Final Restoration Plan for the Anadromous Fish Restoration Program

A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California

Released as a Revised Draft on May 30, 1997
and Adopted as Final on January 9, 2001

UPDATES*

* This page is not included in the Final Restoration Plan for the AFRP. The purpose of this page is to track possible changes in the Plan as more information becomes available.

The following updates have been identified:

Appendix B-1 and Table E-1: The referred winter Chinook salmon run in the Calaveras River is not considered an authentic salmon run in this river and may have been mistaken by a late fall-run (Yoshiyama et al. 2001). Alternative production targets for other salmonids in the Calaveras River are being evaluated in the AFRP project: Lower Calaveras River salmonid life history limiting factor analysis. Updated production targets for salmonids in the Calaveras River will be reported here at the completion of that study (Last updated September 3, 2002).

References

Yoshiyama, R.M., E.R. Gertstung, F.W. Fisher and P.B. Moyle. 2001. Historical and present distribution of Chinook salmon in the Central Valley of California. California Department of Fish and Game. Fish Bulletin 179(1): 71-176.

FINAL RESTORATION PLAN
FOR THE
ANADROMOUS FISH RESTORATION PROGRAM

A PLAN TO INCREASE NATURAL PRODUCTION OF ANADROMOUS FISH
IN THE CENTRAL VALLEY OF CALIFORNIA

Prepared for the Secretary of the Interior by the
United States Fish and Wildlife Service with assistance from
the Anadromous Fish Restoration Program Core Group
under authority of the Central Valley Project Improvement Act.

January 9, 2001

PREFACE

The Central Valley Project Improvement Act (CVPIA) directs the Secretary of the Interior to develop and implement a program that makes all reasonable efforts to double natural production of anadromous fish in Central Valley streams (Section 3406(b)(1)). The program is known as the Anadromous Fish Restoration Program (AFRP).

The document you have before you is the Restoration Plan. The Restoration Plan is a programmatic-level description of the AFRP in broad and general terms, and will be used to guide the long-term development of the AFRP. The Restoration Plan presents the goal, objectives, and strategies of the AFRP; describes how the AFRP identified and prioritized reasonable actions and evaluations; lists those actions and evaluations; and notes those actions and evaluations that are already underway or that may be implemented in the near future.

An initial draft was released for review and comment in December 1995 and a revised draft was released for review and comment in 1997. This Final Plan incorporates those 1997 comments to the extent the Department of the Interior (Interior) deemed appropriate. The Programmatic Environmental Impact Statement (PEIS) required by Section 3409 of the CVPIA has been completed.

The AFRP will use all the authority and resources provided by the CVPIA to restore anadromous fish and will rely heavily on local involvement and partnerships with property owners, watershed workgroups, public and private organizations, county and local governments, and state and federal agencies. To make restoration efforts as efficient as possible, the AFRP will coordinate restoration efforts with those by other groups, such as the California Department of Fish and Game, Category III of the Bay-Delta Agreement, the San Joaquin River Management Program, and the CALFED Bay-Delta Program. Successful implementation of the Restoration Plan will depend on the continued participation of the public and interested parties and support of involved state and federal agencies.

Comment: the CALFED Restoration Coordination Program and the CALFED Ecosystem Restoration Program of

ACKNOWLEDGMENTS

The Restoration Plan is the responsibility of the USFWS as the lead agency for the AFRP. The USFWS thanks the AFRP's Core Group, including Randy Brown of the California Department of Water Resources, Jim Bybee of the National Marine Fisheries Service (NMFS), Susan Hatfield and Bruce Herbold of the United States Environmental Protection Agency (USEPA), Ken Lentz of the USBR, and Terry Mills and Alan Barraco of the California Department of Fish and Game. However, this plan does not commit any Core Group member's agency to implement any of the actions noted herein. The USFWS thanks Laura King of the USBR, Gary Stern of the NMFS, Tom Hagler of the USEPA, and Dana Jacobsen of the Office of the Solicitor, and the members of Interior's Washington Office Policy Group, including Ted Boling of the Office of the Assistant Secretary for Fish and Wildlife and Parks, Dana Cooper of the Office of the Assistant Secretary for Water and Science, Barbara Geigle of the Office of the Solicitor, Rowan Gould of the USFWS, and Steve Magnuson of the USBR; and the staffs at the Central Valley Fish and Wildlife Restoration Program, including Roger Dunn, Roger Guinee, Andy Hamilton, Jim McKevitt, and Larry Puckett; the Sacramento Field Office, including Rick Morat and Mike Thabault; the Northern Central Valley Fish and Wildlife Office, including Jim Smith; and the Sacramento-San Joaquin Estuary Fishery Resource Office, including Pat Brandes, Dan Castleberry, Kathy Corbin, John Icanberry, Marty Kjelson, Yvette Leatherman, Sam Lohr, Gary Rensink, Scott Spaulding, and John Wullschleger; for their contributions toward completion of this plan. The USFWS also thanks the many public and private organizations and individuals that took time to help prepare this plan by attending public workshops, meeting on a local watershed or interest level, or writing or calling to voice their concerns.

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[1]Appendices H and I are bound as separate documents. Appendix H presents paraphrased comments and the USFWS=s responses to each of the comments that we received during the designated comment period on the December 6, 1995 draft of the Restoration Plan. Appendix I presents the summarized oral comments and complete written comments that we paraphrased for Appendix H. Although Appendix H provides insight to help the reader further understand the Restoration Plan, it is not essential for using the Restoration Plan. Appendix I is intended to help interested parties see how their comments and the comments of others were paraphrased and represented by the USFWS in Appendix H. Appendices H and I are available upon request from the Program Manager for the AFRP at (209) 946-6400 or at the address listed in Appendix C.

INTRODUCTION

Since settlement of the Central Valley in the mid-1800s, populations of native anadromous fishes (i.e., chinook salmon, steelhead, white sturgeon, and green sturgeon) have declined dramatically. Declines have been so dramatic that several species may be in danger of extinction. At present, winter-run chinook salmon are listed as endangered under the federal and state Endangered Species acts, and all other races of chinook salmon and steelhead have been petitioned for either federal or state listing.

American shad and striped bass were introduced into the Sacramento-San Joaquin system in the 1870s. Both species supported valuable sport and commercial fisheries throughout much of this century, but California Department of Fish and Game (CDFG) data indicate that populations have declined since the mid-1960s.

Habitat degradation is the primary cause of these declines. Hydraulic mining for gold was the first human activity that resulted in large-scale habitat degradation due to sedimentation and diversion of water in many Central Valley streams. Hydraulic mining was prohibited in 1894, but habitat degradation has continued. Habitat quantity and quality have declined due to construction of barriers to migration and levees, modification of natural hydrologic regimes by dams and water diversions, elevated water temperatures, and water pollution. Causes of declines in habitat quality and quantity are examples of factors that may potentially reduce natural production of anadromous fish below levels that would occur in the absence of the factor, and are sometimes called limiting factors or stressors. Although the effects of habitat degradation on fish populations were evident by the 1930s, rates of decline for most anadromous fish species increased following completion of major water project facilities.

Other factors that may have adversely affected natural stocks of anadromous fish include overharvest, illegal harvest, hatchery production, and introduction of competitors, predators and diseases. Fish populations may also vary due to natural events. Droughts and poor ocean conditions, such as El Niño, may reduce populations. However, populations in healthy habitats typically recover within a few years after natural events. The decline of fish populations has continued through cycles of beneficial and adverse natural conditions, indicating the need to improve habitat.

STATUTORY SCHEME

Section 3406(b)(1) of the Central Valley Project Improvement Act (CVPIA) requires the Secretary of the Department of the Interior (Secretary) to Adevelop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967 - 1991...@ Section 3406(b)(1) also states that Athis goal shall not apply to the San Joaquin River between Friant Dam and the Mendota Pool.@ Further, Section 3406(b)(1)(A) requires that the program Agive first priority to measures which

protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures mandated by this subsection; shall be reviewed and updated every five years; and shall describe how the Secretary intends to operate the Central Valley Project to meet the fish, wildlife and habitat restoration goals and requirements set forth in this title and other project purposes.@

The Secretary directed the U.S. Fish and Wildlife Service (USFWS) and the U.S. Bureau of Reclamation (USBR) to jointly implement the CVPIA, and Section 3406(b)(1) in particular. The USFWS and USBR are approaching implementation of this directive through development of an Anadromous Fish Restoration Program (AFRP) to address those species identified for restoration in the CVPIA. Those six anadromous fish species are chinook salmon *(Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), white sturgeon (*Acipenser transmontanus*), and green sturgeon (*A. medirostris*). The term AAFRP@ is the umbrella term for all of the components of the Department of the Interior=s (Interior) and its agency and private partner=s efforts to make all reasonable efforts to at least double the natural production of anadromous fish. This Restoration Plan presents the goal, objectives, and strategies of the AFRP; describes processes the AFRP used to identify, develop, and select restoration actions; and lists actions and evaluations determined, at a programmatic level, to be reasonable to implement as part of the AFRP.

