tract, Bacon Island, Bouldin Island, and Holland Tract in Contra Costa and San Joaquin Counties. July 1997. California Department of Fish and Game Exhibit DFG-7. Submitted to State Water Resources Control Board.

Robison, G.E., and Beschta, R.L. 1990. Identifying trees in riparian areas that can provide coarse woody debris to streams. Forest Service 36:790-801.

Rutter, C. 1904. Natural history of the quinnat salmon. Investigations on Sacramento River, 1896-1901. Bull. U.S. Fish Comm. 22:65-141.

Salmon and Steelhead Hatchery Assessment Group. 2003. Hatchery broodstock summaries and assessments for chum, coho, and Chinook salmon and steelhead stocks within evolutionarily significant units listed under the Endangered Species Act. May 2003. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA, and Southwest Fisheries Science Center, La Jolla, CA.

Sandercock, F.K. 1991. Life history of coho salmon. *In* C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press. Vancouver. 564 pages.

Sato, G.M., and P.B. Moyle. 1989. Ecology and conservation of spring-run Chinook salmon. Annual report, Water Resources Center Project W-719, July 30, 1988-June 30, 1989.

Saunders, R.L. 1965. Adjustment of buoyancy in young Atlantic salmon and brook trout by changes in swim bladder volume. Journal of the Fisheries Research Board of Canada 22:335-352.

Schaffter, R.G. 1980. Fish occurrence, size, and distribution in Sacramento River near Hood, California, during 1973 and 1974. California Department of Fish and Game, Admin. Report No. 80-3.

Schiewe, M.H. 1997. Memorandum to W. Stelle and W. Hogarth. Conclusions regarding the Updated Status of Coho Salmon from Northern California and Oregon Coasts. National Marine Fisheries Service, Northwest Fisheries Science Center, Coastal Zone & Estuarine Studies Division. Seattle, WA. 70 pages plus appendices.

Schlicting, D. 1991. Annual report Feather River Hatchery, 1988-89. California Department of Fish and Game, Anadromous Fisheries Branch, Admin. Report No. 91-12. 11 pages.

Seymour, A.H. 1956. Effects of temperature on young Chinook salmon. Ph.D. thesis. University of Washington. Seattle.

Shapovalov, L. and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri)* and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. California Department of Fish and Game, Fish Bulletin 98. 375 pages.

Shelton, J. M. 1955. The hatching of Chinook salmon eggs under simulated stream conditions. Progressive Fish-Culturist 17:20-35.

Shirvell, C.S. 1990. Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) cover habitat under varying streamflows. Canadian Journal of Fisheries and Aquatic Sciences 47:852-860.

Slater, D.W. 1963. Winter-run Chinook salmon in the Sacramento River, California, with notes on water temperature requirements at spawning. U.S. Fish and Wildlife Service, Special Science Report Fisheries 461:9.

Smith, A.K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. Transactions of the American Fisheries Society 10:312-316.

Smith, L.S. 1982. Decreased swimming performance as a necessary component of the smolt migration in salmon in the Columbia River. Aquaculture 28:153-161.

Snider, B., R. Titus, and B. Payne. 1997. Lower American River emigration survey, November 1994 - September 1995. September 1997. California Department of Fish and Game, Environmental Services Division.

Snider, B., R. Titus, and B. Payne. 1998. Lower American River emigration survey, October 1995-September 1996. September 1998. California Department of Fish and Game, Environmental Services Division.

Snider B., and R. Titus. 2000a. Lower American River emigration survey, October 1996–September 1997. California Department of Fish and Game, Environmental Services Division Annual Report 0-2.. 58 pages.

Snider, B., and R. Titus. 2000b. Timing, composition and abundance of juvenile anadromous salmonid emigration in the Sacramento River near Knights Landing, October 1996 - September 1999. California Department of Fish and Game, Habitat Conservation Division, Stream Evaluation Program. Tech. Reports No. 4, 5, and 6.

Snider B., R. Titus, and K. Vyberberg. 2001. Evaluation of effects of flow fluctuations on the anadromous fish populations in the Lower American River. California Department of Fish and Game Stream Evaluation Program. Sacramento.

Snider, B. 2001. Evaluation of effects of flow fluctuations on the anadromous fish populations in the Lower American River. California Department of Fish and Game, Habitat Conservation Division. Stream Evaluation Program. Tech. Reports No.1 and 2 with appendices 1-3. Sacramento.

Sommer, T., D. McEwan, and R. Brown. 2001a. Factors affecting Chinook spawning in the Lower Feather River. Pages 269-294 *in* R.L. Brown, editor. Contributions to the Biology of Central Valley Salmonids, Volume 1. Fish Bulletin 179.

Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. 2001b. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58:325-333.

South Delta Improvement Program. 2003. Administrative Draft Environmental Impact Statement/Environmental Impact Report. October 2003. Prepared for U.S. Bureau of Reclamation and California Department of Water Resources by Jones and Stokes. Sacramento, CA.

Spaar, S.A. 1988. Suisun Marsh Salinity Control Gate, preproject fishery resource evaluation. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 17. March 1988.

S.P. Cramer and Associates. 2002. CALFED proposal for a resistance board weir on the Lower Stanislaus River for salmon and steelhead. Tri-Dam Project (Oakdale Irrigation District and South San Joaquin Irrigation District). Proposal submitted April 2002 to NOAA Fisheries for ESA compliance. 27 pages.

S.P. Cramer and Associates. 2004. Weekly Stanislaus River Weir Updates. Available: www.stanislausriver.com

Staley, J.R. 1976. American River steelhead (*Salmo gairdnerii gairdnerii*) management,1956-1974. California Department of Fish and Game, Region 2, Inland Fisheries, Anadromous Branch, Admin. Report No. 76-2.

Stevens, D.E. 1961. Food habits of striped bass, *Roccus saxatilis* (Walbaum) in the Rio Vista area of Sacramento River. Master's Thesis. University of California. Berkeley.

Stillwater Sciences. 2004. Gravel Enhancement Projects below dams in California. Summary of information from various projects. Draft database developed for the CALFED Bay-Delta Authority. 8 pages. Available: http://flume.stillwatersci.com

Stone, L. 1874. Report of operations during 1872 at the U.S. salmon-hatching establishment on the McCloud River, and on the California Salmonidae generally; with a list of specimens collected. Report to U.S. Commissioner of Fisheries for 1872-1873, 2:168-215.

Surface Water Resources, Inc. 2001. American River Basin Cumulative Impact Report prepared for Placer County Water Agency Pump Station Project.

Surface Water Resources, Inc. 2001a. Initial fisheries and aquatic habitat management and restoration plan for the Lower American River. Prepared for the Instream Habitat (FISH) Working Group.

Surface Water Resources, Inc. 2001b. Aquatic resources of the Lower American River: Baseline report. Prepared for Instream Habitat (FISH) Working Group.

Tenera. 2004. Fish entrainment sampling report for the Contra Costa Canal Headworks, expanded monitoring March 13 to May 3, 2004. Prepared by Carol Raifsnider, Tenera Environmental, for the U.S. Bureau of Reclamation and Contra Costa Water District. Lafayette, CA.

Thompson, K. 1972. Determining stream flows for fish life. Pages 31-50 *in* Proceedings, Instream Flow Requirement Workshop. Pacific Northwest River Basin Commission, Vancouver, WA.

Tillman, T.L., G.W. Edwards, and K.A.F. Urquhart. 1996. Adult salmon migration during the various operational phases of Suisun Marsh Salinity Control Gates in Montezuma Slough: August-October 1993. Agreement to California Department of Water Resources, Ecological Services Office by California Department of Fish and Game, Bay-Delta and Special Water Projects Division. 25 pages.

Titus, R.G., D.C. Erman, and W.M. Snider. 1999. History and status of steelhead in California coastal drainages south of San Francisco Bay. Draft manuscript as of July 21, 1999.

TRMFR 2004. Trinity River Fishery Restoration Supplemental Environmental Impact Report Final draft prepared for FWS, Reclamation, Hoopa Valley Tribe and Trinity County by CH2MHill. April 2004.

Tucker, M.E., C.M. Williams, and R.R. Johnson. 1998. Abundance, food habits, and life history aspects of Sacramento squawfish and striped bass at the Red Bluff Diversion Complex, including the Research Pumping Plant, Sacramento River, CA, 1994-1996. Red Bluff Research Pumping Plant Report Series, Vol. 4. U.S. Fish and Wildlife Service, Red Bluff.

Tucker, M.E., C.D. Martin and P.D. Gaines. 2003. Spatial and temporal distribution of Sacramento pikeminnow and striped bass at the Red Bluff Diversion Complex, including the Research Pumping Plant, Sacramento River, CA: 1997-1998. Red Bluff Research Pumping Plant Report Series, Vol. 10. U.S. Fish and Wildlife Service, Red Bluff.

U.S. Army Corps of Engineers. 2001. Draft Environmental Assessment/Initial Study on the American River Project, California. Folsom Dam Modifications. February 2001. Sacramento District and State Board of Reclamation.

U.S. Bureau of Reclamation. 1985. Central Valley fish and wildlife management study: Fishery problems at Red Bluff Diversion Dam and Tehama-Colusa Canal fish facilities. Mid-Pacific Region. Sacramento, CA. 109 pages.

U.S. Bureau of Reclamation. 1991. Planning Report/Environmental Impact Statement: Appendix A, Shasta outflow temperature control. Mid Pacific Region. Sacramento, CA.

U.S. Bureau of Reclamation. 1992. Long-term Central Valley Project Operations Criteria and Plan. Biological Assessment for ESA section 7(a)(2) consultation. October 1992.

U.S. Bureau of Reclamation. 1995. Re-evaluation of louver efficiencies for juvenile Chinook salmon and striped bass at the Tracy Fish Collection Facility. Prepared by the Denver Office. Tracy Technical Report, Volume 3.

U.S. Bureau of Reclamation. 1997a. Central Valley Project Improvement Act (CVPIA) Draft Programmatic Environmental Impact Statement. Prepared for the U.S. Department of the Interior. Sacramento, CA.

U.S. Bureau of Reclamation. 1997b. Hydraulic field evaluation of the right abutment fish ladder at Red Bluff Diversion Dam. Red Bluff Diversion Dam Fish Passage Program.

U.S. Bureau of Reclamation. 1999a. Memorandum to Charles Liston regarding results from the model study if the Tracy Facility Crab Screen. 28 pages.

U.S. Bureau of Reclamation. 1999b. Evaluation plan for the Tracy Fish Collection Facility mitten crab exclusion program, 1999. Prepared by the Denver Technical Service Center, D-8290 and D-8560 Mid-Pacific Region, Tracy Project Office. 3 pages.

U.S. Bureau of Reclamation. 2000. Effects of Lower Stony Creek water management on winter-run Chinook salmon, spring-run Chinook salmon, fall/late fall-run Chinook salmon, and steelhead. Biological Assessment prepared by the Northern California Area Office, Red Bluff Field Station, December 12, 2000. 51 pages.

U.S. Bureau of Reclamation. 2001. Letter to NOAA Fisheries from Michael Ryan, documenting observations of juvenile salmon monitoring as required by the winter-run biological opinion. Dated February 5, 2001.

U.S. Bureau of Reclamation. 2003a. Long-term Central Valley Project and State Water Project Operating Criteria and Plan. Draft dated June 2003. Biological Assessment for ESA section 7(a)(2) consultation. Mid-Pacific Region. Sacramento, CA.

U.S. Bureau of Reclamation. 2003b. Sacramento River Settlement Contractors Long-term Contract Renewal. Biological assessment for ESA section 7(a)(2) consultation. Prepared for U.S. Bureau of Reclamation by CH2MHILL. Sacramento, CA. 120 pages with appendices.

U.S. Bureau of Reclamation and State Water Resource Control Board. 2003c. Final Draft Environmental Impact Statement/Environmental Impact Report for Battle Creek Salmon and Restoration Project. Prepared for CALFED Bay-Delta Program. July 2003.

U.S. Bureau of Reclamation. 2004a. Long-term Central Valley Project and State Water Project Operating Criteria and Plan. Various drafts dated January 8, February 13, March 18, March 22, May 24, and June 30, 2004. Biological Assessment for ESA section 7(a)(2) consultation. Mid-Pacific Region. Sacramento, CA.

U.S. Bureau of Reclamation. 2004b. Letter dated June 30, 2004 from Chet Bowling to Rod McInnis, NOAA Fisheries concerning temperature compliance on the American River for the interim OCAP biological opinion. Temperature modeling and Operations Plan for Folsom Reservoir was attached.

U.S. Bureau of Reclamation. 2004c. Empirical and experimental analyses of secondary louver efficiency at the Tracy Fish Collection Facility: March 1996 to November 1997. Prepared by Mark Bowen, *et al.* for Mid-Pacific Region Technical Services Center. January 2004. Tracy Technical Series Vol.11. 33 pages.

U.S. Bureau of Reclamation and Orange Cove Irrigation District. 1999. Draft Environmental Assessment/Initial Study for Mill Creek Anadromous Fish Adaptive Management Enhancement Plan. August 1999.

U.S. Bureau of Reclamation and Tehama-Colusa Canal Authority. 2002. Red Bluff Diversion Dam Fish Passage Improvement Project. Final draft prepared by CH2MHill. Willows, CA.

U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. 2000. Trinity River Mainstem Fishery Restoration Environmental Impact Report/Environmental Impact Statement. Final draft.

U.S. Department of Interior. 1999. Final Programmatic Environmental Impact Statement for the Central Valley Project Improvement Act. October 1999. Technical Appendix, 10 volumes.

U.S. Environmental Protection Agency. 1994. Methods for measuring the toxicity and bioaccumulation of sediment associated contaminants with freshwater invertebrates. EPA 600-R-94-024. Duluth, MN.

U.S. Fish and Wildlife Service. 1981. Report on problem number A-2: Anadromous fish passage at Red Bluff Diversion Dam. Central Valley Fish and Wildlife Management Study. Ecological Services, Sacramento, CA.

U.S. Fish and Wildlife Service. 1990. Evaluation of the measure of raising the Red Bluff Diversion Dam gates on improving anadromous salmonid fish passage based on observations of radio-tagged fish. FWS Report # AFF1-FAO-90-10. 21 pages.

U.S. Fish and Wildlife Service. 1991-2001. Survival and Productivity of juvenile Chinook salmon in the Sacramento-San Joaquin Estuary. Annual Progress Reports. Fisheries Assistance Office. Stockton, CA.