COMPLIANCE WITH RELATED STATUTES

A number of related statutes affect the development and implementation of this Restoration Plan under the CVPIA. The most important of these related statutes are the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA).

National Environmental Policy Act

This Restoration Plan was developed to comply with Section 3406(b)(1) of the CVPIA. The impacts of this programmatic-level Restoration Plan are being analyzed in the Programmatic Environmental Impact Statement (PEIS), which is being prepared pursuant to NEPA and to Section 3409 of the CVPIA. The revised Restoration Plan remains subject to change, based on the results of the PEIS, as well as through adaptive management of the actions during the life of the Restoration Plan.

While the PEIS is being finalized, Interior will continue to manage the water dedicated by Section 3406(b)(2) of the CVPIA for the primary purpose of implementing the fish, wildlife, and habitat restoration purposes of the CVPIA, as determined by the Ninth Circuit Court of Appeals in Westlands v. United States, 43 F. 3d 457 (9th Cir. 1994). The court in that case concluded that the requirements in certain sections of the CVPIA to take action immediately upon enactment of the CVPIA created an

irreconcilable conflict with the requirements of NEPA. The court concluded, therefore, that NEPA analysis of the dedication and management of the 3406(b)(2) water was not required.

The impacts of implementing individual actions identified in the Restoration Plan pursued under authority other than Section 3406(b)(2) will be analyzed in site-specific NEPA documentation, as appropriate.

Endangered Species Act

Section 7(a) of the ESA states in part that "The Secretary shall review other programs administered by him and utilize such programs in furtherance of the purposes of this Act." For example, in March 1993 the USFWS listed the delta smelt as a threatened species pursuant to the ESA. In December 1994, critical habitat was designated for the delta smelt. In November 1996, the USFWS published the Final Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes (DNFRP) (USFWS 1996). The DNFRP identifies both flow and non-flow actions. The flow actions identified in the DNFRP are classified as "priority one actions," meaning that they are actions considered necessary for the recovery of the species. Many actions in this Restoration Plan are flow-related, and the life stages of many of the anadromous species overlap with critical life stages of the delta smelt and other native fishes in the Delta. The implementation schedule for actions within the DNFRP are immediate and ongoing. Therefore, many actions in the Restoration Plan will contribute towards recovery of Delta native fishes.

Actions within the Restoration Plan may have effects not foreseen at this time. All actions implemented through the AFRP will need to be reviewed for their effects on listed and proposed species. Any such actions that may affect those species will be subject to further review under the Secretary's authorities under Section 7(a)(2) of the ESA. It is Interior's intention that the USFWS, National Marine Fisheries Service (NMFS), and CDFG work closely together to coordinate actions in the implementation and recovery plans for anadromous fish and listed and proposed species.

PURPOSES

The AFRP is an opportunity for the USFWS and USBR to collaborate with other agencies, organizations and the public to increase natural production of anadromous fish in the Central Valley by augmenting and assisting restoration efforts presently conducted by local watershed workgroups, the CDFG, and others. Purposes of the CVPIA (Section 3402) relevant to the AFRP are:

- To protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley;
- To address impacts of the Central Valley Project (CVP) on fish, wildlife, and associated habitats;
- To improve the operational flexibility of the CVP;
- To contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay and Sacramento-San Joaquin Delta Estuary; and

- To achieve a reasonable balance among competing demands for the use of CVP water, including the requirements of fish and wildlife, agricultural, municipal and industrial, and power contractors.

GOAL AND OBJECTIVES

The goal of the AFRP, as stated in Section 3406(b)(1) of the CVPIA, is to Adevelop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991.@ Section 3406(b)(1) also states that Athis goal shall not apply to the San Joaquin River between Friant Dam and the Mendota Pool.@

Six general objectives need to be met to achieve the program goal:

- Improve habitat for all life stages of anadromous fish through provision of flows of suitable quality, quantity, and timing, and improved physical habitat;
- Improve survival rates by reducing or eliminating entrainment of juveniles at diversions;
- Improve the opportunity for adult fish to reach their spawning habitats in a timely manner;
- Collect fish population, health, and habitat data to facilitate evaluation of restoration actions;
- Integrate habitat restoration efforts with harvest and hatchery management; and
- Involve partners in the implementation and evaluation of restoration actions.

STRATEGIES

Fishery managers must address complex biological, economic, social, and technological issues to substantially restore natural production of anadromous fish in the Central Valley. Restoration will be costly and require changing the way aquatic resources and habitats are managed. Because the challenge is great, the AFRP requires solid strategies to select and implement effective restoration actions.

The AFRP strategies consist of two components, implementation *principles* and an implementation *approach*. Implementation principles are the tenets guiding selection and prioritization of actions. The implementation approach describes key aspects of how restoration actions will be implemented.

Implementation principles

Restoration actions are being selected and prioritized based on the magnitude of the contribution to doubling natural production, the status of target species and races, and on Section 3406(b)(1)(A) of the CVPIA, which directs the AFRP to give first priority to:

- Measures which protect and restore natural channel and riparian habitat values through habitat restoration actions;
- Modifications to Central Valley Project operations; and
- Implementation of the supporting measures mandated by subsection 3406(b) of the CVPIA.

These principles are discussed below.

- Contribution to natural production

Placing priority on actions that result in large increases in natural production will most efficiently contribute to meeting target production levels.

- Species status

Placing priority on actions that benefit species and races whose abundance is precariously low will help maintain the genetic diversity of anadromous fish in the Central Valley. Maintaining genetic diversity will preserve adaptability and resilience, which are essential if natural production is to be sustainable on a long-term basis.

Winter-run chinook salmon are listed as endangered under the federal and state ESAs. Spring-run, late-fall-run, and fall-run chinook salmon have been petitioned for threatened or endangered status throughout their range in Washington, Oregon, California, and Idaho, under the federal ESA (NMFS 1995). The California Fish and Game Commission will take regulatory action concerning the candidacy of spring-run chinook salmon as an endangered species under the state ESA soon. Steelhead have been petitioned for threatened or endangered status throughout its range in Washington, Oregon, California, and Idaho, under the federal ESA (NMFS 1994). A proposed determination by NMFS identified steelhead in the Central Valley as an evolutionary significant unit, and recommended listing as an endangered species (NMFS 1996). A final determination will be made in August 1997. White sturgeon, green sturgeon, striped bass and American shad have also suffered significant, long-term declines.

- Restoring natural habitat values

Protecting and restoring natural channel and riparian habitat values promotes natural processes that regulate geomorphic characteristics, nutrient dynamics, and production capabilities of streams, rivers, and estuaries. Restoring natural processes is essential to ensure that both physical and biological ecosystem components can resist declines and recover after both natural and anthropogenic perturbations, thus contributing to long-term sustainability of natural production.

- Modifying CVP operations

Placing priority on actions that modify CVP operations will directly help minimize impacts on fish, wildlife, and associated habitats; help balance competing demands for the use of CVP water, including the requirements of fish and wildlife; and will focus restoration efforts where the Secretary has the authority to be most effective.

- Implementing supporting measures in the CVPIA

Placing priority on implementing the supporting measures mandated by subsection 3406(b) of the CVPIA focuses restoration efforts where the Secretary has the authority to be most effective.

The implementation principles can be used to compare actions that address a common limiting factor (for example, to compare two actions that address a lack of suitable spawning substrate) as well as to compare actions that address different limiting factors (for example, to compare an action that addresses lack of suitable spawning substrate with an action that addresses illegal harvest) within a watershed. In applying these principles, the AFRP will support actions that contribute to increasing the natural production of anadromous fish through restoration of natural habitat values before supporting actions that increase production by other means.

Implementation approach

The AFRP approach to making all reasonable efforts to at least double natural production of anadromous fish will include partnerships, local involvement, public support, adaptive management, and flexibility.

- Partnerships

A single entity cannot double natural production of anadromous fish throughout the Central Valley. Partnerships are needed. Voluntary collaborations to achieve mutual goals and objectives will accelerate accomplishments, increase available resources, reduce duplication of efforts, encourage innovative solutions, improve communication, and increase public involvement and support through shared authority and ownership of restoration actions. The AFRP will seek partners to facilitate restoration.

- Local involvement

The AFRP will encourage local citizens and groups to share or take the lead in implementing restoration actions. Influences on anadromous fish production in specific watersheds are often related to local water management and land use, which are typically controlled by local individuals and groups. Local people may have innovative approaches to solving problems, and may be able to implement those solutions most efficiently. This approach is consistent with ACalifornia=s Coordinated Regional Strategy to Conserve Biological Diversity@ (MOU 1991), in which 26 state and federal agencies emphasize regional solutions to regional problems.

The AFRP will encourage local involvement by joining with existing local restoration groups and supporting the formation of new groups.

- Public support

Public support is both a product and a prerequisite of partnerships and local involvement. Public sentiment is an indicator of perceived economic and social effects of restoration actions. Public support for an action will facilitate implementation and attract partners for future actions. The AFRP will seek opportunities for the public to assist in planning and implementing restoration actions.

- Adaptive management

The AFRP will employ adaptive management to increase the effectiveness of restoration actions and to address scientific uncertainty. Adaptive management is an approach that allows resource managers to learn from past experiences through formal experiment or by altering actions based on their measured effectiveness. Monitoring programs are the foundation of the adaptive management approach.

- Flexibility

Implementation of restoration actions needs to be flexible so that unforeseen opportunities can be pursued if they meet the intent of the CVPIA. Also, flexibility will help the AFRP address unforeseen factors that arise or problems that intensify in the future. For example, although there is just one evaluation in this plan that addresses the effects of nuisance, non-native aquatic organisms such as the zebra mussel, this may become a problem that will potentially intensify in unforeseen ways in the future. The AFRP has the flexibility to work with partners to develop actions consistent with the intent of the CVPIA to address specific problems as they arise or intensify. This flexibility will facilitate efforts to maximize the effects of restoration efforts and to sustain benefits to fish production that accrue from these restoration efforts and other management activities.

DEVELOPING RESTORATION PLAN ACTIONS

The AFRP is being developed in three steps: (1) attain the best available scientific and commercial data; (2) develop a long-term Restoration Plan that identifies the general approaches and actions to attain the goal; and (3) develop short-term (three-to-five years) implementation plans tiered off the Restoration Plan. One important implementation plan will be the Water Management Plan that will outline how Interior will manage CVP water resources to implement the AFRP. These implementation plans can be modified at any time in response to new information acquired through monitoring or new research; Interior presently anticipates revisions at least every three-to-five years. The long-term Restoration Plan will be reviewed and updated every five years as required by Section 3406(b)(1)(A) of the CVPIA.

IDENTIFYING THE SCIENTIFIC KNOWLEDGE BASE - THE WORKING PAPER

The first step in developing the AFRP was accomplished through development and dissemination of the "Working Paper on Restoration Needs--Habitat Restoration Actions to Double Natural Production of Anadromous Fish in the Central Valley of California (May 9, 1995)" (the Working Paper, USFWS 1995). The Working Paper was developed under the direction of a scientific Core Group composed of representatives of the USFWS, USBR, NMFS, U.S. Environmental Protection Agency (USEPA), CDFG, and California Department of Water Resources (CDWR). The Working Paper focused on identifying the best available science, without regard to whether CVPIA tools might reasonably be brought to bear on the identified scientific issues.

The scientific basis for the AFRP is founded in numerous pre-AFRP research, planning, management, and restoration activities, and the resulting body of information that was produced documenting these activities. In carrying out the development of the AFRP, Interior used information available from a variety of sources. These include published literature on the species, CDFG reports such as ARestoring Central Valley Streams: A Plan For Action@ (Reynolds et al. 1993) and subsequent AStatus of Implementation@ (Mills 1995), the San Joaquin River Management Program=s document title ASan Joaquin River Management Plan@ (SJRMP), Category III of the Bay-Delta Agreement=s list of actions, as well as input from stakeholders and the scientific community in general. The Core Group also sought input from individuals with expertise in the fisheries of the Delta and Central Valley to develop actions deemed necessary to at least double natural production of anadromous fish. The Working Paper listed potential factors or stressors that may limit natural production of anadromous fish and restoration actions that, if implemented, would address these factors and likely result in at least doubling natural production of anadromous fish. Reasonableness was not considered in developing the restoration actions because reasonableness would be addressed in development of this Restoration Plan.

The Working Paper actions included both non-flow actions (such as gravel restoration or use of fish screens) and flow actions. The Working Paper also included estimates of target levels of long-term, average production for four races of chinook salmon, steelhead, striped bass, American shad, and white

and green sturgeon. Production was defined in Appendix A of the Restoration Plan as the number of fish recruited to the adult population, including those harvested. Estimates of target production levels are summarized in Table 1.

The Working Paper was intended to establish a list of restoration actions that, if implemented in its entirety, would likely result in at least doubling the natural production of anadromous fish. The Working Paper relied on the scientific research that was available, with acknowledgment that scientific uncertainty was a reality in many areas. As noted above, the Working Paper did not attempt any consideration of whether the actions were reasonable as required under the CVPIA. Doubling production by implementing a reasonable set of actions (that is, a subset of the Working Paper actions) is less certain than if all the actions were implemented, but it still may be possible to double production of some species and streams. For example, doubling production of fall-run chinook salmon in a small tributary of the upper Sacramento River may be relatively easy, whereas doubling production of striped bass will likely be difficult because of the potential quantity of water that could be required to provide adequate conditions for doubling.

Table 1. Target production levels for anadromous fish in Central Valley rivers and streams.

Species	Target
Chinook salmon, all races[a]	990,000
Fall run	750,000
Late-fall run	68,000
Winter run	110,000
Spring run	68,000
Steelhead[b]	13,000
Striped bass[c]	2,500,000
American shad[d]	4,300
White sturgeon	11,000
Green sturgeon	2,000

[a] Appendix B lists production targets for each race of chinook salmon for each of the streams in the Central Valley. Because of rounding errors, targets for individual races of chinook salmon do not add up to the target for all races.

[b] Production target for steelhead spawning upstream of Red Bluff Diversion Dam. Additional steelhead spawned naturally elsewhere in the Central Valley during 1967 through 1991, but no data exist from which to calculate a target production level. Absence of a production target for a species in a specific area (for example, steelhead downstream of Red Bluff Diversion Dam) does not mean that actions to benefit that species in that area will not be considered, and in fact this Restoration Plan includes several actions for species in reaches that do not have associated production targets.

[c] Production target for striped bass is expressed as the abundance of legal-sized striped bass estimated annually by the CDFG. Estimates of legal-sized fish are used as a surrogate for adult fish because these are the best available data for developing a production target. However, the estimate includes some legal-sized fish that are not sexually mature and does not include some sub-legal-sized fish that are sexually mature.

[d] Production target for American shad is expressed as the juvenile index as derived from the CDFG fall midwater trawl in the Delta.

DEVELOPING THE DRAFT RESTORATION PLAN

The second step in developing an AFRP was the development and release of a draft Restoration Plan on December 6, 1995. The draft Restoration Plan served several functions. First, the draft Restoration Plan reflected the public comments that had been received after release of the Working Paper. In order to inform the public about the Working Paper and solicit comments, Interior held public workshops in five cities throughout northern California in June 1995. In addition, between May and November 1995, AFRP staff participated in over 30 technical workshops to discuss the Working Paper and potential provisions of the Restoration Plan. Information that was developed as a result of this outreach effort was included in the draft Restoration Plan.

The second major function of the draft Restoration Plan was to present specific target flows to be implemented in the Delta and on the CVP-controlled Central Valley streams (Sacramento River, Clear Creek, American River, and Stanislaus River). The draft Restoration Plan also included non-flow actions for all Central Valley streams (CVP-controlled and non-CVP-controlled streams).

Finally, in developing the draft Restoration Plan, Interior began its analysis of the reasonableness of AFRP actions and evaluations at the programmatic level. To assess the reasonableness of proposed AFRP actions and evaluations, Interior conducted two parallel processes. In the first process, Interior reviewed a multi-step process to evaluate each proposed action. This review, which identified reasonable actions, and which will also be used to consider proposed actions in the future, sequentially considered six steps (Figure 1) to address the following three broad categories of questions:

The first category of questions concerned the intent and technical and legal basis of an action. Specific questions Interior addressed were whether the action would benefit natural production consistent with the provisions of the CVPIA; whether key technical and scientific issues were resolved; and whether the action complied with applicable laws and regulations (steps one and two, Figure 1). If any question was not affirmed, the action was either referred to other programs, modified for reconsideration, or eliminated. Otherwise, actions were subjected to the second category of questions.