U.S. Fish and Wildlife Service. 1993. Endangered Species Act - section 7 consultation. Biological Opinion for the Los Vaqueros Project. Prepared for the U.S. Bureau of Reclamation and Contra Costa Water District.

U.S. Fish and Wildlife Service. 1994. East Sand Slough at Lake Red Bluff. Sacramento River. Fish and Wildlife Coordination Act Report. Ecological Services, Sacramento, CA. 15 pages.

U.S. Fish and Wildlife Service. 1995a. Memo from R. Johnson to L. Holsinger on estimates of spawning gravel for winter-run Chinook salmon in the upper Sacramento River. 6 pages.

U.S. Fish and Wildlife Service. 1995b. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. Portland, OR.

U.S. Fish and Wildlife Service. 1995c. Formal consultation and conference on effects of long-term operations of the Central Valley Project and the State Water Project on the threatened Delta Smelt, Delta Smelt Critical Habitat, and proposed threatened Sacramento Splittail. Biological opinion. Ecological Services, Sacramento, CA.

U.S. Fish and Wildlife Service. 1997. Supplemental report on the instream flow requirements for fall-run Chinook salmon spawning in the Lower American River. Sacramento, CA. 12 pages.

U.S. Fish and Wildlife Service. 1998. Trinity River flow evaluation. Prepared for the Secretary, U.S. Dept. of Interior. Prepared by FWS, Coastal California Fish and Wildlife Office, Arcata, CA and the Hoopa Valley Tribe. In consultation with the U.S. Geological Survey, Reclamation, NOAA Fisheries, and DFG. January 1998.

U.S. Fish and Wildlife Service. 1999. Upper Sacramento River winter Chinook salmon carcass survey 1997. Red Bluff Fish and Wildlife Office, Red Bluff, California.

U.S. Fish and Wildlife Service. 2000a. Impacts of riprapping to ecosystem functioning, Lower Sacramento River, California. Technical report prepared for the U.S. Army Corps of Engineers, Sacramento District. 39 pages.

U.S. Fish and Wildlife Service. 2000b. Trinity River Mainstem Fishery Restoration. Final Environmental Impact Statement/Report prepared for FWS, Bureau of Reclamation, Hoopa Valley Tribe and Trinity County. State Clearinghouse No. 1994123009. October 2000.

U.S. Fish and Wildlife Service. 2001a. Abundance and survival of juvenile Chinook salmon in the Sacramento-San Joaquin Estuary: 1997 and 1998. Annual progress report. 131 pages.

U.S. Fish and Wildlife Service. 2001b. Abundance and seasonal, spatial, and diel distribution patterns of juvenile salmonids passing the Red Bluff Diversion Dam, Sacramento River. Draft Progress Report for Red Bluff Research Pumping Plant, Vol.14. Prepared by Philip Gaines and Craig Martin for the U.S. Bureau of Reclamation. Red Bluff, CA.

U.S. Fish and Wildlife Service. 2003a. Flow-habitat relationships for steelhead and fall, late-fall, and winter-run Chinook salmon spawning in the Sacramento River between Keswick Dam and Battle Creek. Sacramento, CA. 76 pages.

U.S. Fish and Wildlife Service. 2003b. Estimating the abundance of Clear Creek juvenile Chinook salmon and steelhead trout by use of a rotary-screw trap. Draft progress report for the period December 1998 to April 2000. Prepared by P.D. Gaines and R.E. Null. Red Bluff, CA.

U.S. Fish and Wildlife Service. 2003c. Abundance and survival of juvenile Chinook salmon in the Sacramento-San Joaquin Estuary: 1999. Annual progress report. 70 pages.

U.S. Fish and Wildlife Service. 2004a. Flow-habitat relationships for spring-run Chinook salmon spawning in Butte Creek. Sacramento, CA. 20 pages.

U.S. Fish and Wildlife Service. 2004b. Draft adult spring Chinook salmon monitoring in Clear Creek, California, 1999-2002. Prepared by J.M. Newton and M.R. Brown. Red Bluff, CA.

U.S. Fish and Wildlife Service and Anderson-Cottonwood Irrigation District. 1999. Final Finding of No Significant Impact/Mitigated Negative Declaration and Environmental Assessment/Initial Study for the Anderson-Cottonwood Irrigation District Fish Passage Improvement Project. July 1999.

U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. 1988. Supplemental Fish and Wildlife Coordination Act Report: Red Bluff Diversion and Tehama-Colusa Canal. February 19, 1988. Sacramento, CA.

U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. 2003. Annual Work Plan Presentation, Central Valley Project Improvement Act, Anadromous Fish Screen Program.

Unwin, M.J., 1997. Fry-to-adult-survival of natural and hatchery produced Chinokk salmon (*Oncorhynchus tshawytscha*) from a common origin. Canadian Journal of Fisheries Aquatic Science 54:1246-1254.

Van Woert, W. 1964. Mill Creek counting station. Office memorandum to Eldon Hughes, May 25, 1964. California Department of Fish and Game, Water Projects Branch, Contract Services Section.

Velson, F.P. 1987. Temperature and incubation in Pacific salmon and rainbow trout, a compilation of data on median hatching time, mortality, and embryonic staging. Canadian Data Report of Fisheries and Aquatic Sciences No. 626.

Vincik, R.F., G.W. Edwards, G.A. Aasen, and R.W. Fujimura. 2003. Suisun Marsh Salinity Control Gates adult salmon passage monitoring, 1998-1999. Unpublished report. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. 27 pages.

Vogel, D.A. 2004. Juvenile Chinook salmon radio-telemetry studies in the northern and central Sacramento-San Joaquin Delta, 2002-2003. Report to the National Fish and Wildlife Foundation, Southwest Region. January 2004. 44 pages.

Vogel, D.A., and G. Taylor. 1987. Survey of the Chinook salmon spawning substrate in the Sacramento River from the Highway 273 Bridge to Keswick Dam. July-August, 1987. Joint Report by Fisheries Assistance Office, Red Bluff and Division of Ecological Services, Sacramento, California. Prepared for the City of Redding. 7 pages with maps.

Vogel, D.A., and K.R. Marine. 1991. Guide to upper Sacramento River Chinook salmon life history. Prepared for the U.S. Bureau of Reclamation, Central Valley Project. 55 pages.

Vogel, D.A., K.R. Marine, and J.G. Smith. 1988. Fish passage action program for Red Bluff Diversion Dam. Final report on fishery investigations. Report No. FR1/FAO-88-19. U.S. Fish and Wildlife Service, Northern Central Valley Fishery Resource Office. Red Bluff, CA.

Walters, C.J., R. Hilborn, R.M. Peterman, and M.J. Stanley. 1978. Model for examining early ocean limitation of Pacific salmon production. Journal of the Fisheries Research Board of Canada 35:1303-1315.

Waples, R.S. 1991. Pacific Salmon, *Oncorhynchus* spp., and the definition of "species" under the Endangered Species Act. Marine Fisheries Review 53:11-21.

Ward, P.D., T.R. Reynolds and C.E. Garman. 2003. Butte Creek spring-run Chinook salmon *Oncorhynchus tshawytscha*, pre-spawn mortality evaluation. California Department of Fish and Game, Inland Fisheries, Admin. Report No. 2004-5. Chico.

Water Forum. 2001. FISH Plan. Draft. October 31, 2001.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Tech. Mem. NMFS-NWFSC-24, Northwest Fisheries Science Center, Seattle, Washington. 258 pages.

Whitmore, C.M., C.E. Warren, and P. Doudoroff. 1960. Avoidance reactions of salmonid and centrarchid fishes to low oxygen concentrations. Transactions of the American Fisheries Society 89:17-26.

Williams, R.N., J.A. Lichatowich, P.R. Mundy and M Powell. 2003. Integrating artificial production with salmonid life history, genetic, and ecosystem diversity: a landscape perspective. September 2003. Issue paper for Trout Unlimited, West Coast Conservation Office. Portland, OR.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley Drainage of California. *In* Sierra Nevada Ecosystem Project, Final Report to Congress, Volume III. Assessments, Commissioned Reports, and Background Information. Centers for Water and Wildland Resources, University of California. Davis.

Yoshiyama, R.M., E.R.Gerstung, F.W. Fisher, and P.B. Moyle. 2001. Chinook salmon in the California Central Valley: an assessment. Fisheries 25(2):6-20.

Yoshiyama, R.M., F.W. Fisher, and P.B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley region of California. North American Journal of Fisheries Management 18:487-521.

Zaugg, W.S., and H.H. Wagner. 1973. Gill ATPase activity related to parr-smolt transformation in steelhead trout (*Salmo gairdneri*): influence of photoperiod and temperature. Comparative Biochemistry and Physiology 49:955-965.

Zedonis, P. 1996. Memo to the files. Fry stranding on the Trinity River with recommendations. U.S. Fish and Wildlife Service. Weaverville Sub-Office, Weaverville, California. April 5, 1996. 2 pages.

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
<u>**Central Valley**</u>	***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*	373	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)*	128	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	Sum
1968	BN	0	0	0	0	0	3446	10648	13980	1632	120	80	72	29958
1969	W	300	2772	2698	3420	275	284	14958	24124	3394	212	0	24	62229
1970	W	138	12	277	1083	1874	1189	10831	12784	8230	2100	540	12	36748
1971	W	0	3188	14062	223	1431	5528	3992	6013	778	0	0	0	36182
1972	BN	0	0	312	549	150	4822	13500	43387	19640	0	0	385	83864
1973	AN	1407	3598	5390	1848	667	1814	6634	22334	3817	0	0	0	52299
1974	W	899	1463	3150	907	927	4008	13108	87987	44862	3597	0	1	140087
1975	W	91	4638	2408	1748	1860	4904	5508	15181	683	27	80	402	36948
1976	C	2518	3559	2656	931	1076	10287	3040	13088	1802	114	251	24	39315
1977	C	139	128	642	2224	983	593	68	4822	612	0	0	0	9911
1978	AN	0	269	19066	45621	6668	511	19	2330	12400	632	0	21	88409
1979	BN	37139	653	3736	2399	1187	2304	28993	59790	9633	6647	359	70	151810
1980	AN	1515	5392	5249	5938	383	193	19669	27041	22838	725	725	931	90922
1981	D	985	948	1482	1756	3604	8327	66039	19115	362	0	85	0	89549
1982	W	395	2937	13086	6700	26915	23973	33993	110099	24446	0	0	0	238003
1983	W	0	8086	52757	12609	12758	4798	0	1178	37498	134	0	0	127823
1984	W	0	162	0	0	30	1659	27280	40078	45130	3	575	0	115947
1985	D	10514	8859	9883	121	947	2261	28246	96273	8769	409	0	19	166199
1986	W	719	1090	1952	1638	13422	18900	133773	178667	90240	0	0	0	438301
1987	D	0	153	549	63	405	4316	40904	95002	9263	573	69	33	151800
1988	C	2	18	28794	2948	4035	3005	44738	71036	21163	1781	309	24	177178
1989	D	39	460	1016	2982	170	8319	49525	42894	602	0	122	0	105704
1990	C	38	756	1277	2463	1103	4689	17377	8984	595	75	0	0	37316
1991	C	9	0	42	91	99	4795	18804	12268	680	0	0	0	37958
1992	C	73	1262	9	904	8445	9256	1058	2366	0	0	0	6	23398
1993	AN	0	0	183	1822	926	138	1487	2628	726	8	94	0	7807
1994	C	22	77	901	193	219	263	269	1767	30	0	0	0	3761
1995	W	0	10	707	6049	1389	18	14	3926	8084	184	12	0	19891
1996	W	0	0	0	3013	280	444	3337	8496	1563	14	0	10	14567
1997	W	3	112	46	18	36	1674	6014	2583	835	30	0	9	11539
1998	W	8	4	463	352	108	4	0	1713	1610	120	0	0	4383
1999	W	27	10	12	34	844	1874	23609	23864	469	48	44	42	50758
2000	AN	8	39	69	815	6826	3356	33830	9144	3851	33	16	633	46258
2001	D	227	62	180	263	1220	6422	13223	6747	0	0	0	0	35304
2002	D	0	0	462	1083	272	524	1606	2098	32	0	15	0	6090
2003	AN	0	4	718	0	0	0	0	0	0	0	0	0	730

Table A3: continued
Historical Chinook salmon salvage numbers from the SWP and CVP export facilities.

CVP Export Facilities

Year	WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Sum
1957	AN	0	0	0	0	0	3288	148864	25407	11600	512	312	192	217906
1958	W	0	0	0	0	0	0	0	0	0	528	48	0	576
1959	BN	0	0	0	0	0	29088	45476	19812	5148	276	84	48	100032
1960	D	0	0	0	0	0	8868	26040	25140	105684	432	48	0	165412
1961	D	0	0	0	0	0	4512	21444	25380	18792	408	72	0	70608
1962	BN	0	0	0	0	0	0	20424	68032	13944	312	48	0	92760
1963	W	0	0	0	0	0	0	0	14040	8196	336	48	60	23080
1964	D	0	0	0	0	372	1776	30144	57936	39864	888	0	108	131088
1965	W	0	0	0	0	0	2052	6864	232816	87072	3364	84	192	332144
1966	BN	12	0	0	0	0	11628	68868	23544	14568	288	84	72	119482
1967	W	96	0	0	0	0	4476	4140	29040	19200	3408	360	24	57744
1968	BN	72	0	0	1236	48667	36768	64812	47256	8584	0	48	1030	187963
1969	W	4008	6228	744	6828	1152	600	12828	36565	7032	804	0	132	76182
1970	W	744	0	0	0	25621	57100	136348	28023	17060	180	0	324	282349
1971	W	276	60	0	0	1200	21604	92700	183116	119156	3466	24	0	431482
1972	BN	144	3360	7464	0	6184	22052	69064	146352	59140	60	12	3360	309362
1973	AN	684	0	0	0	1896	4092	79480	78816	12096	144	0	0	175330
1974	W	34008	11688	1932	0	990	25444	40476	169916	31658	2358	24	36	318068
1975	W	1188	0	0	672	2184	8736	36760	61758	13404	432	122	60	114094
1976	C	252	121	36	0	676	13487	33618	61216	19800	0	216	24	115848
1977	C	216	240	312	2232	1044	204	1920	5448	1900	0	0	0	13416
1978	AN	0	0	108	0	0	300	984	4332	4280	192	0	0	10236
1979	BN	28592	2448	3480	2784	168	1058	82304	40100	5468	0	0	194	144876
1980	AN	0	795	0	0	125	293	93926	60083	7320	1197	0	0	163924
1981	D	316	1338	306	96	0	1703	39907	25975	5468	0	0	0	87068
1982	W	2360	499	6872	2411	6414	13170	8536	95364	68330	336	233	0	202402
1983	W	0	14836	12814	6962	4110	8149	47667	112807	31936	928	0	0	239997
1984	W	2302	489	66	162	0	8461	89303	81817	1904	990	0	0	182784
1985	D	10744	6671	5008	0	7319	4540	49790	65700	1623	103	0	0	143490
1986	W	8063	3839	5060	1810	401303	34136	87614	180070	46188	10257	0	0	767257
1987	D	642	75	968	308	504	716	47962	39177	0	0	0	0	90251
1988	C	0	0	2308	3728	2106	1494	24108	22219	206	57	0	0	56178
1989	D	0	0	302	73	0	6151	13674	20686	2459	0	0	0	43238
1990	C	0	0	0	92	103	71	2095	3940	918	0	0	0	6107
1991	C	0	0	0	0	198	2527	18360	7006	292	0	0	0	28383
1992	C	0	2708	138	510	3907	19002	17349	1893	0	0	0	0	44604
1993	AN	0	0	24	36	360	360	5364	11724	1020	0	0	0	18888
1994	C	12	402	1134	256	2796	1663	4358	858	36	0	0	0	11575
1995	W	12	0	2262	3852	816	684	9300	24618	23820	1044	0	0	66396
1996	W	144	0	132	804	1044	96	19066	15483	3072	0	0	0	39903
1997	W	24	192	72	192	12	16298	19728	13380	3920	12	12	24	53864
1998	W	48	48	344	49512	37752	11032	12552	43872	13316	180	0	0	168123
1999	W	0	84	0	2196	36148	9773	33354	36851	12252	36	36		132730
2000	AN	12	96	132	1212	27472	7336	30024	9946	1972	36	0	204	78202
2001	D	36	48	168	276	1176	2977	21804	2560	516	0	12	0	29563
2002	D	0	0	168	936	204	1833	9274	1728	660	12	12	0	14871
2003	AN	180	156	565	0	0	0	0	0	0	0	0	0	920

Table A4:
Historical Central Valley steelhead salvage from the SWP and CVP export facilities.