The second category of questions considered authority to implement the action. If the CVPIA specifically authorizes or directs Interior to implement the action and it does not require a partner (step three, Figure 1), it was considered reasonable for inclusion in the Restoration Plan. For example, Section 3406(b) includes a number of specific actions or programs to be implemented by the Secretary. The actions and programs determined consistent with the goal and objectives of the AFRP were considered reasonable. This same conclusion applies to certain explicit measures in the CVPIA that are also Atools@ for attaining the goal of the AFRP. That is, Interior believes that it is reasonable, at a programmatic level, to conclude that using the tools in subsections 3406 (b)(1)(B), (b)(2) and (b)(3) -- reoperation of the CVP, use of the 800,000 acre-feet of dedicated water for fish and wildlife restoration, and acquisition of additional water from willing sellers -- is reasonable for purposes of this programmatic level analysis.

If the action requires a partner with the authority to implement it, and the partners support implementation, then the action was considered reasonable (step four, Figure 1). Otherwise the action was subjected to the third category of questions.

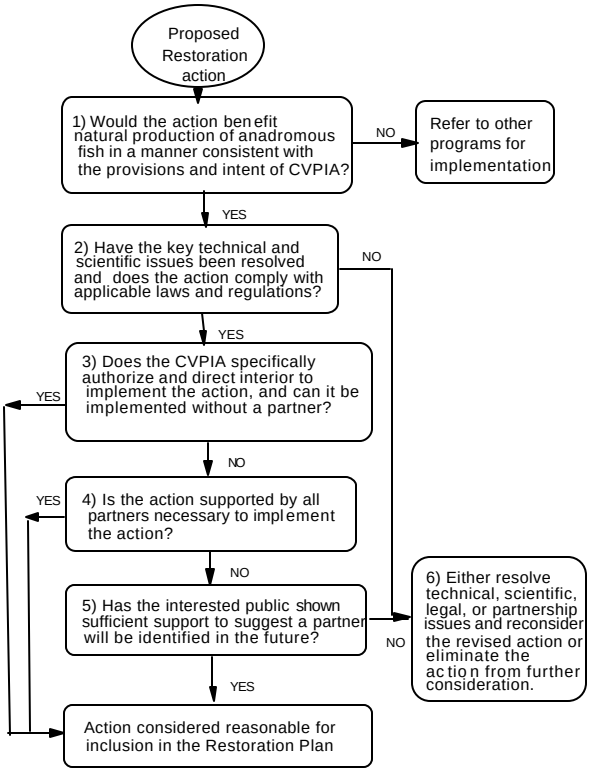

Figure 1. Process used to identify reasonable restoration actions for inclusion in the Restoration Plan (see explanation in text).

The third category of questions concerned support from the interested public for actions that would require partnerships to implement but the partnerships were not yet established. For example, some of the proposed actions require a cost-share partner as either stipulated in the CVPIA or due to the nature of the action. In these cases, Interior evaluated whether the interested public has expressed sufficient support for a particular action that it may be reasonable to assume that a cost-share partner will eventually come forward (step five, Figure 1). If partners were likely to come forward, an action was considered reasonable. Otherwise, an action was either modified for reconsideration or eliminated. Forming partnerships will be a dynamic and ongoing process continuing through the implementation phase of the AFRP, as described below.

A second reasonableness evaluation process was also being conducted during the development of the draft Restoration Plan. As noted above, the draft Restoration Plan included specific flows targets to be implemented in the Delta and on the four major CVP-controlled Central Valley streams. These flows will be addressed in the PEIS. To evaluate the reasonableness of these flows, the AFRP staff consulted with the staff developing the PEIS in an iterative process. The process resulted in modeling a range of flows, which was based on a series of assumptions considering the relative availability of water and the expected benefits to fish of flows on CVP-controlled streams and the Delta. Although the flows modeled by the PEIS may not exactly match the targets in this Restoration Plan, a range of flow regimes

encompassing the targets are analyzed that more realistically portrays possible water use and acquisition scenarios than was given in the Working Paper. Differences are due primarily to the fact that the PEIS, as a NEPA document, has to take the final evaluative step of estimating how implementation of the AFRP would occur in the future.

In addition, the Restoration Plan does not contain flow targets for non-CVP-controlled streams, but the PEIS modeled stream flows that would likely result from a reasonable level of water acquisition. To model stream flows, the PEIS made a series of assumptions about water availability and funding availability.[2] There is no need for this programmatic Restoration Plan to make similar projections, because the availability of water or funding for particular actions is something that will become known with certainty as the AFRP is implemented over the years.

DEVELOPING THE REVISED DRAFT RESTORATION PLAN

After release of the draft Restoration Plan in December 1995, Interior engaged in a substantial public outreach effort to describe the draft and solicit public comments. This effort began with general public workshops in four cities in northern California in early 1996, and has continued throughout 1996 and early 1997 as AFRP staff has attended over 50 technical workshops and meetings to discuss various aspects of the draft Restoration Plan.

The Revised Draft Restoration Plan includes summarized oral comments and copies of the written comments received from the public (Appendix I), along with a comprehensive response-to-comments document prepared by the AFRP staff (Appendix H). The release of the draft Restoration Plan generated substantial response from potential partners on those actions that will require a partner for

[2]For purposes of the PEIS to estimate how implementation of the AFRP would occur in the future and to model flows primarily on non-CVP-controlled streams, Interior will rely on four fundamental criteria to forecast the implementation of the water acquisition program consistent with the Restoration Plan. These include: (1) biological priorities (AFRP staff provided the PEIS staff with these priorities and the resulting guidelines for allocation of acquired water in a document titled "Draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the Central Valley Project Improvement Act," dated October 22, 1996); (2) water availability; (3) cost of water; and (4) fund availability.

implementation. Again, as was done with the draft, information about the availability or absence of a necessary partner is reflected in this Revised Draft Restoration Plan, even though this action-specific information more appropriately belongs in the detailed implementation plans described below. The AFRP staff have concluded that including this additional information about specific proposed actions presents a more complete portrayal of the current status of the AFRP, even though it risks confusing the programmatic-level analyses with action-specific detail.

DEVELOPING SPECIFIC IMPLEMENTATION PLANS

The third step in developing an AFRP will take place in the near future as Interior develops specific implementation plans. One of these will be the Implementation Plan, wherein Interior will identify specific actions from the Restoration Plan that are deemed the highest priority and the most readily implementable in the three-to-five year period. Interior will work closely with stakeholders, the interested public, and the CALFED Restoration Coordination Program of the CALFED Bay-Delta Program to identify the short-term priorities for the Implementation Plan.

Information contained in the Implementation Plan will primarily be organized into two categories, general and action-specific. The general information will include a more detailed description of the overall AFRP than this Restoration Plan; including processes such as public involvement and partnerships, proposal submission, environmental compliance, implementation, coordination and integration with other restoration programs, and coordination and integration among restoration actions.

Action-specific information will include current data concerning individual actions that are underway or have high potential for implementation in the near future. The information for each action will be organized in a format similar to the template in Appendix D of this Restoration Plan, and will include the action=s location, relevance to the AFRP, description, objectives, background, monitoring, costs, schedule, and involved parties. The Implementation Plan will also describe evaluations and monitoring activities supported by the AFRP.

In developing the Implementation Plan, USFWS and USBR are interested in receiving substantial input from interested parties and potential partners. To encourage input, the Implementation Plan will be developed in an open forum. Initial drafts of the various components of the Implementation Plan will be available on the AFRP Internet homepage (http:\\www.delta.dfg.ca.gov\usfws\afrp\afrp.html), and will be available in hard copy on request. Comments on any component are invited. In addition, USFWS and USBR will continue to consider action proposals they receive and to solicit action proposals to address specific problems. Proposals should be submitted to the Program Manager of the USFWS=s Central Valley Fish and Wildlife Restoration Program (CVFWRP) at the address listed in Appendix C, using a format similar to that described in Appendix D.

Interior anticipates that a first draft of the Implementation Plan will be released in 1997, but it will continue to be a living document. Because both general and action-specific details are in various stages of development and likely to evolve as information is gathered, partnerships are formed, and actions are implemented, the Implementation Plan must be responsive to change. The Implementation Plan will continue to be maintained on the Internet to allow interested parties and partners the opportunity to receive and comment on the most current information available concerning the AFRP and its implementation. Hard copies of the entire Implementation Plan will be made periodically to provide a record of its status, and it will be distributed to individuals upon request. Following development of the first Implementation Plan, the scope of the Implementation Plan will expand to include a three-to-five year period from the present.

One component of Restoration Plan implementation will be discussed in a separate implementation plan, the Water Management Plan. This Water Management Plan will guide Interior=s management of water for environmental purposes, including use of the water dedicated or acquired for environmental purposes under Sections 3406(b)(2) and (b)(3) of the CVPIA. The Water Management Plan will use a longer planning horizon (three-to-five years at a minimum), so as to enable water project operators to efficiently plan project operations to maximize environmental benefits while minimizing water supply impacts. Interior also intends that the Water Management Plan will contain a detailed description of the process for accounting for the dedication of (b)(2) water, and will include the basis for any potential Secretarial findings that (b))(2) water may not be necessary in certain circumstances under Section 3406(b)(2)(D) of the CVPIA.

Interior will make its final conclusions about the reasonableness of particular AFRP actions in these implementation plans. There are several possible reasons why an action that is reasonable at the programmatic level may become unreasonable at the specific action implementation level. First, in the process of developing specific implementation plans for actions and implementing the action, additional information will be collected on the action, including information developed during feasibility analyses and the environmental documentation process. This new information may show actions that were considered to be reasonable at the programmatic level to be unreasonable to implement. Second, the cost-sharing partner identified in the CVPIA for many of the actions or categories of actions may not be able or willing to participate on a particular project. Third, many actions in the Restoration Plan will be implementable only with the assistance and cooperation of state, local, or private party partners (for example, granting or selling easements or screening diversions). For actions that require the assistance or cooperation of partners, the Restoration Plan actions will be reasonable only to the extent that Interior can identify willing partners for cooperative projects. Finally, Interior recognizes that an authorized program that is reasonable at the programmatic level may become unreasonable if the particular implementation is carried out in an arbitrary manner as these plans prioritize the particular implementation scenarios.

IMPLEMENTATION PROCESS

This section of the Restoration Plan provides a general description of the implementation process, including prioritizing and implementing actions, monitoring and evaluating the effects of actions, dealing with varying degrees of scientific certainty, and public involvement. The implementation process is based on the implementation principles and approaches described in the strategies section of this Restoration Plan.

CRITERIA TO PRIORITIZE REASONABLE ACTIONS

Because resources are not sufficient to implement all reasonable actions simultaneously, an attempt will be made to implement high-priority items first. Priorities will be used to focus initial efforts. Monitoring will provide information to help in reevaluating priority for remaining actions. However, the implementation schedule should be flexible so the AFRP can take advantage of unique opportunities, even if it results in implementing actions that are not the highest priority.

Prioritization criteria primarily include biological considerations, which are derived from the implementation principles described in the strategies section of this Restoration Plan. In the following sections, watersheds are prioritized, followed by a list of criteria to prioritize types of actions within each watershed.

Watershed priority

Watersheds, or parts of watersheds, are prioritized based on a combination of biological and non-biological factors. Biological factors include the capacity to increase natural production within each watershed and the presence of species and races of anadromous fish with special status. Information used to prioritize watersheds are summarized in Appendix E.

Watersheds with a high capacity to increase fish production, relative to production during the baseline period, are assigned priority over those watersheds with a lower capacity to increase production. Thus, higher priority is generally placed on watersheds with severely degraded habitat than those with less severely degraded habitat.

Watersheds that support, or have the potential to support species or races of special status are assigned priority over those watersheds that do not.

A non-biological consideration is the ability of the Secretary to facilitate restoration. Because the CVPIA directs the AFRP to address effects of the CVP on anadromous fish and habitat, and provides more tools to the USFWS and USBR to implement restoration actions for such streams and facilities

than elsewhere, streams with CVP facilities or flows controlled primarily by the CVP are considered high priority.
The watershed of highest priority for restoration is assigned to the Sacramento-San Joaquin Delta because it is highly degraded, many anadromous fish rear in the Delta, and all anadromous fish in the Central Valley must pass through it as both juveniles and adults.

The following watersheds are assigned equal priority but rank below the Delta:

- The Sacramento River because it provides habitat for endangered winter-run chinook salmon, is the primary area for production of most species and races, and is strongly influenced by operation of the CVP.
- Tributaries of the upper Sacramento River that have high potential for sustaining natural production of spring-run chinook salmon and steelhead, and for promoting genetic diversity. These streams include Clear, Battle, Antelope, Mill, Deer, Big Chico, and Butte creeks.
- The American River because it is strongly influenced by operation of the CVP.
- The mainstem San Joaquin River and its tributaries below Mendota Pool, because fall-run chinook salmon there may be distinct from fall run in the Sacramento River, production of San Joaquin fall-run chinook salmon often falls to very low levels, and the tributaries are highly degraded.

Action priority

Within each watershed actions are prioritized. The criteria to prioritize actions address factors that limit natural production of anadromous fish. Limiting factors have been identified in the Working Paper (USFWS 1995) and through substantial comments and data supplied by various groups. In addition, these priorities comply with Section 3406(b)(1)(A) of the CVPIA and recognize the authorities of Interior.

In general, actions scored as a high priority if they promote natural channel and riparian habitat values and natural processes, such as those affecting stream flow, water temperature, water quality, and riparian areas. Actions are assigned a medium priority if they affect emigration or access to streams, such as sites of entrainment into diversions and migration barriers. Actions score a low priority if they do not directly affect habitat, such as hatchery practices and harvest regulations. Hatchery production should only be used as a last resort to supplement or to re-establish natural production, and then only after investigations on the desirability of developing and implementing additional hatchery production. In a few cases, actions that are likely to provide benefits disproportionate to the priority they would be assigned based on these criteria are assigned the appropriate priority. Where this occurs, the rationale for the assigned priority is given in a footnote. For example, in some watersheds, factors associated with fish access to habitat, rather than habitat quality, may be identified as the primary limiting factor. In these cases, actions to improve fish passage may be elevated to high priority, and so noted in a footnote to the action in the Actions and Evaluations section of this Restoration Plan.

IMPLEMENTING RESTORATION PLAN ACTIONS

The Secretary has several tools available to implement actions. These tools include the tools in the CVPIA and cooperating with others. Because these tools are in various stages of development and are likely to evolve as they are used and partnerships are formed, this section of the Restoration Plan describes these tools in general terms. We expect to provide detail as it becomes available on these tools in implementation plans.

Tools in the CVPIA

Tools available to the Secretary for achieving the goal of the AFRP include implementing all sections of the CVPIA. Sections 3406(b)(1)(B) through (21) of the CVPIA authorize and direct the Secretary, in consultation with other state and federal agencies, Indian tribes, and affected interests, to take specific actions. These actions are briefly described below. Details are provided in the CVPIA.

3406(b)(1)(B) - Modify CVP operations based on recommendations of USFWS after consultation with CDFG.

3406(b)(2) - Manage 800,000 acre-feet of CVP yield for fish, wildlife, and habitat restoration purposes after consultation with USBR and CDWR and in cooperation with CDFG.

3406(b)(3) - Acquire water to supplement the quantity of water dedicated for fish and wildlife water needs under (b)(2), including modifications of CVP operations; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land.

3406(b)(4) - Mitigate for Tracy Pumping Plant operations.

3406(b)(5) - Mitigate for Contra Costa Canal Pumping Plant operations.

3406(b)(6) - Install temperature control device at Shasta Dam.

3406(b)(7) - Meet flow standards that apply to CVP.

3406(b)(8) - Use pulse flows to increase migratory fish survival.

3406(b)(9) - Eliminate fish losses due to flow fluctuations of the CVP.

3406(b)(10) - Minimize fish passage problems at Red Bluff Diversion Dam.

3406(b)(11) - Implement Coleman National Fish Hatchery Development Plan and modify Keswick Dam Fish Trap.

3406(b)(12) - Provide increased flows and improve fish passage and restore habitat in Clear Creek.

3406(b)(13) - Replenish spawning gravel and restore riparian habitat below Shasta, Folsom, and New Melones reservoirs.

3406(b)(14) - Install new control structures at the Delta Cross Channel and Georgiana Slough.

3406(b)(15) - Construct, in cooperation with the State and in consultation with local interests, a seasonally operated barrier at head of Old River.

3406(b)(16) - In cooperation with independent entities and the State, monitor fish and wildlife resources in the Central Valley.

3406(b)(17) - Resolve fish passage and stranding problems at Anderson-Cottonwood Irrigation District Diversion Dam.

3406(b)(18) - If requested by the State, assist efforts to restore the striped bass fishery in the Bay-Delta estuary.

3406(b)(19) - Reevaluate carryover storage criteria for reservoirs on the Sacramento and Trinity rivers.

3406(b)(20) - Participate with the State and other federal agencies in the implementation of the on-going program to mitigate for the Glenn-Colusa Irrigation District=s Hamilton City Pumping Plant.

3406(b)(21) - Assist the State in efforts to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions.

In addition to these actions, Section 3406(e)(1 through 6) directs the Secretary to investigate and provide recommendations on the feasibility, cost, and desirability of implementing the actions listed below.