SWP Export Facilities

Year	WY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Sum
1968	BN	0	0	0	0	0	766	744	348	84	0	0	12	1954
1969	W	0	12	34	38	13	58	9	20	80	0	0	0	229
1970	W	0	24	120	170	13	25	242	0	0	24	0	0	618
1971	W	0	0	48	38	98	334	348	72	0	0	0	0	984
1972	BN	0	12	0	49	60	1813	710	141	0	0	0	0	2784
1973	AN	0	0	105	41	72	48	78	40	259	0	0	0	639
1974	W	0	0	0	0	58	879	141	11	480	0	0	21	1591
1975	W	1	0	0	0	435	2404	1116	229	40	0	0	13	4238
1976	C	8	120	0	82	224	1898	341	98	0	0	0	8	2815
1977	C	9	7	2	8	169	439	123	222	2	1230	0	0	2197
1978	AN	0	5	2238	390	5107	254	98	95	435	0	0	0	9031
1979	BN	0	0	0	18	25	464	1011	969	0	0	0	0	2484
1980	AN	0	30	23	391	935	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	10985	2441	179	0	0	0	17228
1983	W	17	0	0	290	99	0	0	258	0	0	0	0	642
1984	W	0	0	0	0	0	41	357	18	0	0	0	0	416
1985	D	0	0	22	0	325	1221	1185	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	1286	0	69	3387	976	448	0	0	0	0	6148
1988	C	0	0	172	38	2403	823	2116	405	25	0	0	0	6063
1989	D	0	0	0	46	469	4767	2105	404	0	0	0	0	7821
1990	C	0	0	0	0	1317	2198	1039	19	0	0	0	0	4570
1991	C	0	0	0	22	23	5799	91	0	0	0	0	0	5935
1992	C	92	498	0	148	5418	3887	201	33	0	0	0	0	10248
1993	AN	0	0	18	1330	8981	792	353	200	0	0	0	0	11252
1994	C	0	0	0	21	107	164	22	61	0	15	0	0	390
1995	W	2	0	4	380	362	78	8	98	117	30	0	0	1046
1996	W	4	0	0	3009	597	190	192	151	7	0	0	0	3150
1997	W	0	17	17	0	9	88	101	22	0	0	0	0	256
1998	W	28	0	30	62	18	0	0	0	8	0	0	0	132
1999	W	39	0	0	13	7	177	597	195	42	8	4	0	1070
2000	AN	8	38	3	731	4405	791	231	27	58	8	0	0	6292
2001	D	3	64	173	397	2932	4498	358	57	0	0	0	0	8332
2002	D	0	0	2	612	537	698	159	22	18	12	0	0	2019

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	Sum
1979	BN	0	0	0	402	372	494	1080	0	0	0	0	0	2338
1980	AN	0	0	0	0	0	90	743	126	0	0	0	0	959
1981	D	0	0	252	248	1259	1009	186	287	0	0	0	0	3301
1982	W	0	0	0	0	0	0	0	297	0	0	0	0	297
1983	W	0	0	1080	0	0	0	0	0	0	0	0	0	1080
1984	W	0	14	0	0	0	143	187	70	0	0	0	0	417
1985	D	0	0	0	0	93	134	127	101	0	0	0	0	446
1986	W	0	0	0	26	534	127	505	236	46	45	0	0	1511
1987	D	0	0	0	143	112	718	776	275	0	0	0	0	2024
1988	C	0	0	0	246	0	491	1039	1648	0	0	0	0	3424
1989	D	0	0	139	0	252	5051	3139	1212	0	0	0	0	9793
1990	C	0	0	0	0	1085	2139	786	0	0	0	0	0	4010
1991	C	0	0	0	95	109	4412	1263	98	0	0	0	0	5977
1992	C	0	0	0	4216	1788	2716	342	0	0	0	0	0	9062
1993	AN	0	0	0	0	3490	3060	684	84	24	0	0	0	7332
1994	C	0	0	12	30	678	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	308	24	354	94	12	0	0	0	2230
1997	W	0	0	24	12	0	168	336	80	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	324	336	508	161	24	0	0	0	1522
2000	AN	0	24	24	444	1822	336	204	80	0	0	0	0	2874
2001	D	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	4308	4078	3906	3939	3651	2883	2254	2867	4374	4560	4479
Today b(2) (2003)	4081	4211	4091	3903	3888	3661	2303	2254	2884	4378	4560	4479
Today EWA (2003)	4123	4027	3637	3342	3257	3754	2795	2083	2643	4419	4554	4465
Future SDIP (2030) 4a	4259	4478	4359	4093	3541	3250	2676	2227	2808	4402	4605	4500
Future EWA (2030) 5a	4274	4357	3582	3492	3348	3637	2849	2074	2871	4354	4594	4564
Above Normal												
D1641 with b(2) (1997)	3633	3538	3808	4224	4340	3873	2652	1863	2333	4576	4537	4454
Today b(2) (2003)	3867	3551	3863	4219	3939	3601	2650	1767	2807	4578	4539	4456
Today EWA (2003)	3740	3580	3578	3839	3507	4013	2540	1639	2869	4581	4503	4417
Future SDIP (2030) 4a	3759	3642	3988	4187	4207	3170	2632	2007	2641	4527	4479	4525
Future EWA (2030) 5a	3733	3813	3806	3957	3351	3848	2600	1551	2041	4539	4460	4585
Below Normal												
D1641 with b(2) (1997)	3782	3906	4060	4226	3848	3771	2394	1667	2861	4259	4408	4340
Today b(2) (2003)	3741	3900	3876	4225	3958	3582	2213	1637	3362	4059	4435	4342
Today EWA (2003)	3771	3788	3808	3898	3800	3374	2164	1259	2862	4094	4359	4118
Future SDIP (2030) 4a	3759	4062	4035	4871	3535	3171	2162	1585	2896	3912	4029	4374
Future EWA (2030) 5a	3903	3648	3886	4078	4026	3168	2154	1263	2849	3960	4247	4218
Dry												
D1641 with b(2) (1997)	3764	3560	3993	4222	3942	3509	1883	1558	2561	3657	3647	3882
Today b(2) (2003)	3709	3638	3994	4222	3940	3246	1869	1515	2509	3394	3330	3966
Today EWA (2003)	3748	3356	3573	3652	3768	3144	1921	1063	3447	3341	3063	3893
Future SDIP (2030) 4a	3838	3461	4188	4057	3725	3568	1962	1517	2290	2887	3351	3872
Future EWA (2030) 5a	3858	3362	3784	3898	4040	3210	1934	1086	2102	2827	2528	3850
Critical												
D1641 with b(2) (1997)	3479	3048	2824	3206	2930	1759	1094	1244	1220	1087	1425	2775
Today b(2) (2003)	3420	3069	2682	3184	2501	1794	943	1236	1166	1099	1353	2651
Today EWA (2003)	3469	2947	2648	2852	2804	1743	964	869	1093	941	1244	2634
Future SDIP (2030) 4a	3466	2723	2362	3460	3073	1874	1081	1062	935	870	1011	2362
Future EWA (2030) 5a	3321	2718	2644	3089	2290	1929	1138	838	1011	867	938	2656
Average												
D1641 with b(2) (1997)	3800	3738	3838	3994	3798	3369	2231	1774	2542	3718	3858	4066
Today b(2) (2003)	3774	3737	3813	3990	3776	3358	2219	1747	2523	3628	3778	4065
Today EWA (2003)	3818	3606	3465	3453	3460	3273	2131	1436	2496	3608	3672	3931
Future SDIP (2030) 4a	3676	3815	3875	4156	3698	3370	2166	1738	2467	3446	3832	4079
Future EWA (2030) 5a	3869	3854	3509	3873	3660	3253	2218	1491	2421	3440	3493	4053

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)	4.38	8.36	6.51	3.03	(1.22)	(11.23)	(8.56)	(1.23)	(0.60)	0.58	1.00	2.70
today vs future with EWA (3 v 5a)	3.65	5.95	7.02	4.50	2.72	4.88	2.33	(0.45)	0.97	(1.46)	0.88	2.91
1997 vs future with EWA (1 v 5a)	4.57	1.40	(4.78)	(11.98)	(15.05)	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	0.65	(0.75)	6.48	(18.74)	(1.12)	13.58	4.60	(1.12)	(1.30)	2.93
today vs future with EWA (3 v 5a)	(0.20)	6.51	3.30	6.38	7.33	(9.09)	(1.19)	0.80	2.54	(0.93)	(1.28)	3.80
1997 vs future with EWA (1 v 5a)	2.78	7.78	(5.43)	(8.70)	(8.65)	(8.17)	(1.64)	(16.61)	3.81	(0.81)	(1.91)	2.94
Below Normal												
today vs future no EWA (2 v4a)	0.49	4.15	1.23	8.18	(10.63)	(10.75)	(2.31)	(3.15)	1.21	(4.33)	(3.80)	0.73
today vs future with EWA (3 v 5a)	0.63	1.45	2.15	4.61	6.02	(5.50)	(1.35)	2.67	(0.43)	(5.72)	(2.78)	2.45
1997 vs future with EWA (1 v 5a)	0.83	(1.59)	(8.98)	(3.50)	4.68	(15.43)	(5.70)	(21.95)	(0.42)	(9.38)	(5.53)	(2.80)
Dry												
today vs future no EWA (2 v4a)	3.18	(2.13)	4.91	3.18	(5.40)	(7.99)	3.32	0.12	(9.14)	(14.93)	(14.38)	(2.11)
today vs future with EWA (3 v 5a)	2.95	(0.08)	6.21	8.58	6.42	2.08	0.67	3.11	(14.08)	(12.38)	(17.18)	(1.30)
1997 vs future with EWA (1 v 5a)	3.90	(6.62)	(4.95)	(8.68)	5.17	(9.53)	2.42	(30.33)	(17.93)	(19.95)	(30.87)	(0.93)
Critical												
today vs future no EWA (2 v4a)	1.05	(11.65)	6.73	8.31	5.81	10.05	14.20	(14.07)	(19.79)	(20.15)	(25.33)	(4.11)
today vs future with EWA (3 v 5a)	(4.28)	(7.77)	(0.15)	7.36	6.63	10.64	15.67	(6.71)	(7.60)	2.78	(24.62)	0.07
1997 vs future with EWA (1 v 5a)	(4.52)	(10.87)	(6.34)	(4.33)	2.40	8.68	10.08	(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	(2.91)	(8.38)	(2.38)	(0.63)	(2.81)	(4.87)	(4.92)	0.60
today vs future with EWA (3 v 5a)	1.33	2.15	4.49	6.06	5.46	0.38	1.51	0.36	(2.94)	(4.38)	(4.89)	1.80
1997 vs future with EWA (1 v 5a)	1.82	(1.39)	(5.95)	(8.04)	(3.59)	(3.41)	(0.65)	(18.78)	(4.73)	(7.24)	(9.60)	(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	July	Aug	Sept	Grand Total	WY
1993														
Salvage Number			318	1470	1125	344	83	0	0				3538	AN
todayvs future no EWA (2 v 4a)	5	2	(6)	(3)	4	3	4	8	1	0	7	1		
todayvs 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	15	(2)		
Change in Salmon Salvage													Sum of Change	% Change
todayvs future no EWA (2 v 4a)			(28)	(39)	48	9	3	0	0				(7)	(0)
todayvs future with EWA(3 v 5a)			(0)	11	33	12	1	0	0				51	1
1997 vs future with EWA (1 v 5a)			(31)	(124)	(49)	32	(14)	0	0		-		(186)	(5)
1994														
Salvage Number			238	215	2941	1625	432	6	0				5457	C
todayvs future no EWA (2 v 4a)	(1)	(3)	2	2	8	8	7	(7)	(7)	(12)	(8)	(7)		
todayvs future with EWA(3 v 5a)	(1)	(7)	(0)	6	1	8	8	(5)	3	3	(18)	(3)		
1997 vs future with EWA (1 v 5a)	3	(8)	(3)	(6)	5	5	1	(35)	8	52	37	(3)		
Change in Salmon Salvage													Sum of Change	% Change
todayvs future no EWA (2 v 4a)			5	5	222	130	30	(0)	0				391	7
todayvs 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)	136	89	4	(2)	0				207	4
1995														
Salvage Number			36	4082	268	34	384	16	0				4820	W
todayvs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(5)	(0)		
todayvs future with EWA(3 v 5a)	3	2	7	5	4	6	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
todayvs future no EWA (2 v 4a)			2	189	12	3	7	0	0				214	4
todayvs future with EWA(3 v 5a)			3	215	11	2	15	1	0				248	5
1997 vs future with EWA (1 v 5a)			(1)	(120)	(10)	7	(45)	(5)	0				(172)	(4)
1996														
Salvage Number			36	3281	386	73	40	12	0				3828	W
todayvs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(5)	(0)		
todayvs 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
todayvs future no EWA (2 v 4a)			2	152	18	6	1	0	0				179	5
todayvs future with EWA(3 v 5a)			3	173	16	3	2	1	0				198	5
1997 vs future with EWA (1 v 5a)			(1)	(96)	(14)	16	(5)	(4)	0				(103)	(3)
1997														
Salvage Number			520	1	0	337	23	0	0				881	W
todayvs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(5)	(0)		
todayvs 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
todayvs future no EWA (2 v 4a)			33	0	0	28	0	0	0				62	7
todayvs 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	196	12	0	0				720	W
today vs future no EWA (2 v4a)	4	4	6	5	5	9	2	1	(2)	3	(6)	(0)		
today vs future with EWA (3 v5a)	3	2	7	5	4	8	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v5a)	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	6	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 v5a)			(0)	(12)	(4)	48	(1)	0	0				25	3
1999														
Salvage Number			48	56	85	1109	435	0	0				1732	W
today vs future no EWA (2 v4a)	4	4	6	5	5	6	2	1	(2)	2	(5)	(0)		
today vs future with EWA (3 v5a)	3	2	7	5	4	5	4	8	3	2	(6)	(3)		
1997 vs future with EWA (1 v5a)	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 v5a)			(1)	(2)	(3)	239	(31)	0	0				189	11
2000														
Salvage Number			138	975	1148	590	166	0	0				3002	AN
today vs future no EWA (2 v4a)	5	2	(8)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(6)	0	1		
1997 vs future with EWA (1 v5a)	7	0	(8)	(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)	(20)	48	18	7	0	0				39	1
today vs future with EWA (3 v5a)			(1)	7	33	21	3	0	0				62	2
1997 vs future with EWA (1 v5a)			(8)	(82)	(50)	46	(28)	0	0				(113)	(4)
2001														
Salvage Number			504	509	2261	3301	138	0	0				7273	D
today vs future no EWA (2 v4a)	(0)	(2)	3	3	(2)	(1)	4	(3)	(7)	(2)	(6)	(4)		
today vs future with EWA (3 v5a)	(1)	1	5	8	3	3	1	4	(9)	(4)	(8)	(7)		
1997 vs future with EWA (1 v5a)	2	(5)	(2)	(7)	2	(2)	(6)	(40)	(14)	8	(10)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v4a)			15	13	(37)	(58)	5	0	0				(60)	(1)
today vs future with EWA (3 v5a)			28	29	82	95	2	0	0				217	3
1997 vs future with EWA (1 v5a)			(11)	(35)	58	(86)	(11)	0	0				(87)	(1)
2002														
Salvage Number			850	1623	378	1067	138	0	0				4047	D
today vs future no EWA (2 v4a)	(0)	(2)	3	3	(8)	(1)	4	(3)	(7)	(2)	(5)	(4)		
today vs future with EWA (3 v5a)	(1)	1	5	8	3	3	1	4	(9)	(8)	(8)	(7)		
1997 vs future with EWA (1 v5a)	2	(5)	(8)	(7)	2	(2)	(6)	(40)	(14)	8	(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 v5a)			(18)	(110)	9	(24)	(11)	0	0				(153)	(4)
2003														
Salvage Number			310	6830	1130	1138	64	24	13				9388	AN
today vs future no EWA (2 v4a)	5	2	(8)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(6)	0	1		
1997 vs future with EWA (1 v5a)	7	0	(8)	(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)	40	32	40	1	(1)	0				119	1
1997 vs future with EWA (1 v5a)			(12)	(578)	(49)	105	(11)	(2)	(0)				(555)	(8)