3406(e)(1) - Measures to maintain suitable temperatures for anadromous fish survival by controlling or relocating the discharge of irrigation return flows and sewage effluent, and by restoring riparian forests.

3406(e)(2) - Opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries; Provided, That additional hatchery production shall only be used to supplement or to re-establish natural production while avoiding adverse effects on remaining wild stocks.

3406(e)(3) - Measures to eliminate barriers to upstream and downstream migration of salmonids.

3406(e)(4) - Installation and operation of temperature control devices at Trinity Dam and Reservoir.

3406(e)(5) - Measures to assist in the successful migration of anadromous fish at the Delta Cross Channel and Georgiana Slough.

3406(e)(6) - Other measures to protect, restore, and enhance natural production of salmon and steelhead in tributary streams of the Sacramento and San Joaquin rivers.

Finally, Section 3406(g) of the CVPIA directs the Secretary, in cooperation with the state of California, to develop models and data to evaluate the ecologic and hydrologic effects of existing and alternate operations of public and private water facilities and systems to improve scientific understanding and enable the Secretary to fulfill requirements of the CVPIA.

The CVPIA establishes the ACentral Valley Project Restoration Fund@ and gives the Secretary the authority to use the fund Ato carry out the habitat restoration, improvement and acquisition (from willing sellers) provisions@ of the CVPIA (Section 3407), including the actions listed above. Focus areas for expenditure of the Restoration Fund are being developed in coordination with interested parties and will be described in a report to Congress in mid-1997 pursuant to sections 3407(a) and (f) of the CVPIA.

Some of the tools provided in the CVPIA involve the supplementation of stream flows on specific stream reaches. To guide the acquisition of water on both CVP and non-CVP streams, USFWS released a document titled ADraft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the Central Valley Project Improvement Act,@ dated October 22, 1996. These guidelines are intended for use in developing the long-term Water Management Plan and the implementation plan for the water acquisition program, and were used in developing alternatives for analysis in the PEIS.

The specific instream flows implemented on non-CVP streams will be the result of water acquired from willing sellers as authorized by Section 3406(b)(3) of the CVPIA. Considerable uncertainty characterizes the water acquisition process due to the many complex factors influencing the sale of water. The PEIS analyzed stream flows on non-CVP streams that would likely result from a reasonable level of water acquisition based on the draft guidelines for allocation of acquired water and considering water availability, cost of water and fund availability in its modeling. While stream flows on a long-term basis on non-CVP streams are difficult to predict, water acquisition decisions will be defined in annual implementation plans.

Restoration actions using the tools listed above will be implemented by the USFWS and USBR to contribute to doubling production of anadromous fishes. Each of these tools is being managed separately under the coordination of the Program Manager for the CVFWRP. Actions not directly addressed by tools in the CVPIA will be managed by the AFRP Program Manager (address listed in Appendix C), and their implementation will depend on partnership with local watershed workgroups and other agencies, especially the CDFG. Managers of these tools and the AFRP will use this plan as a guide to help establish priorities and identify actions. Specific actions will be selected according to the overall strategies stated in the Introduction to this Restoration Plan. These managers will ensure that actions conducted pursuant to the CVPIA will be coordinated with and complementary to ongoing restoration actions of other groups in the Central Valley and Bay-Delta, such as CDFG, Category III of the Bay-Delta Agreement, the San Joaquin River Management Program, mitigation agreements, and ad hoc groups such as the Spring-Run Chinook Salmon Workgroup.

Several tools may contribute to goals other than increasing natural production of anadromous fish. For example, 3406(b)(18) and (e)(2) may include artificial production, or other contributions to total production, such as pen rearing of salvaged striped bass, that would not directly contribute to natural production (see the AFRP Position Paper in Appendix A for definition of natural production). In fact, some fishery interests believe that artificial production is needed to supplement reasonable habitat restoration actions to stabilize or increase total production of fall-run chinook salmon in the San Joaquin tributaries and striped bass. While the AFRP can not directly support artificial production and pen rearing, it will coordinate its efforts with these and similar efforts conducted under other subsections of the CVPIA to achieve the greatest benefit for fish and wildlife.

Tools available to the Secretary to implement actions on streams and in the Delta where flows are controlled primarily by CVP structures are greater than the tools available on streams where flows are not controlled by CVP structures. For example, modification of CVP operations (Section 3406(b)(1)(B)) and use of (b)(2) water (the 800,000 acre-feet of CVP yield dedicated for fish and wildlife and habitat restoration by Section 3406(b)(2)) are limited to CVP-controlled streams and the Delta. The CVP-controlled streams include the Sacramento, American, Stanislaus, and San Joaquin rivers and Clear Creek. (Restoration of anadromous fish habitat on the San Joaquin River is limited to

the section downstream of Mendota Pool.) In addition, the CVP controls exports at the Tracy Pumping Plant, located in the south Delta.
The long-term Water Management Plan and water accounting system are being developed and will focus on modifications to CVP operations, accounting for the management of (b)(2) water, and acquisition of supplemental water (Section 3406(b)(3)) to provide flows of suitable quality, quantity, and timing to meet fish, wildlife, and habitat restoration purposes. This long-term Water Management Plan, as well as appropriate annual water management plans (i.e., annual CVP operational forecasts), will integrate upstream and Delta flows to make efficient use of the water resources available.

During 1993 through 1997, the approach described in the May 28, 1996 memorandum titled AGuidelines for Section 3406(b)(2) Water for Fish and Wildlife Restoration@ (the approach was initially described in a December 1994 letter of agreement between the USFWS and USBR, also known as the Awhite paper@) was used to manage (b)(2) water, wherein the USFWS submitted annual habitat and flow objectives to the USBR for implementation in the Sacramento, American, and Stanislaus rivers, and the Delta. In 1995 through 1997, flow objectives for Clear Creek were also submitted to USBR. These objectives considered the projected hydrologic conditions and were developed annually in coordination with CDFG, CDWR, USBR, and other interested parties.

Cooperation with others

In most streams of the Central Valley, the Secretary does not have direct authority to implement actions to restore anadromous fish production because the CVP does not control facilities or flows. Streams not controlled by the CVP include Battle, Antelope, Mill, Deer, Big Chico, and Butte creeks and Feather, Yuba, Bear, Cosumnes, Mokelumne, Calaveras, Tuolumne and Merced rivers, as well as a portion of the Delta. Private land owners, public and private irrigation districts, utilities, the State Water Project (SWP), municipalities, and industry manage facilities and flows on these streams. To assist in restoration of these streams, the Secretary will need the cooperation of others. Cooperation through partnerships of the USFWS and USBR with other entities that have the authority, interests, or resources to facilitate restoration, provides a tool to implement actions. The USFWS and USBR encourage potential partners to enter into voluntary relationships with the agencies to conduct restoration actions. Potential partners needing CVPIA resources to implement habitat restoration actions consistent with the AFRP should send a request to the Program Manager of the CVFWRP at the address listed in Appendix C.

Mechanisms under which the USFWS and USBR can establish cooperative relationships are discussed in AConservation Partnerships: A Field Guide to Public-Private Partnering for Natural Resource Conservation@ (MIEB 1993). Selection of the appropriate mechanism will depend on the role of the USFWS or USBR in relation to the partners. Figure 2 is a guide for selecting mechanisms, which are briefly explained below:

- Interagency agreements--used when one agency is providing payments, goods or services to another agency. For federal agencies, the Economy Act allows for this if an efficiency gain can be realized.

- Procurement arrangements--used when an agency pays to receive a direct benefit. It is treated as a procurement action.

- Memoranda of understanding--most commonly used to establish partnerships and document specific responsibilities; signatories agree to work toward mutual goals, perform joint work, or share research results, but no obligation of funds may be included.

- Grants--allow the USFWS and USBR to transfer money, property, services or anything of value to an outside group for a project of mutual interest where substantial agency involvement is not anticipated.

- Cooperative agreements --allow the USFWS and USBR to transfer money, property, services or anything of value to an outside group for a project of mutual interest where substantial agency involvement is anticipated.

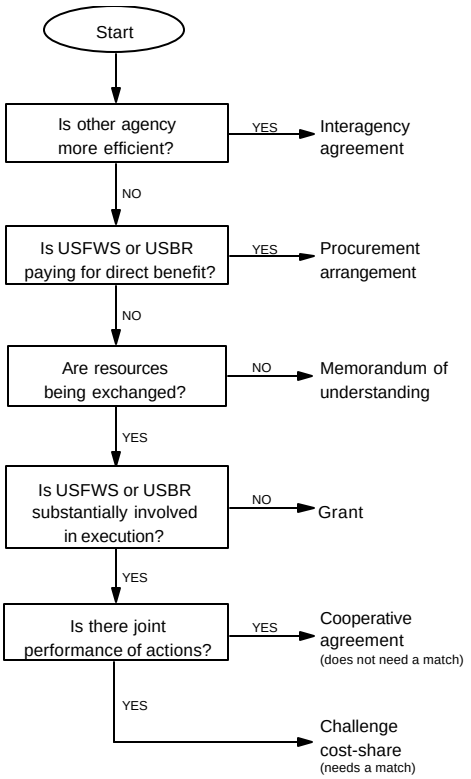

Figure 2. Mechanisms for working together (adapted from MIEB 1993).

- Challenge cost-sharing--allow the USFWS and USBR and other federal agencies to receive funds and requires recipients to match this money with non-federal funds, labor, materials, equipment or land and water, typically of one-to-one.

Through these mechanisms, the USFWS and USBR can make agreements and direct funds, including a portion of the Restoration Fund, or services to partners. The partners could then implement specific restoration actions. The CVPIA (Section 3407(e)) provides the Secretary with the flexibility to use several of the mechanisms for working together to fund non-federal partners by stating:

> AIf the Secretary determines that the State of California or an agency or subdivision thereof, an Indian tribe, or a non-profit entity concerned with restoration, protection, or enhancement of fish,

> wildlife, habitat, or environmental values is able to assist in implementing any action authorized by this title in an efficient, timely, and cost effective manner, the Secretary is authorized to provide funding to such entity on such terms and conditions as he deems necessary to assist in implementing the identified action.@

Funds dispersed through this section are subject to cost-share requirements contained in other sections of the CVPIA. Potential partners and possible mechanisms for working together are:

Local agencies and groups--Watershed workgroups, conservation groups, water districts, non-profit groups, organized school groups, and individual property owners can help implement restoration actions. Agreements can be reached with these groups, or funds and services can be directed to them through memoranda of understanding, grants, cooperative agreements, and challenge cost-sharing. In areas where there is local support but no watershed workgroups, the USFWS and USBR may provide funds and help for forming one. Information on forming and supporting local watershed workgroups is contained in the ACalifornia Coordinated Resource Management and Planning Handbook@ (CCRMP 1990). In addition, the USFWS and USBR are developing a grant program, Project Double, designed to allow small groups to participate in restoration actions.

State agencies--The CDFG, CDWR, Reclamation Board, State Water Resources Control Board (SWRCB), and other state agencies have expertise, abilities, experience, and are willing to assist in implementing many restoration actions. The USFWS and USBR can enter into procurement arrangements, memoranda of understanding, grants, and cooperative agreements with state agencies.

Other federal agencies--The Natural Resources Conservation Service (NRCS), U.S. Forest Service (USFS), Bureau of Land Management (BLM), NMFS, U.S. Geologic Survey (USGS), U.S. Army Corps of Engineers (COE), Western Area Power Administration and other federal agencies likely have specific expertise and abilities, and are willing to help implement specific actions. Through interagency and procurement arrangements, the USFWS and USBR can enter into agreements with other federal agencies to provide funding or services for development, review, and implementation of restoration actions.

MONITORING AND EVALUATION

Monitoring, using standardized and validated methods, is essential to obtain data on anadromous fish production and associated habitats to facilitate an evaluation of the effects of restoration actions. When possible, data collection should begin before specific restoration actions are implemented so that an adequate baseline is established. Data collected after implementation of actions can then be compared to the baseline. These data are essential for evaluating the contribution of actions to doubling natural production.

Most data used to establish the AFRP production targets were derived from sampling programs conducted by the CDFG (Mills and Fisher 1994). These programs consisted primarily of carcass counts, angler surveys, and ocean harvest records of salmonids; adult and juvenile population estimates and angler surveys of striped bass; an index of juvenile abundance of American shad; and adult population estimates of both white sturgeon and green sturgeon. These data represent the most complete data set on anadromous fish in most Central Valley streams and the Bay-Delta. The AFRP recommends that these programs continue and that efforts be made to refine methods and integrate the CDFG monitoring with that needed by the AFRP. This would reduce duplication and effectively allocate funding by both entities for monitoring throughout the Central Valley.

AFRP and CDFG monitoring will also be integrated and coordinated with existing programs such as the Interagency Ecological Program (IEP) and associated real-time monitoring, and others initiated to comply with mitigation requirements for specific projects. An oversight committee or forum is needed to coordinate activities of all those involved and to ensure that efforts are complementary, encourage an open exchange of information, and establish a repository or clearinghouse for data. An additional function of such a group would be to help direct monitoring activities by identifying deficiencies in the current data base. The IEP is an appropriate entity for coordinating monitoring in the Bay-Delta and for managing all data. An IEP project work team or similar forum, which would include experts in various watersheds, should be established to provide oversight for Central Valley streams. A scientific peer review process should be used to aid in evaluating the effects of restoration actions.

A diverse array of data will be required to fully evaluate restoration actions in the Central Valley and the Bay-Delta. The AFRP proposes a hierarchical approach to monitoring, from fine to coarse spatial and temporal scales (for example, action-specific, watershed-specific, and system-wide scales, and short- versus long-term temporal scales). Monitoring at all scales is needed so that restoration can be adaptively modified and refined.

Action-specific

Monitoring the effects of specific restoration actions shall facilitate evaluation at the finest spatial, and possibly temporal resolution. This could be a short-term process, intended to determine the immediate effectiveness of restoration actions. For example, the effectiveness of a fish screen, the revegetation of a restored streambank, and the effects of an operational change on flow and temperature would all be monitored. Results of action-specific evaluations will contribute to an evaluation of the overall success of Section 3406(b) of the CVPIA (described below).

Restoration actions implemented pursuant to Section 3406(b) of the CVPIA will include a plan to assess the effectiveness of each action. Ensuring that each action includes monitoring will be the responsibility of the AFRP, designated agencies, and partners.

Watershed-specific

The purpose of monitoring at the watershed level would be to evaluate the cumulative effects of all restoration actions within a single watershed. Data collected specifically for a watershed may span a short or long period, and should address the overall results of multiple actions. For example, monitoring at the watershed level could answer whether there has been an improvement in the abundance, timing, health and distribution of juvenile anadromous fish, or in selected habitat variables. The effectiveness of restoration actions in specific watersheds will be determined primarily by evaluation of indices of abundance, health and survival of juvenile life-history stages and estimates of adult production. Results of watershed-specific evaluations will also contribute to an evaluation of the overall success.

Systemwide and long-term

The long-term effects of restoration actions need to be assessed throughout the Central Valley and Bay-Delta. For example, the primary biological measure may be production of adult fish, but it could also include measures of abundance at adult or juvenile life stages. Production of adult fish should be monitored in all watersheds.

Systemwide monitoring needs to include hatchery-produced fish, primarily chinook salmon and steelhead. All or a constant fraction of hatchery salmonids released from Central Valley hatcheries should be uniquely marked according to site of origin and site and date of release. This would allow managers to differentiate between wild and hatchery fish spawning in streams, clarify the distribution of hatchery fish in the system, determine their relative contribution to commercial and sport harvest, and evaluate factors affecting fish survival. Specific studies should be designed to determine how hatchery fish interact with naturally produced fish so that the effects of hatchery practices on population genetics and dynamics can be evaluated.

Other components of the Central Valley ecosystem that will be monitored include long-term changes in characteristics of stream channels, riparian areas, and water quality. Additional sampling of fish assemblages could be incorporated into sampling protocols, and the resulting data used to evaluate fish community responses to restoration actions through time.

Section 3406(b)(16) of the CVPIA directs the Secretary to Aestablish in cooperation with independent entities and the State of California, a comprehensive assessment program to monitor fish and wildlife resources in the Central Valley to assess the biological results and effectiveness of actions implemented pursuant to this subsection.@ The Comprehensive Assessment and Monitoring Program (CAMP) was initiated pursuant to Section 3406(b)(16) and will assist in directing future monitoring activities. A draft implementation plan prepared for CAMP uses a watershed-specific approach for evaluating long-term trends in anadromous fish. Therefore, CAMP will not address action- or site-specific monitoring. It will rely on information from other monitoring programs to provide the basis for evaluating the overall

success of restoration actions. Because the AFRP restoration targets are based on natural production of adult anadromous fish, CAMP will emphasize this attribute in selected watersheds. However, measures of hatchery production and harvest will be needed to determine success toward doubling natural production of anadromous fish.