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	July	Aug	Sept	Grand Total	WY
1993														
Loss Number			1707	6225	3802	680	185	8	0				12498	AN
today vs future no EWA (2 v 4a)	5	3	(6)	(3)	4	3	4	6	1	8	7	1		
today vs future with EWA (3 v5a)	6	2	(1)	1	3	4	2	(4)	0	(8)	8	1		
1997 vs future with EWA (1 v5a)	7	0	(6)	(8)	(4)	9	(17)	(30)	(3)	7	16	(2)		
Change in Salmon Loss													Sum of Change	% Change
today vs future no EWA (2 v 4a)			(94)	(166)	161	16	7	0	0	0	0	0	(76)	(1)
today vs future with EWA (3 v5a)			(30)	45	110	20	3	0	0	0	0	0	168	1
1997 vs future with EWA (1 v5a)			(101)	(527)	(165)	54	(31)	0	0	0	0	0	(771)	(6)
1994														
Loss Number			792	490	2480	2155	399	33					6328	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 v5a)	(1)	(7)	(8)	6	1	8	8	(5)	3	3	(19)	(3)		
1997 vs future with EWA (1 v5a)	3	(6)	(3)	(6)	5	5	1	(36)	8	52	37	(3)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			13	11	185	173	28	(2)	0	0	0	0	412	7
today vs future with EWA (3 v5a)			(9)	28	30	175	31	(1)	0	0	0	0	248	4
1997 vs future with EWA (1 v5a)			(27)	(28)	113	118	4	(13)	0	0	0	0	173	3
1995														
Loss Number			23	13707	737	64	201	28					13043	W
today vs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(6)	(8)		
today vs future with EWA (3 v5a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			1	590	35	6	5	0	0	0	0	0	638	5
today vs future with EWA (3 v5a)			2	678	31	3	12	2	0	0	0	0	726	5
1997 vs future with EWA (1 v5a)			(0)	(375)	(27)	14	(34)	(8)	0	0	0	0	(431)	(3)
1996														
Loss Number			110	11967	1038	330	48	8					13403	W
today vs future no EWA (2 v 4a)	4	4	6	5	5	8	3	1	(2)	3	(6)	(8)		
today vs future with EWA (3 v5a)	3	2	7	5	4	6	4	8	3	2	(6)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			7	549	42	27	1	0	0	0	0	0	632	5
today vs future with EWA (3 v5a)			8	628	44	15	2	1	0	0	0	0	698	5
1997 vs future with EWA (1 v5a)			(2)	(349)	(38)	71	(6)	(2)	0	0	0	0	(324)	(2)
1997														
Loss Number			1638	4	0	407	107						2158	W
today vs future no EWA (2 v 4a)	4	4	6	5	5	8	2	1	(2)	2	(6)	(8)		
today vs future with EWA (3 v5a)	3	2	7	5	4	5	4	8	3	2	(6)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA (2 v 4a)			106	0	0	34	7	0	0	0	0	0	148	7
today vs future with EWA (3 v5a)			115	0	0	19	18	0	0	0	0	0	151	7
1997 vs future with EWA (1 v5a)			(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	July	Aug	Sept	Grand Total	WY
1998														
Loss Number			19	1000	77	180	9						1293	W
today vs future no EWA(2 v4a)	4	4	8	5	5	8	2	1	(3)	2	(6)	(0)		
today vs future with EWA(3 v5a)	3	2	7	6	4	6	4	8	3	2	(6)	(3)		
1997 vs future with EWA(1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v4a)			1	47	3	15	0	0	0	0	0	0	66	5
today vs future with EWA(3 v5a)			1	53	3	8	0	0	0	0	0	0	65	5
1997 vs future with EWA(1 v5a)			(0)	(30)	(3)	39	(1)	0	0	0	0	0	5	0
1999														
Loss Number			31	68	59	2493	1544						4195	W
today vs future no EWA(2 v4a)	4	4	6	5	5	8	2	1	(2)	2	(6)	(0)		
today vs future with EWA(3 v5a)	3	2	7	6	4	6	4	8	3	2	(6)	(3)		
1997 vs future with EWA(1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(0)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v4a)			2	3	3	205	28	0	0	0	0	0	241	6
today vs future with EWA(3 v5a)			2	4	2	114	62	0	0	0	0	0	184	4
1997 vs future with EWA(1 v5a)			(0)	(2)	(3)	536	(180)	0	0	0	0	0	352	8
2000														
Loss Number			394	2608	3828	1580	248						8658	AN
today vs future no EWA(2 v4a)	5	2	(8)	(3)	4	3	4	6	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 v5a)	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 v4a)			(21)	(70)	162	43	10	0	0	0	0	0	124	1
today vs future with EWA(3 v5a)			(4)	18	111	56	4	0	0	0	0	0	186	2
1997 vs future with EWA(1 v5a)			(33)	(221)	(167)	148	(42)	0	0	0	0	0	(304)	(4)
2001														
Loss Number			1688	1297	6013	15408	258						24660	D
today vs future no EWA(2 v4a)	(0)	(2)	3	3	(7)	(1)	4	(6)	(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 v5a)	2	(5)	(2)	(7)	2	(6)	(6)	(40)	(14)	8	(10)	(3)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v4a)			51	34	(99)	(225)	9	0	0	0	0	0	(230)	(1)
today vs future with EWA(3 v5a)			86	73	165	391	4	0	0	0	0	0	721	3
1997 vs future with EWA(1 v5a)			(26)	(89)	148	(344)	(30)	0	0	0	0	0	(340)	(1)
2002														
Loss Number			2560	4835	1222	3056	265						10677	D
today vs future no EWA(2 v4a)	(0)	(2)	3	3	(7)	(1)	4	(6)	(7)	(3)	(6)	(4)		
today vs future with EWA(3 v5a)	(1)	1	5	8	3	3	1	4	(8)	(4)	(6)	(7)		
1997 vs future with EWA(1 v5a)	2	(5)	(2)	(7)	2	(6)	(6)	(40)	(14)	8	(10)	(3)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v4a)			75	127	(20)	(30)	9	0	0	0	0	0	161	1
today vs future with EWA(3 v5a)			130	274	34	52	4	0	0	0	0	0	490	5
1997 vs future with EWA(1 v5a)			(54)	(328)	30	(45)	(21)	0	0	0	0	0	(418)	(4)
2003														
Loss Number			515	20412	3287	3108	198	23	8				27578	AN
today vs future no EWA(2 v4a)	5	2	(8)	(3)	4	3	4	8	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 v5a)	7	0	(8)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon Loss													Sum of Change	
today vs future no EWA(2 v4a)			(39)	(545)	139	94	8	1	0	0	0	0	(341)	(1)
today vs future with EWA(3 v5a)			(5)	148	95	109	3	(1)	0	0	0	0	348	1
1997 vs future with EWA(1 v5a)			(30)	(1729)	(143)	289	(34)	(8)	(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	July	August	Sept	Grand Total	year type
1993														
Salvage Number	0	0	0	0	0	63	3308	4327	28	0	0	0	7741	AN
today vs future no EWA (2 v 4a)	5	2	(8)	(3)	4	3	4	8	1	0	7	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)	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)			0	0	0	2	130	262	0	0	0	0	394	5
today vs future with EWA (3 v 5a)			0	0	0	2	55	(154)	0	0	0	0	(96)	(1)
1997 vs future with EWA (1 v 5a)			0	0	0	6	(561)	(1691)	(1)	0	0	0	(2247)	(29)
1994														
Salvage Number	0	0	0	0	0	230	3364	600	0	0	0	0	4193	C
today vs future no EWA (2 v 4a)	(1)	(3)	2	2	8	8	7	(7)	(7)	(12)	(9)	(7)		
today vs future with EWA (3 v 5a)	(1)	(7)	(0)	6	1	9	8	(6)	3	3	(19)	(3)		
1997 vs future with EWA (1 v 5a)	3	(8)	(3)	(8)	5	6	1	(30)	6	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	304	(26)	0	0	0	0	297	8
1997 vs future with EWA (1 v 5a)			0	0	0	18	31	(199)	0	0	0	0	(150)	(4)
1995														
Salvage Number	0	0	0	0	16	336	6698	14416	7463	0	0	0	29008	W
today vs future no EWA (2 v 4a)	4	4	6	5	5	6	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)	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)					1	28	136	208	(120)	0	0	0	237	1
today vs future with EWA (3 v 5a)					1	15	278	1170	209	0	0	0	1669	6
1997 vs future with EWA (1 v 5a)					(1)	73	(797)	(4394)	(226)	0	0	0	(5245)	(18)
1996														
Salvage Number		0	0	0	23	431	20144	7706	301	0	0	0	28670	W
today vs future no EWA (2 v 4a)	4	4	6	6	5	9	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)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(3)	(0)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)			0	0	1	36	371	112	(6)	0	0	0	514	2
today vs future with EWA (3 v 5a)			0	0	1	20	808	630	8	0	0	0	1487	5
1997 vs future with EWA (1 v 5a)			0	0	(1)	93	(2344)	(2306)	(10)	0	0	0	(4570)	(16)
1997														
Salvage Number	8	0	0	0	21	17015	24557	1580	38	0	0	0	43228	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	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	33	(1)	0	0	0	1899	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)	3873	(2858)	(472)	(1)	0	0	0	342	1

Table A8: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	August	Sept	Grand Total	year type
1998														
Salvage Number	0	0	0	0	12	7283	10603	16207	564	0	0	0	34679	W
today vs future no EWA (2 v 4a)	4	4	8	5	5	8	2	1	(2)	2	(5)	(8)		
today vs future with EWA (3 v5a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	1	602	193	224	(8)	0	0	0	1020	3
today vs future with EWA (3 v5a)	0	0	0	0	1	336	421	1315	16	0	0	0	2088	6
1997 vs future with EWA (1 v5a)	0	0	0	0	(0)	1573	(1223)	(4818)	(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	4	6	5	5	8	2	1	(2)	2	(5)	(8)		
today vs future with EWA (3 v5a)	3	2	7	5	4	5	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	3	263	744	176	(8)	0	0	0	1184	2
today vs future with EWA (3 v5a)	0	0	0	0	3	148	1622	981	1	0	0	0	2753	5
1997 vs future with EWA (1 v5a)	0	0	0	0	(3)	696	(4710)	(3802)	(1)	0	0	0	(7819)	(14)
2000														
Salvage Number	0	0	0	0	136	3092	39347	2168	18	0	0	0	44746	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 v5a)	5	2	(1)	1	3	4	2	(4)	0	(8)	0	1		
1997 vs future with EWA (1 v5a)	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 v 4a)	0	0	0	0	6	83	1550	125	0	0	0	0	1765	4
today vs future with EWA (3 v5a)	0	0	0	0	4	109	659	(78)	0	0	0	0	693	2
1997 vs future with EWA (1 v5a)	0	0	0	0	(6)	287	(6678)	(840)	(1)	0	0	(0)	(7239)	(16)
2001														
Salvage Number	0	0	0	0	0	2690	14128	1383	0	0	0	0	18204	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 v5a)	(1)	1	6	8	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA (1 v5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(18)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	0	0	(39)	501	(35)	0	0	0	0	428	2
today vs future with EWA (3 v5a)	0	0	0	0	0	68	195	56	0	0	0	0	319	2
1997 vs future with EWA (1 v5a)	0	0	0	0	0	(60)	(1113)	(546)	0	0	0	0	(1717)	(9)
2002														
Salvage Number				36	12	1121	9043	846	24	0	0		10031	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 v5a)	(1)	1	6	8	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA (1 v5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(18)	(3)		
Change in Salmon Salvage													Sum of Change	% Change
today vs future no EWA (2 v 4a)	0	0	0	1	(0)	(18)	320	(13)	(2)	0	0	0	288	3
today vs future with EWA (3 v5a)	0	0	0	2	0	38	135	28	(2)	0	0	0	182	2
1997 vs future with EWA (1 v5a)	0	0	0	(2)	0	(20)	(712)	(278)	(5)	0	0	0	(1017)	(9)
2003														
Salvage Number	0	0	0	43	24	5208	10362	914	0	0	0	0	16570	AN
today vs future no EWA (2 v 4a)	5	2	(6)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA (3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(8)	0	1		
1997 vs future with EWA (1 v5a)	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 v 4a)	0	0	0	(1)	1	141	409	53	0	0	0	0	603	4
today vs future with EWA (3 v5a)	0	0	0	0	1	182	174	(32)	0	0	0	0	325	2
1997 vs future with EWA (1 v5a)	0	0	0	(4)	(1)	435	(1782)	(358)	0	0	0	0	(1639)	(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	July	Aug	Sept	Grand Total	WY
1993	0	0	0			103	5618	7528	40				13290	AN
Loss Number	6	2	(8)	(3)	4	3	4	6	1	0	7	1		
today vs future no EWA (2 v4a)	5	2	(1)	1	3	4	2	(4)	0	(0)	0	1		
today vs future with EWA (3 v 5a)	7	0	(6)	(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	408	0	0	0	0	662	6
today vs future no EWA (2 v4a)			0	0	0	4	94	(287)	0	0	0	0	(189)	(1)
today vs future with EWA (3 v 5a)			0	0	0	10	(954)	(2939)	(1)	0	0	0	(3884)	(29)
1997 vs future with EWA (1 v 5a)														
1994	0	0				201	3407	1140					4749	C
Loss Number	(1)	(3)	2	2	8	8	7	(7)	(7)	(13)	(8)	(7)		
today vs future no EWA (2 v4a)	(1)	(7)	(0)	8	1	6	8	(5)	3	3	(18)	(3)		
today vs future with EWA (3 v 5a)	3	(8)	(3)	(6)	5	6	1	(36)	8	62	37	(3)		
1997 vs future with EWA (1 v 5a)														
													Sum of Change	
Change in Salmon Loss			0	0	0	18	240	(75)	0	0	0	0	181	4
today vs future no EWA (2 v4a)			0	0	0	16	286	(52)	0	0	0	0	230	5
today vs future with EWA (3 v 5a)			0	0	0	11	31	(398)	0	0	0	0	(356)	(7)
1997 vs future with EWA (1 v 5a)														
1995	0				24	237	4008	13800	15082				33852	W
Loss Number	4	4	6	5	5	6	2	1	(2)	2	(8)	(0)		
today vs future no EWA (2 v4a)	3	2	7	6	4	6	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			0	0	1	20	80	388	(254)	0	0	0	120	0
today vs future no EWA (2 v4a)			0	0	1	11	197	1509	423	0	0	0	2141	6
today vs future with EWA (3 v 5a)			0	0	(1)	51	(571)	(5527)	(479)	0	0	0	(6526)	(17)
1997 vs future with EWA (1 v 5a)														
1996		0	0	0	30	1555	22536	14113	747				38981	W
Loss Number	4	4	8	5	5	6	2	1	(2)	2	(5)	(0)		
today vs future no EWA (2 v4a)	3	2	7	6	4	6	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			0	0	1	128	415	304	(13)	0	0	0	735	2
today vs future no EWA (2 v4a)			0	0	1	72	803	1145	21	0	0	0	2142	6
today vs future with EWA (3 v 5a)			0	0	(1)	330	(2023)	(4184)	(24)	0	0	0	(6508)	(17)
1997 vs future with EWA (1 v 5a)														
1997	39	0	0	0	45	15226	36773	3181	23	0	0	0	55292	W
Loss Number	4	4	6	6	6	9	2	1	(2)	2	(5)	(0)		
today vs future no EWA (2 v4a)	3	2	7	6	4	5	4	6	3	2	(6)	(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	45	(0)	0	0	0	1982	4
today vs future no EWA (2 v4a)	1	0	0	0	2	700	1474	259	1	0	0	0	2437	4
today vs future with EWA (3 v 5a)	3	0	0	0	(2)	3287	(4279)	(948)	(1)	0	0	0	(1940)	(4)
1997 vs future with EWA (1 v 5a)														

Table A9: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Grand Total	WY
1998														
Loss Number	0	0	0	0	8	4800	8110	14219	1082				28230	W
today vs future no EWA(2 v4a)	4	4	8	5	5	8	3	1	(2)	2	(5)	(8)		
today vs future with EWA(3 v5a)	3	2	7	5	4	6	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon loss													Sum of Change	
today vs future no EWA(2 v4a)	0	0	0	0	0	398	149	205	(18)	0	0	0	733	3
today vs future with EWA(3 v5a)	0	0	0	0	0	221	325	1164	31	0	0	0	1731	6
1997 vs future with EWA (1 v5a)	0	0	0	0	(0)	1038	(944)	(4226)	(35)	0	0	0	(4169)	(15)
1999														
Loss Number	0	0	0		84	3155	92273	22693	18				128173	W
today vs future no EWA(2 v4a)	4	4	8	5	5	8	2	1	(2)	2	(5)	(0)		
today vs future with EWA(3 v5a)	3	2	7	5	4	6	4	8	3	2	(5)	(3)		
1997 vs future with EWA (1 v5a)	8	2	(1)	(3)	(4)	22	(12)	(30)	(3)	0	(2)	(8)		
Change in Salmon loss													Sum of Change	
today vs future no EWA(2 v4a)	0	0	0	0	4	264	1697	471	(0)	0	0	0	2435	2
today vs future with EWA(3 v5a)	0	0	0	0	4	147	3699	3545	1	0	0	0	8498	5
1997 vs future with EWA (1 v5a)	0	0	0	0	(3)	680	(10718)	(9695)	(1)	0	0	0	(19739)	(15)
2000														
Loss Number	0	0	0		264	7283	84002	7132	84			38	98801	AN
today vs future no EWA(2 v4a)	5	2	(8)	(3)	4	3	4	8	1	0	7	1		
today vs future with EWA(3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(8)	0	1		
1997 vs future with EWA (1 v5a)	7	0	(8)	(8)	(4)	8	(17)	(39)	(3)	7	15	(2)		
Change in Salmon loss													Sum of Change	
today vs future no EWA(2 v4a)	0	0	0	0	11	197	3310	414	1	0	0	0	3933	4
today vs future with EWA(3 v5a)	0	0	0	0	8	255	1408	(252)	0	0	0	0	1419	1
1997 vs future with EWA (1 v5a)	0	0	0	0	(11)	679	(14258)	(2780)	(3)	0	0	(0)	(16375)	(17)
2001														
Loss Number	0	0	0			7435	28768	5204	0				41394	D
today vs future no EWA(2 v4a)	(8)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(5)	(4)		
today vs future with EWA(3 v5a)	(1)	1	8	6	3	3	1	4	(8)	(4)	(8)	(7)		
1997 vs future with EWA (1 v5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	6	(10)	(3)		
Change in Salmon loss													Sum of Change	
today vs future no EWA(2 v4a)	0	0	0	0	0	(110)	1019	(132)	0	0	0	0	778	2
today vs future with EWA(3 v5a)	0	0	0	0	0	189	397	210	0	0	0	0	795	2
1997 vs future with EWA (1 v5a)	0	0	0	0	0	(166)	(2253)	(3067)	0	0	0	0	(4486)	(11)
2002														
Loss Number				21	8	1248	10828	2483	18				14679	D
today vs future no EWA(2 v4a)	(8)	(2)	3	3	(2)	(1)	4	(3)	(7)	(3)	(5)	(4)		
today vs future with EWA(3 v5a)	(1)	1	5	6	3	3	1	4	(8)	(8)	(8)	(7)		
1997 vs future with EWA (1 v5a)	2	(5)	(2)	(7)	2	(2)	(8)	(40)	(14)	8	(10)	(3)		
Change in Salmon loss													Sum of Change	
today vs future no EWA(2 v4a)	0	0	0	1	(0)	(18)	384	(82)	(1)	0	0	0	303	2
today vs future with EWA(3 v5a)	0	0	0	1	0	32	148	99	(1)	0	0	0	280	2
1997 vs future with EWA (1 v5a)	0	0	0	(1)	0	(20)	(930)	(974)	(2)	0	0	0	(1887)	(13)
2003														
Loss Number	0	0	0	48	87	12237	27971	2873					42303	AN
today vs future no EWA(2 v4a)	5	2	(8)	(3)	4	3	4	6	1	0	7	1		
today vs future with EWA(3 v5a)	5	2	(1)	1	3	4	2	(4)	0	(8)	0	1		
1997 vs future with EWA (1 v5a)	7	0	(8)	(8)	(4)	9	(17)	(39)	(3)	7	15	(2)		
Change in Salmon loss													Sum of Change	
today vs future no EWA(2 v4a)	0	0	0	(1)	3	301	1102	180	0	0	0	0	1584	4
today vs future with EWA(3 v5a)	0	0	0	0	3	409	489	(91)	0	0	0	0	809	2
1997 vs future with EWA (1 v5a)	0	0	0	(4)	(2)	(141)	(4748)	(1083)	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 - TFPF (USBR)				SWP - JSS Delta FPF (DWR)				GRAND TOTAL LOSS
			Loss	Loss			Loss	Loss	
	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		3333	0	6667
Arrive at Screens	13333	0			13333	0			
Pre Screen Loss	0.150		2353	0	0.750		40000	0	42353
Arrive at Facility	15686	0			53333	0			
CHT&R Loss	0.020		200	0	0.020		200	0	400
Released Alive	9800	0			9800	0			
Loss Total			5886	0			43533	0	49420
Loss (CCA Incidental Take)				5886				43533	49420
Salvage				10000				10000	20000
Take (Arrive at the Facilities)				15686				53333	69019

Through Delta Survival Level	% Survival	Number Entering Central Delta CVP	SWP	Total
Low	0.05	313,725	1,066,667	1,380,392
High	0.66	23,767	80,808	104,575

Table A10: Simple Model for Through-Delta Expansion - part 2

Effects of Future Pumping Changes									
				Number Fish Entering Delta From Sacramento River					
Assume 10,000 fish in expanded salvage									
CVP	Arrive at screen			Low Survival - 5%			High Survival - 66%		
% increase	Initial	Future	Change	Initial	Future	Change	Initial	Future	Change
3%	15,686	16,157	471	313,720	323,132	9,412	23,767	24,480	713
5%	15,686	16,470	784	313,720	329,406	15,686	23,767	24,955	1,188
10%	15,686	17,255	1,569	313,720	345,092	31,372	23,767	26,143	2,377
SWP	Arrive at screen			Low Survival - 5%			High Survival - 66%		
% increase	Initial	Future	Change	Initial	Future	Change	Initial	Future	Change
3%	53,333	54,933	1,600	1,066,667	1,098,667	32,000	80,808	83,232	2,424
5%	53,333	56,000	2,667	1,066,667	1,120,000	53,333	80,808	84,848	4,040
10%	53,333	58,667	5,333	1,066,667	1,173,333	106,667	80,808	88,889	8,081

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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
D1641 with b(2) (1997)	4732	5374	6384	6866	6415	5314	4416	4470	5488	5589	6368	6522
Today b(2) (2003)	4706	5397	6401	6866	6407	5317	4430	4460	5474	5601	6352	6522
Today EWA (2003)	5127	5570	6010	6647	6311	6667	3418	2298	5025	5367	6795	6815
Future SDIP (2030) Study 4	5239	5815	7421	7398	6731	6352	5088	4849	5769	6055	5875	7066
Future EWA (2030) Study 5	5707	5659	7280	7212	6527	7246	3819	2458	5788	8055	6874	7098
Above Normal												
D1641 with b(2) (1997)	4038	4516	6088	7703	7147	5822	4226	3740	4455	5801	4791	5831
Today b(2) (2003)	3973	4520	6090	7677	7159	5844	4231	3739	4583	5544	4792	5772
Today EWA (2003)	4066	4325	5936	7211	6989	6342	2978	2004	4166	6344	6156	5646
Future SDIP (2030) Study 4	4434	4772	5908	7588	7496	7044	4673	3876	4744	6110	4890	5632
Future EWA (2030) Study 5	4637	4860	6164	7409	7008	7368	3284	1868	4425	7139	5422	5584
Below Normal												
D1641 with b(2) (1997)	4506	4158	5514	6497	5883	5466	3697	2816	3391	5387	5822	5550
Today b(2) (2003)	4415	4171	5468	6471	5697	5572	3691	2917	3986	5390	5805	5516
Today EWA (2003)	4852	4065	5105	6261	6247	5530	2547	1598	3338	6448	6794	5243
Future SDIP (2030) Study 4	4403	4421	6244	7042	6189	6124	3777	3311	3972	5823	6061	5171
Future EWA (2030) Study 5	4672	4303	5852	6637	6261	5887	2536	1354	3638	7030	6963	5046
Dry												
D1641 with b(2) (1997)	3935	3188	5143	5631	5049	4144	2242	1886	2617	5104	4280	4349
Today b(2) (2003)	3884	3170	5100	5646	5026	4191	2302	1631	2791	4833	4268	4312
Today EWA (2003)	4170	2966	4923	5141	5070	4153	1833	1013	2421	6378	4745	4818
Future SDIP (2030) Study 4	4030	3297	5518	6114	5307	4432	2337	1878	2581	4986	4515	4109
Future EWA (2030) Study 5	4258	3245	5648	5835	5361	4438	1874	930	2492	6870	4422	4122
Critical												
D1641 with b(2) (1997)	2936	2236	4001	4665	3049	2364	1018	846	566	1018	826	1791
Today b(2) (2003)	2914	2277	4004	4667	3144	2365	992	824	653	970	919	1935
Today EWA (2003)	3190	2258	4016	4167	3390	2297	939	605	783	2185	2623	1952
Future SDIP (2030) Study 4	3223	2166	4234	4942	3491	2619	993	921	710	894	804	1861
Future EWA (2030) Study 5	3478	2195	3828	4336	3463	2478	935	529	614	2173	2733	1949
Average												
D1641 with b(2) (1997)	4139	4053	5534	6300	5585	4706	3248	2979	3663	4745	4736	5031
Today b(2) (2003)	4091	4065	5521	6296	5607	4729	3257	2920	3721	4674	4736	5030
Today EWA (2003)	4421	4027	5278	5937	5671	5174	2456	1572	3364	5451	5596	5116
Future SDIP (2030) Study 4	4386	4282	6073	6694	5920	5409	3539	3154	3796	4991	4727	5046
Future EWA (2030) Study 5	4694	4219	5957	6351	5615	5646	2834	1527	3658	5983	5518	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	19.93	15.13	8.72	6.39	8.10	(6.93)	9.35
today vs future with EWA (3 v 5)	11.31	1.60	20.81	9.50	3.42	8.88	11.78	7.46	15.18	12.81	1.15	4.16
1997 vs future with EWA (1 v 5)	30.61	5.32	13.72	6.04	1.74	36.35	(13.62)	(46.00)	6.50	9.34	7.60	8.65
Above Normal												
today vs future no EWA (2 v 4)	11.35	6.59	(2.99)	(1.16)	4.71	20.56	10.46	3.66	3.30	10.21	3.04	(2.42)
today vs future with EWA (3 v 5)	13.43	12.38	3.84	2.75	0.30	18.18	10.35	(6.76)	5.70	12.64	(11.95)	(1.11)
1997 vs future with EWA (1 v 5)	14.91	7.63	1.25	(3.63)	(1.93)	26.32	(22.29)	(50.05)	(0.87)	27.47	13.17	(4.29)
Below Normal												
today vs future no EWA (2 v 4)	(0.28)	6.99	14.19	9.82	4.94	10.08	2.33	13.48	(0.80)	8.04	4.40	(6.25)
today vs future with EWA (3 v 5)	(3.72)	5.95	15.23	5.99	0.23	8.44	1.91	(14.71)	6.93	9.06	2.94	(3.76)
1997 vs future with EWA (1 v 5)	3.68	3.40	6.68	2.14	8.43	7.66	(29.79)	(63.59)	(6.95)	30.51	19.95	(9.09)
Dry												
today vs future no EWA (2 v 4)	3.75	3.99	9.23	9.29	5.59	6.75	1.54	2.96	(7.51)	3.15	6.76	(4.70)
today vs future with EWA (3 v 5)	2.04	8.22	14.72	10.77	5.73	6.88	2.28	(8.20)	2.91	7.76	(8.81)	(10.74)
1997 vs future with EWA (1 v 5)	9.14	1.77	9.83	1.13	6.19	7.09	(16.40)	(53.41)	(4.79)	34.60	3.30	(5.23)
Critical												
today vs future no EWA (2 v 4)	10.57	(4.95)	5.74	5.99	11.04	10.73	0.10	11.76	9.73	(7.91)	(12.55)	(3.91)
today vs future with EWA (3 v 5)	8.95	(2.77)	(4.80)	4.07	2.18	7.77	(0.35)	(12.62)	(21.50)	(0.82)	8.33	(0.19)
1997 vs future with EWA (1 v 5)	19.73	(1.76)	(4.33)	(7.05)	13.57	3.56	(8.24)	(44.20)	6.13	113.59	231.02	8.63
Average												
today vs future no EWA (2 v 4)	7.21	6.33	9.99	6.34	5.59	14.15	9.63	9.02	1.74	6.79	(0.30)	0.32
today vs future with EWA (3 v 5)	6.17	4.76	12.89	6.99	2.61	9.10	7.27	(2.94)	9.05	9.77	(1.44)	(1.47)
1997 vs future with EWA (1 v 5)	13.40	4.09	7.65	0.81	3.92	19.91	(18.69)	(48.73)	(0.15)	35.09	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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
D1641 with b(2) (1997)	4087	4208	4076	3968	3838	3861	2893	2254	2867	4374	4560	4479
Today b(2) (2003)	4061	4211	4081	3953	3866	3851	2828	2254	2694	4376	4603	4479
Today EWA (2003)	4123	4027	3627	3342	3257	3754	2786	2083	2643	4418	4664	4465
Future SDIP (2030) Study 4	4215	4354	4371	4135	3813	3449	2710	2247	2871	4431	4590	4696
Future EWA (2030) Study 5	4111	4282	3869	3389	3416	3826	2782	2074	2873	4388	4601	4680
Above Normal												
D1641 with b(2) (1997)	3833	3538	3809	4224	4240	3973	3062	1959	2833	4676	4637	4464
Today b(2) (2003)	3867	3561	3953	4218	3889	3801	2852	1767	2807	4678	4538	4465
Today EWA (2003)	3740	3660	3575	3829	3897	4013	2640	1538	3869	4681	4608	4417
Future SDIP (2030) Study 4	3810	3798	4007	4217	4387	3483	2886	2023	2936	4600	4401	4618
Future EWA (2030) Study 5	3630	3712	3819	3936	3787	3838	3081	1581	2914	4632	4210	4480
Below Normal												
D1641 with b(2) (1997)	3752	3806	4050	4228	3848	3771	2284	1657	3861	4359	4496	4040
Today b(2) (2003)	3741	3800	3878	4235	3866	3852	2213	1637	3862	4059	4405	4942
Today EWA (2003)	3771	3798	3808	3869	3800	3374	2184	1258	2882	4094	4383	4118
Future SDIP (2030) Study 4	3779	4007	4033	4452	3802	3215	2164	1555	2886	3911	4348	4169
Future EWA (2030) Study 5	3770	3891	3688	4135	4035	3172	2147	1076	2871	3910	4292	4080
Dry												
D1641 with b(2) (1997)	3764	3563	3863	4222	3842	3800	1888	1559	2881	3867	3847	3852
Today b(2) (2003)	3719	3538	3994	4222	3840	3246	1699	1516	2808	3294	3300	3955
Today EWA (2003)	3748	3388	3873	3582	3798	3144	1821	1063	2447	3241	3083	3803
Future SDIP (2030) Study 4	3764	3402	4300	4275	3850	3187	1886	1470	2330	2928	2838	3782
Future EWA (2030) Study 5	3806	3337	3705	3765	4080	3216	1808	1048	2180	2861	2277	3702
Critical												
D1641 with b(2) (1997)	3473	3049	2834	3208	2320	1759	1039	1349	1220	1067	1408	2779
Today b(2) (2003)	3420	3089	2862	3194	2301	1794	948	1239	1166	1088	1363	2861
Today EWA (2003)	3489	2847	2649	2852	2304	1743	864	889	1093	941	1344	2634
Future SDIP (2030) Study 4	3347	3321	3056	3453	2889	1850	1030	1093	934	837	977	2463
Future EWA (2030) Study 5	3229	2735	2378	3058	2930	1830	1124	833	969	872	938	2481
Average												
D1641 with b(2) (1997)	3800	3736	3838	3894	3738	3399	2231	1774	2543	3718	3859	4056
Today b(2) (2003)	3774	3737	3813	3890	3778	3298	2219	1747	2523	3628	3778	4055
Today EWA (2003)	3818	3608	3456	3483	3460	3273	2131	1436	2496	3608	3673	3861
Future SDIP (2030) Study 4	3848	3768	4018	4108	3757	3121	2190	1732	2491	3457	3531	3964
Future EWA (2030) Study 5	3775	3675	3604	3830	3664	3276	2181	1339	2132	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

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Wet												
today vs future no EWA (2 v 4)	3.3	3.4	6.6	1.9	(1.9)	(5.6)	(7.4)	(0.3)	(0.4)	1.3	0.9	2.6
today vs future with EWA (3 v 5)	(0.3)	5.8	0.9	0.9	4.9	3.0	(0.1)	(0.5)	1.0	(0.7)	0.9	3.0
1997 vs future with EWA (1 v 5)	0.0	1.3	(10.2)	(15.1)	(13.3)	0.0	(3.5)	(8.0)	0.2	0.3	0.9	2.5
Above Normal												
today vs future no EWA (2 v 4)	3.9	6.9	1.4	(0.1)	7.5	(10.7)	0.5	14.5	4.6	(1.5)	(3.0)	1.4
today vs future with EWA (3 v 5)	(2.9)	3.7	1.1	9.4	5.3	(3.6)	0.4	0.9	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												
today vs future no EWA (2 v 4)	1.0	2.7	1.4	5.4	(3.9)	(9.5)	(2.2)	(5.0)	0.1	(4.4)	(3.3)	(4.0)
today vs future with EWA (3 v 5)	(0.0)	2.7	2.2	3.3	6.9	(8.0)	(1.7)	(14.5)	0.3	(4.9)	(2.0)	(0.9)
1997 vs future with EWA (1 v 5)	(0.3)	(0.4)	(6.9)	(4.7)	4.6	(15.9)	(6.0)	(35.0)	0.4	(9.2)	(4.8)	(6.0)
Dry												
today vs future no EWA (2 v 4)	2.0	(3.2)	5.2	1.2	(2.2)	(1.6)	4.5	(3.0)	(7.1)	(13.6)	(20.9)	(4.4)
today vs future with EWA (3 v 5)	1.6	(0.8)	3.7	6.0	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)	(10.6)	6.2	(9.4)	(1.7)	(32.9)	(14.9)	(19.3)	(37.5)	(4.6)
Critical												
today vs future no EWA (2 v 4)	(2.2)	(6.7)	13.9	9.3	2.3	6.7	9.6	(11.6)	(20.7)	(23.1)	(27.9)	(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)	(10.3)	(6.7)	(3.7)	(0.8)	4.0	6.7	(33.1)	(21.4)	(30.6)	(34.2)	(10.5)
Average												
today vs future no EWA (2 v 4)	1.9	0.6	5.3	2.9	(0.5)	(5.3)	(1.6)	(0.9)	(2.5)	(4.7)	(6.5)	(1.5)
today vs future with EWA (3 v 5)	(1.1)	1.9	1.4	4.5	5.6	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)	(3.5)	(2.2)	(21.7)	(4.3)	(6.6)	(11.8)	(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	Sept	Grand Total	WY
1993														
Salvage Number			516	1410	1125	344	83	0	0				3558	AN
today vs future no EWA (2 v4)	8	8	(1)	(1)	8	8	7	7	4	5	(8)	(1)		
today vs future with EWA (3 v5)	6	9	3	6	2	9	6	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	9	8	(2)	(5)	(5)	15	(14)	(30)	1	16	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			(7)	(11)	64	29	5	0	0				79	2
today vs future with EWA (3 v5)			15	88	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			238	216	2941	1626	432	6	0				5457	C
today vs future no EWA (2 v4)	4	(7)	9	7	7	10	4	(3)	(10)	(18)	(22)	(8)		
today vs future with EWA (3 v5)	1	(5)	(4)	6	3	7	7	(9)	(18)	1	(3)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(6)	(8)	7	4	0	(38)	(15)	40	63	(3)		
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)			(13)	(12)	192	64	1	(2)	0				239	4
1995														
Salvage Number			39	4062	208	34	391	18	0				4820	W
today vs future no EWA (2 v4)	8	8	12	6	2	9	6	8	3	5	(3)	6		
today vs future with EWA (3 v5)	8	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)	(30)	4	5	5	8		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			4	227	6	3	24	1	0				265	6
today vs future with EWA (3 v5)			5	240	11	2	28	1	0				288	6
1997 vs future with EWA (1 v5)			2	(86)	(11)	8	(37)	(5)	0				(130)	(3)
1996														
Salvage Number			30	3281	388	73	40	12	0				3823	W
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	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	192	9	7	2	1	0				216	6
today vs future with EWA (3 v5)			5	194	16	6	3	0	0				222	6
1997 vs future with EWA (1 v5)			2	(77)	(16)	17	(8)	(4)	0				(81)	(2)
1997														
Salvage Number			520	1	0	337	23	0	0				881	W
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	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)			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)			23	(0)	0	81	(3)	0	0				101	12

Table A15: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Grand Total	WY
1998														
Salvage Number			4	400	109	198	13	0	0				730	W
today vs future no EWA (2 v4)	8	8	12	0	2	9	8	8	3	5	(3)	8		
today vs future with EWA (3 v5)	8	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	8		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			0	33	3	18	1	0	0				44	8
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				32	5
1999														
Salvage Number			48	56	66	1108	436	0	0				1732	W
today vs future no EWA (2 v4)	8	5	13	8	3	9	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	8	3	13	8	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	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			6	3	3	102	27	0	0				130	8
today vs future with EWA (3 v5)			8	3	3	74	28	0	0				116	7
1997 vs future with EWA (1 v5)			2	(1)	(3)	288	(42)	0	0				221	13
2000														
Salvage Number			128	978	1143	520	186	0	0				3002	AN
today vs future no EWA (2 v4)	8	5	(1)	(1)	5	8	7	7	4	5	(8)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	2	9	6	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	8	5	(2)	(5)	(8)	16	(14)	(39)	1	15	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			(2)	(7)	65	47	11	0	0				114	4
today vs future with EWA (3 v5)			4	45	23	50	9	0	0				131	4
1997 vs future with EWA (1 v5)			(3)	(48)	(59)	58	(23)	0	0				(46)	(2)
2001														
Salvage Number			504	909	2281	3351	138	0	0				7273	D
today vs future no EWA (2 v4)	3	0	7	6	2	2	3	0	(7)	(8)	(8)	(3)		
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	(16)	(8)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			35	27	49	95	4	0	0				209	3
today vs future with EWA (3 v5)			51	45	148	189	(1)	0	0				430	6
1997 vs future with EWA (1 v5)			12	(20)	140	0	(13)	0	0				118	2
2002														
Salvage Number			850	1823	379	1057	138	0	0				4047	D
today vs future no EWA (2 v4)	3	0	7	5	3	2	3	0	(7)	(4)	(8)	(5)		
today vs future with EWA (3 v5)	2	3	10	9	8	5	(1)	(4)	(9)	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)			58	86	8	28	4	0	0				182	5
today vs future with EWA (3 v5)			86	143	35	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			210	6620	1120	1122	84	24	12				9388	AN
today vs future no EWA (2 v4)	8	5	(1)	(1)	6	8	7	7	4	5	(8)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	2	9	6	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	8	5	(2)	(5)	(8)	15	(14)	(38)	1	15	3	(2)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			(3)	(52)	64	91	4	3	0				108	1
today vs future with EWA (3 v5)			5	316	22	98	4	(1)	0				445	5
1997 vs future with EWA (1 v5)			(5)	(334)	(58)	165	(9)	(9)	0				(350)	(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	July	Aug	Sept	Grand Total	WY
1993														
Salmon Loss			1707	8225	3803	580	185	0	0				12499	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	8	3	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v 5)	8	8	3	5	2	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)			(22)	(48)	217	47	12	0	0	0	0	0	208	2
today vs future with EWA (3 v 5)			49	290	78	49	11	0	0	0	0	0	473	4
1997 vs future with EWA (1 v5)			(37)	(304)	(197)	86	(25)	0	0	0	0	0	(478)	(4)
1994														
Salmon Loss			792	480	2480	2166	389	33					8339	C
today vs future no EWA (2 v4)	4	(7)	9	7	7	10	4	(2)	(10)	(16)	(23)	(6)		
today vs future with EWA (3 v 5)	1	(5)	(4)	6	3	7	7	(8)	(18)	1	(1)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(6)	(6)	7	4	0	(38)	(12)	48	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	3
today vs future with EWA (3 v 5)			(31)	28	66	141	28	(3)	0	0	0	0	228	4
1997 vs future with EWA (1 v5)			(48)	(28)	101	85	1	(13)	0	0	0	0	157	2
1995														
Salmon Loss			33	12787	737	54	391	39					13942	W
today vs future no EWA (2 v4)	8	6	12	6	3	9	6	6	3	5	(1)	6		
today vs future with EWA (3 v 5)	8	3	13	8	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	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			3	711	18	6	18	2	0	0	0	0	757	5
today vs future with EWA (3 v 5)			3	759	29	4	19	1	0	0	0	0	816	6
1997 vs future with EWA (1 v5)			1	(299)	(29)	15	(28)	(8)	0	0	0	0	(348)	(2)
1996														
Salmon Loss			116	11862	1039	330	48	8					13403	W
today vs future no EWA (2 v4)	8	8	12	6	2	9	6	6	3	5	(1)	6		
today vs future with EWA (3 v 5)	8	3	13	8	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	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			14	659	25	30	3	0	0	0	0	0	732	5
today vs future with EWA (3 v 5)			15	703	41	23	3	0	0	0	0	0	785	6
1997 vs future with EWA (1 v5)			5	(277)	(41)	79	(5)	(3)	0	0	0	0	(241)	(2)
1997														
Salmon Loss			1633	4		407	107	0					2156	W
today vs future no EWA (2 v4)	8	5	12	6	2	9	6	6	3	5	(1)	6		
today vs future with EWA (3 v 5)	8	3	13	8	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	5	8		
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 v 5)			218	0	0	27	7	0	0	0	0	0	252	12
1997 vs future with EWA (1 v5)			73	(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	Grand Total	WY
1998														
Salmon loss			19	1009	77	180	9						1290	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	8	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(23)	4	5	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			2	56	2	17	1	0	0	0	0	0	77	6
today vs future with EWA (3 v5)			2	60	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			31	88	80	2483	1544						4195	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	8	4	7	6	4	10	7	1	4		
1997 vs future with EWA (1 v5)	11	4	4	(2)	(4)	24	(10)	(23)	4	5	5	6		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			4	4	1	228	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	(3)	(2)	595	(148)	0	0	0	0	0	445	11
2000														
Salmon loss			304	2608	3829	1590	240						8659	AN
today vs future no EWA (2 v4)	8	6	(1)	(1)	6	8	7	7	4	5	(8)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	2	8	6	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	6	6	(2)	(5)	(5)	15	(14)	(38)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			(5)	(20)	218	128	16	0	0	0	0	0	337	4
today vs future with EWA (3 v5)			11	121	76	136	14	0	0	0	0	0	358	4
1997 vs future with EWA (1 v5)			(8)	(127)	(190)	232	(34)	0	0	0	0	0	(137)	(2)
2001														
Salmon loss			1668	1297	8013	15403	258						34680	D
today vs future no EWA (2 v4)	3	0	7	5	2	2	3	0	(7)	(4)	(8)	(8)		
today vs future with EWA (3 v5)	2	3	10	8	6	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(3)	2	(4)	8	0	(10)	(44)	(10)	12	(15)	(8)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			116	66	130	378	7	0	0	0	0	0	700	3
today vs future with EWA (3 v5)			170	115	380	783	(2)	0	0	0	0	0	1428	6
1997 vs future with EWA (1 v5)			40	(52)	372	1	(26)	0	0	0	0	0	335	1
2002														
Salmon loss			2330	4635	1222	2068	265						10877	D
today vs future no EWA (2 v4)	3	0	7	5	2	2	3	0	(7)	(4)	(8)	(8)		
today vs future with EWA (3 v5)	2	3	10	9	8	5	(1)	(4)	(4)	1	(14)	(8)		
1997 vs future with EWA (1 v5)	5	(2)	2	(4)	6	0	(10)	(44)	(10)	12	(15)	(6)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			172	255	30	50	6	0	0	0	0	0	513	5
today vs future with EWA (3 v5)			252	427	29	101	(2)	0	0	0	0	0	807	8
1997 vs future with EWA (1 v5)			60	(193)	78	0	(26)	0	0	0	0	0	(83)	(1)
2003														
Salmon loss			513	20482	3287	3108	108	23	9				27530	AN
today vs future no EWA (2 v4)	9	6	(1)	(1)	6	8	7	7	4	5	(8)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	2	9	6	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	6	6	(2)	(5)	(5)	15	(14)	(38)	1	15	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			(7)	(156)	127	238	13	2	0	0	0	0	288	1
today vs future with EWA (3 v5)			14	951	86	264	11	(1)	0	0	0	0	1308	5
1997 vs future with EWA (1 v5)			(11)	(839)	(171)	483	(27)	(8)	0	0	0	0	(764)	(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	July	August	Sept	Grand Total	year type
1993														
Salvage Number	0	0	0	0	0	68	3306	4337	38	0	0	0	7749	AN
today vs future no EWA (2 v4)	6	5	(1)	(1)	6	6	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	2	8	8	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	3	5	(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	5	219	309	1	0	0	0	534	7
today vs future with EWA (3 v5)			0	0	0	6	188	(161)	1	0	0	0	44	1
1997 vs future with EWA (1 v5)			0	0	0	10	(463)	(1689)	0	0	0	0	(2132)	(28)
1994														
Salvage Number	0	0	230	3364	599	0	0	0	0	0	0	0	4193	C
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	(8)	(4)	6	3	7	7	(8)	(16)	1	(3)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(6)	(8)	7	4	0	(38)	(12)	48	63	(3)		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			21	232	39	0	0	0	0	0	0	0	292	7
today vs future with EWA (3 v5)			(8)	191	16	0	0	0	0	0	0	0	199	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	7463	0	0	0	0	0	0	29058	W
today vs future no EWA (2 v4)	8	5	12	6	2	9	6	6	3	5	(2)	6		
today vs future with EWA (3 v5)	8	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	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			42	391	349	684	0	0	0	0	0	0	1466	5
today vs future with EWA (3 v5)			46	400	586	408	0	0	0	0	0	0	1511	5
1997 vs future with EWA (1 v5)			16	(160)	(671)	1757	0	0	0	0	0	0	1070	4
1996														
Salvage Number		0	0	0	33	431	20144	7768	301	0	0	0	28870	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)	8	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	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	1	40	1235	441	10	0	0	0	1735	6
today vs future with EWA (3 v5)			0	0	1	29	1300	288	30	0	0	0	1646	6
1997 vs future with EWA (1 v5)			0	0	(1)	103	(1626)	(2832)	11	0	0	0	(4344)	(15)
1997														
Salvage Number	8	0	0	0	21	17015	24557	1689	36	0	0	0	43326	W
today vs future no EWA (2 v4)	8	8	12	6	2	9	8	8	3	5	(3)	8		
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	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	1	0	0	0	1	1561	1604	80	1	0	0	0	3159	7
today vs future with EWA (3 v5)	0	0	0	0	1	1131	1595	59	4	0	0	0	2790	6
1997 vs future with EWA (1 v5)	1	0	0	0	(1)	4079	(2348)	(518)	1	0	0	0	1214	3

Table A17: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	August	Sept	Grand Total	WY
1998														
Salvage Number	0	0	0	0	12	7288	10508	16207	594	0	0	0	34679	W
today vs future no EWA (2 v4)	8	6	13	8	2	9	6	8	3	5	(3)	6		
today vs future with EWA (3 v5)	8	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)	(30)	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	2253	7
today vs future with EWA (3 v5)	0	0	0	0	0	485	673	687	57	0	0	0	1817	6
1997 vs future with EWA (1 v5)	0	0	0	0	(0)	1747	(1005)	(5264)	21	0	0	0	(4521)	(13)
1999														
Salvage Number	0	0	0	0	34	3177	40480	12087	34	0	0	0	55831	W
today vs future no EWA (2 v4)	8	6	12	8	2	9	6	8	3	5	(3)	6		
today vs future with EWA (3 v5)	8	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)	(30)	4	5	5	6		
Change in Salmon Salvage													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	1	292	2481	688	1	0	0	0	3481	6
today vs future with EWA (3 v5)	0	0	0	0	3	211	2812	445	2	0	0	0	3273	6
1997 vs future with EWA (1 v5)	0	0	0	0	(3)	762	(3869)	(3940)	1	0	0	0	(7050)	(13)
2000														
Salvage Number	0	0	0	0	136	3092	39347	2156	10	0	0	6	44745	AN
today vs future no EWA (2 v4)	6	6	(1)	(1)	6	6	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	6	3	5	2	9	6	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	6	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	0	8	247	2604	154	1	0	0	(0)	3014	7
today vs future with EWA (3 v5)	0	0	0	0	3	282	2234	(75)	1	0	0	(0)	2425	5
1997 vs future with EWA (1 v5)	0	0	0	0	(7)	450	(5303)	(840)	0	0	0	(0)	(5790)	(13)
2001														
Salvage Number	0	0	0	0	0	2698	14128	1380	0	0	0	0	18204	D
today vs future no EWA (2 v4)	3	0	7	8	2	2	3	0	(7)	(9)	(8)	(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	(0)	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)	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	(93)	(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				36	12	1121	9043	696	24	0	0		10931	D
today vs future no EWA (2 v4)	3	0	7	8	2	2	3	0	(7)	(9)	(8)	(9)		
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	(0)	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)	0	0	0	3	0	28	262	0	(2)	0	0	0	290	3
today vs future with EWA (3 v5)	0	0	0	3	1	55	(97)	(30)	(1)	0	0	0	(69)	(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	34	5208	10382	914	0	0	0	0	16570	AN
today vs future no EWA (2 v4)	6	6	(1)	(1)	6	6	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	6	6	3	5	2	9	6	(3)	4	7	(10)	(0)		
1997 vs future with EWA (1 v5)	6	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	(0)	1	418	697	55	0	0	0	0	1172	7
today vs future with EWA (3 v5)	0	0	0	2	0	443	540	(32)	0	0	0	0	953	6
1997 vs future with EWA (1 v5)	0	0	0	(2)	(1)	780	(1403)	(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	Grand Total	WY
1993														
Salmon Loss	0	0	0			103	5616	7508	40				13269	AN
today vs future no EWA (2 v4)	8	8	(1)	(1)	8	8	7	7	4	5	(8)	(1)		
today vs future with EWA (3 v5)	8	8	3	3	2	9	6	(3)	4	7	(10)	(8)		
1997 vs future with EWA (1 v5)	5	6	(2)	(5)	(5)	15	(14)	(24)	1	16	3	(2)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	0	8	373	537	2	0	0	0	919	7
today vs future with EWA (3 v5)			0	0	0	9	310	(282)	2	0	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)	3	7	7	10	4	(2)	(10)	(16)	(22)	(6)		
today vs future with EWA (3 v5)	1	(5)	(4)	6	3	7	7	(9)	(10)	1	(2)	(3)		
1997 vs future with EWA (1 v5)	5	(7)	(6)	(6)	7	4	0	(28)	(12)	40	63	(3)		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	0	30	146	(26)	0	0	0	0	149	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	4809	18599	15082				38982	W
today vs future no EWA (2 v4)	8	8	12	6	2	9	8	8	3	5	(3)	6		
today vs future with EWA (3 v5)	8	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)	(23)	4	5	5	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	1	22	301	1066	510	0	0	0	1899	5
today vs future with EWA (3 v5)			0	0	1	16	317	605	1520	0	0	0	2459	7
1997 vs future with EWA (1 v5)			0	0	(1)	57	(469)	(6063)	548	0	0	0	(5921)	(15)
1996														
Salmon Loss		0	0	0	30	1555	22536	14113	747				38981	W
today vs future no EWA (2 v4)	8	8	12	8	2	9	6	8	3	5	(3)	8		
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)	(23)	4	5	5	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)			0	0	1	142	1382	801	35	0	0	0	2362	6
today vs future with EWA (3 v5)			0	0	1	103	1454	520	78	0	0	0	2154	6
1997 vs future with EWA (1 v5)			0	0	(1)	373	(2180)	(4801)	27	0	0	0	(6536)	(16)
1997														
Salmon Loss	39	0	0	0	46	15226	36773	3191	23	0	0	0	55298	W
today vs future no EWA (2 v4)	8	6	12	8	2	9	6	6	3	5	(3)	6		
today vs future with EWA (3 v5)	8	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)	(23)	4	5	5	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	3	0	0	0	1	1397	2254	181	1	0	0	0	3836	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)	3650	(3516)	(1040)	1	0	0	0	(903)	(2)

Table A18: continued

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Grand Total	WY
1998														
Salmon Loss	0	0	0		8	4830	8110	14819	1093				28830	W
today vs future no EWA (2 v4)	8	6	12	6	2	9	8	8	3	6	(3)	6		
today vs future with EWA (3 v5)	5	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	5	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	0	440	487	807	37	0	0	0	1782	6
today vs future with EWA (3 v5)	0	0	0	0	0	319	523	523	110	0	0	0	1478	5
1997 vs future with EWA (1 v5)	0	0	0	0	(0)	1151	(775)	(4634)	40	0	0	0	(4220)	(15)
1999														
Salmon Loss	0	0	0		94	3135	82273	32582	18				128173	W
today vs future no EWA (2 v4)	8	6	12	6	2	9	6	6	3	5	(3)	8		
today vs future with EWA (3 v5)	5	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	8		
Change in Salmon Loss													Sum of Change	% change
today vs future no EWA (2 v4)	0	0	0	0	3	283	5657	1851	1	0	0	0	7804	6
today vs future with EWA (3 v5)	0	0	0	0	4	212	5955	1200	2	0	0	0	7373	6
1997 vs future with EWA (1 v5)	0	0	0	0	(4)	786	(8822)	(10625)	1	0	0	0	(18684)	(15)
2000														
Salmon Loss	0	0	0		284	7293	84002	7122	84			28	98801	AN
today vs future no EWA (2 v4)	0	6	(1)	(1)	6	8	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	2	8	8	(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	15	588	5580	508	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)	5151	6
1997 vs future with EWA (1 v5)	0	0	0	0	(14)	1054	(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)	2	0	7	5	2	2	3	0	(7)	(4)	(8)	(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)	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	354	(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	8	1248	10828	2463	18				14579	D
today vs future no EWA (2 v4)	3	0	7	5	2	2	3	0	(7)	(4)	(8)	(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)	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	51	(68)	(108)	(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	(2146)	(15)
2003														
Salmon Loss	0	0	0	48	57	12257	27871	2573					43903	AN
today vs future no EWA (2 v4)	0	6	(1)	(1)	6	8	7	7	4	5	(0)	(1)		
today vs future with EWA (3 v5)	8	8	3	5	3	8	8	(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	884	1851	183	0	0	0	0	3022	7
today vs future with EWA (3 v5)	0	0	0	2	1	1042	1588	(88)	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

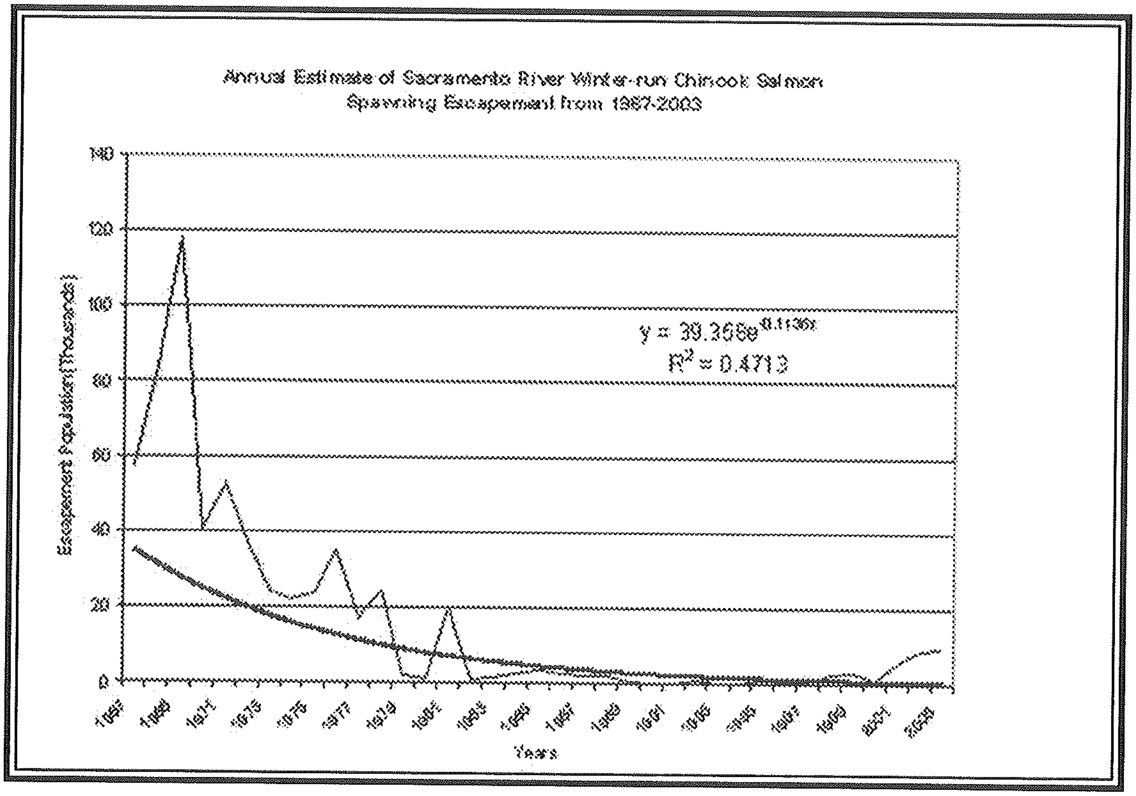


Figure B1:
Annual estimated Sacramento River winter-run Chinook salmon escapement population.
Sources: PFMC 2002, DFG 2004, NOAA Fisheries 1997
Trendline for figure B1 is an exponential function: $Y=39.358\ e^{-0.1136x}$, $R^2=0.4713$.

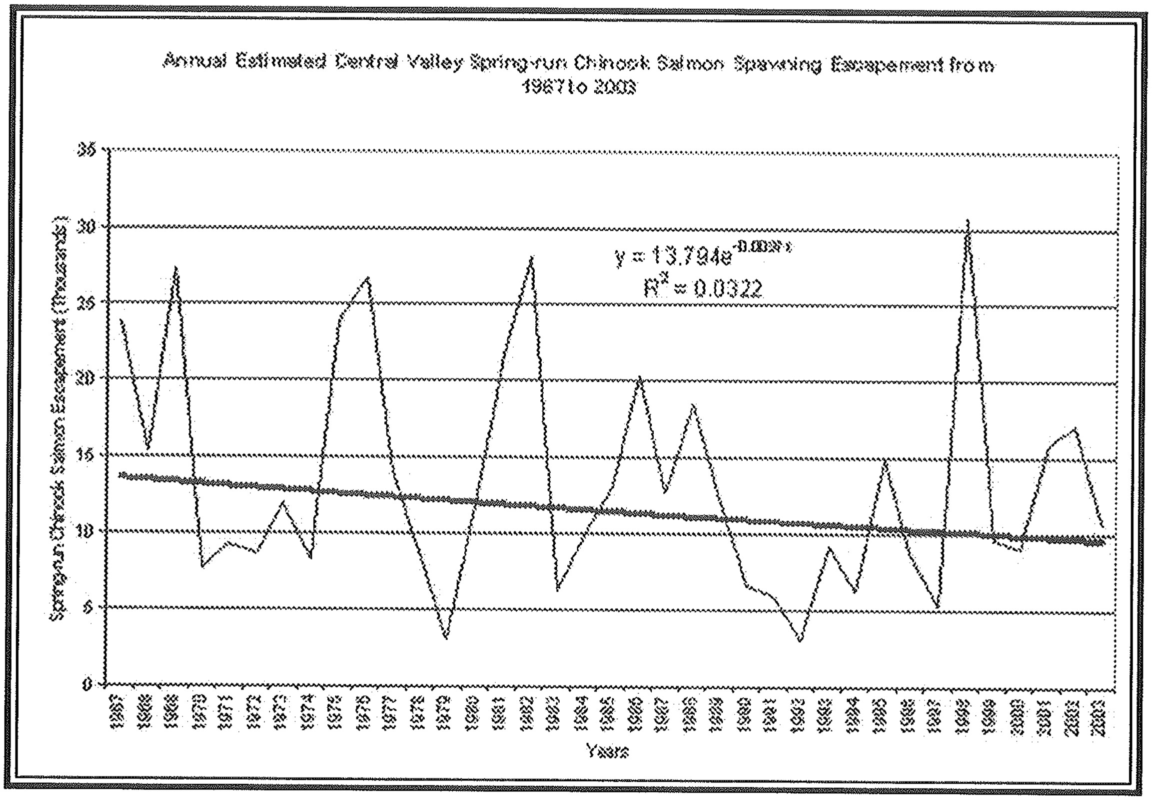
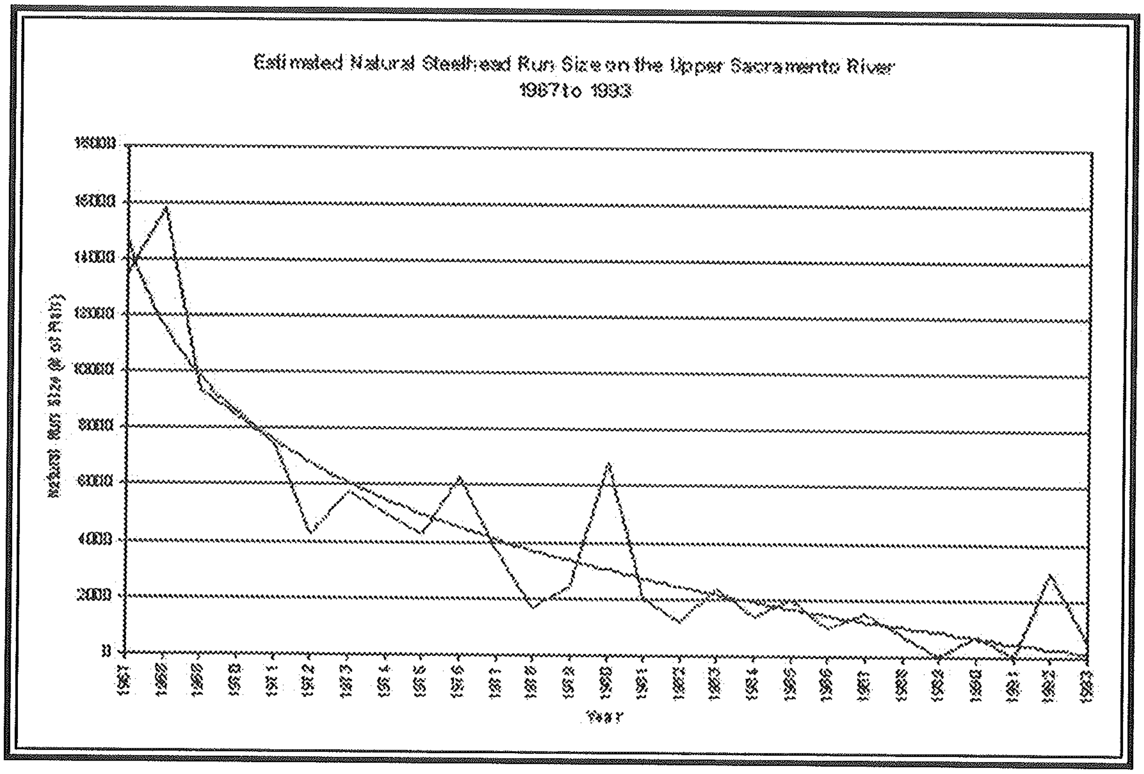


Figure B2:
Annual estimated Central Valley spring-run Chinook salmon escapement population for the Sacramento River watershed for years 1967 through 2003.
Sources: PFMC 2002, DFG 2004, Yoshiyama 1998.
Trendline for figure B2 is an exponential function: $Y=13.794\ e^{-0.0097}$, $R^2 = 0.0322$.



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

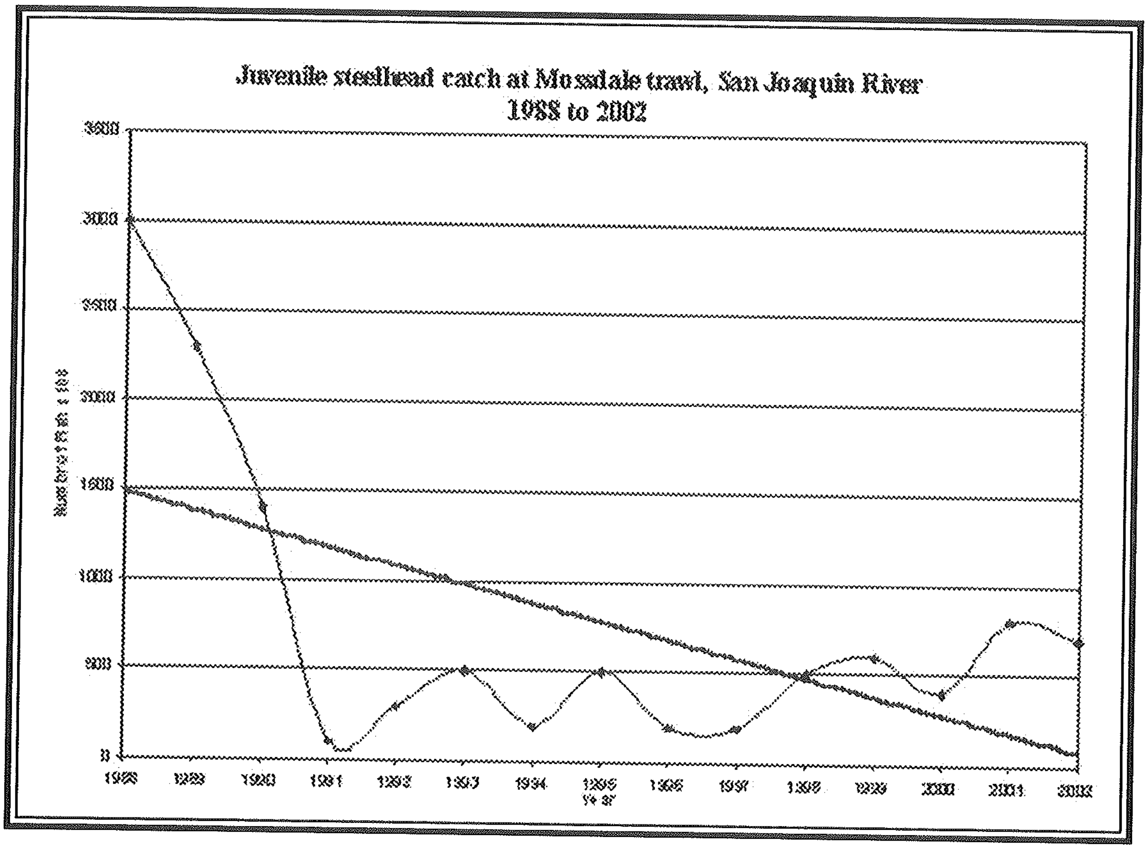


Figure B4:
Estimated number of juvenile Central Valley steelhead derived from the Mossdale trawl surveys on the San Joaquin River from 1988 to 2002.
Source: Marston (DFG), 2003.

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

[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:

<u>Central Valley Project (Reclamation)</u>

<u>Delta Cross-Channel Gates</u>

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.

<u>Freeport Regional Water Project, Rock Slough Intake and other Fish Screening Projects, including CVPIA-AFSP</u>

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

[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.