DEALING WITH VARYING DEGREES OF SCIENTIFIC CERTAINTY

Biological resource management decisions are always made with varying degrees of scientific certainty. Primary factors contributing to scientific certainty are the variability of biological processes and the physical conditions on which they depend, and our ability to quantify variability. For anadromous fish, their large geographic range and long life-span restrict the ability of resource managers to employ many control and replicate groups in studies, as is common in other fields of science (Hilborn and Ludwig 1993). It is often difficult or impossible to gather enough data to describe key processes, evaluate important variables, and predict results of management actions with absolute certainty. Thus, analyses are subject to different interpretations by interest groups, and professional judgement plays a role in management decisions.

By acknowledging varying degrees of scientific certainty in making decisions, biological resource managers engage in risk assessment. Anyone making a decision must balance the certainty of a predicted effect of a management action with the need to act. An example is the certainty of effects resulting from acting to recover winter-run chinook salmon in the Sacramento River compared to the probable results of not acting, which are continued decline and likely extinction of the race. However, managers must also consider the human dimension as part of the system in making decisions. That is, they must assess the relationship between human activities and the resource, such as potential economic and social effects of implementing management actions versus not implementing management actions.

An approach to address scientific certainty about the effects of restoration actions is to employ adaptive management. The essence of adaptive management is that in the face of uncertainty, management actions should be treated as experiments, intended to yield information as well as to meet other goals. This approach can be separated into three phases:

- First, implement initial actions, based on available data and professional judgement.
- Second, monitor initial actions to evaluate their effectiveness.
- Third, modify actions, if necessary and reasonable, to improve their benefits, stop unnecessary actions, and respond to improved scientific certainty.

Actions in the Restoration Plan correspond to the first phase of adaptive management. To address the second phase, every action will be monitored so its effectiveness can be assessed. An additional benefit of monitoring is increased certainty of an action=s effects on anadromous fish and their habitats. Many activities in the Restoration Plan are evaluations of potential problems affecting anadromous fish. Evaluations will provide insight into restoration opportunities by improving scientific certainty. The third

phase will be addressed through annual evaluations and continued interaction with interest groups. Where appropriate, scientific peer review will be used in the adaptive management approach.

Evaluations are important for contested issues, especially where questions of scientific certainty surrounding an issue prevents progress toward restoration. The AFRP will encourage interest groups involved in such issues to agree in advance to take specific actions contingent upon the results of evaluations.

It is the position of the USFWS and USBR that the levels of scientific certainty used in developing the Restoration Plan are sufficient to support the recommended actions at the programmatic level. Considering the status of listed and potentially listed species and races of anadromous fish and the substantial declines in others, there is a real urgency for action to reverse these trends. In addition, delays to restore some anadromous fish stocks may ultimately reduce future management options, relegating options to more costly actions.

The USFWS and USBR will continue to use the best available scientific information to make and implement management decisions. In the biological sciences and in managing natural ecosystems, varying degrees of scientific certainty is a reality. Therefore, professional judgement will continue to be employed to make the best possible recommendations, especially when the need for restoration is great.

PUBLIC INVOLVEMENT

Section 3406(b)(1) of the CVPIA presents two great challenges. First, Congress directed the Secretary to determine actions that are reasonable to implement. Second, the Secretary=s authority is limited. This limitation emphasizes the need for voluntary partnerships to restore natural production in the Central Valley. Even for actions that the Secretary is authorized to take, partnerships are important if the actions are to be performed efficiently. Public support and local involvement are integral parts of the AFRP=s strategies and implementation.

The USFWS and USBR are committed to involving the public as much as possible in planning and implementing restoration actions.

Approach

There are two levels of public involvement for the AFRP. The first level is programmatic, and involves planning a comprehensive program. At this level, all areas of the Central Valley are included. To plan and implement a comprehensive program, the AFRP will require ongoing, intensive public involvement. The USFWS and USBR will work with the public to nurture a process which ensures consistent participation of interested parties.

The second level is action-specific and involves implementing specific actions in individual watersheds. At the action-specific level, the AFRP will work with local watershed workgroups, local agencies and interested parties to plan and implement actions. These local watershed workgroups involve local citizens, property owners, and public and private organizations in the planning and implementation of actions within their watershed. In 1996, the AFRP partnered with local watershed workgroups, including the Mill Creek, Deer Creek Watershed, and Butte Creek Watershed conservancies and the Lower Tuolumne River Technical Advisory Committee, and with Category III of the Bay-Delta Agreement to fund eleven actions, including funding to support planning efforts by several of the local watershed workgroups. The AFRP will continue to coordinate with local watershed workgroups, the CALFED Restoration Coordination Program of the CALFED Bay-Delta Program, and other partners to implement actions in the Restoration Plan.

Environmental documentation is an important public process that addresses both programmatic and action-specific restoration efforts. NEPA and California Environmental Quality Act (CEQA) processes require public involvement in the planning and assessment of actions prior to implementation. The PEIS provides a mechanism for programmatic-level public involvement in determining the broad impacts of implementing actions in the Restoration Plan. NEPA and CEQA processes will also be required prior to implementation of many of the individual actions, providing additional opportunity for public involvement at the action-specific level.

Programmatic public involvement activities to date

CVPIA signed by President Bush.	October 1992
Draft Plan of Action for the Central Valley Anadromous Fish Restoration Program released.	August 1993
Coalition of senior fish experts from the USFWS, USBR, NMFS, USEPA, CDFG, and CDWR formed the Core Group to direct the development of the AFRP.	October 1993
Public workshops held in Oakland, Fort Bragg, Sacramento, Fresno, and Red Bluff to introduce the AFRP and to discuss the draft Plan of Action.	October-November 1993
Core Group initiated efforts to develop actions deemed necessary to at least double natural production of anadromous fish.	March 1994
Final Plan of Action for the Central Valley Anadromous Fish	May 1994

Restoration Program released.	
Public workshop held in Sacramento to discuss the final Plan of Action.	May 1994
Draft Position Paper for Development of the Anadromous Fish Restoration Program released.	July 1994
Public workshop held in Sacramento to discuss the draft Position Paper.	July 1994
Central Valley Anadromous Sport Fish Annual Run-size, Harvest, and Population Estimates, 1967 through 1991, Third Draft, released by CDFG.	August 1994
Public workshop held in Stockton to discuss CDFG=s Central Valley Anadromous Sport Fish Annual Run-size, Harvest, and Population Estimates.	October 1994
Working Paper on Restoration Needs released.	May 1995
Public workshops held in Oakland, Redding, Sacramento, Modesto, and Monterey to discuss the Working Paper on Restoration Needs; opportunity extended to public to comment orally or in writing on Working Paper.	June 1995
AFRP staff attended over 30 technical workshops and meetings to discuss the Working Paper and development of the draft Anadromous Fish Restoration Plan.	May-November 1995
Draft Anadromous Fish Restoration Plan released.	December 1995
Public workshops held in Oakland, Sacramento, Modesto, and Chico to discuss the draft Restoration Plan; opportunity extended to public to comment orally or in writing on the Restoration Plan.	January-February 1996
Public workshop held in Sacramento to release the draft guidelines for allocation of water acquired pursuant to Section 3406(b)(3) of the CVPIA.	October 1996

Public workshop held in Sacramento to review the proposed fish flow and habitat objectives and priorities for those Central Valley rivers and the Delta upon which the CVP has direct influence due to their operational facilities.	October 1996
AFRP staff attended over 50 technical workshops and meetings to discuss the draft Restoration Plan, development of the revised draft Restoration Plan, and implementation of actions in the Restoration Plan.	January 1996- February 1997
Revised Draft Restoration Plan for the AFRP released, including Appendix H which provides AFRP responses to comments on the December 1995 draft Restoration Plan.	May 1997

Future public involvement opportunities

- Programmatic

Develop and refine the Implementation Plan.	Beginning summer 1997

- Action-specifi

Implementation of specific actions in the Restoration Plan, including partnership formation, planning, environmental documentation, and permitting.	Ongoing

Public involvement mechanisms

Public participation is critical to successful implementation of the Restoration Plan. The following are public involvement mechanisms established to facilitate public input to the AFRP:

- Draft document review- Allows the public to contribute to document development.
- Final document- Reports progress and offers the public a road map for implementation.
- Press releases- Announce significant events and the opportunity for involvement.
- Letters to interested parties- Provide information.

- Workshops and meetings- Offer an informal, public setting for discussion and learning to occur both for the AFRP and the attending public.

- Educational materials- Provide summary or pertinent information about anadromous fish and the AFRP.

- Records of comments and responses- Summarize comments and AFRP responses.

- Environmental documentation- NEPA and CEQA compliance affords structured public involvement in scoping and review.

- Permitting- If required, regulatory permitting affords the public structured public involvement.

- Grapevine - Toll-free and automated information line that provides information on meeting schedules, document releases, workshop announcements, and other events. To reach this service, dial (800) 742-9474 or (916) 979-2330 and dial extension 542 after the recorded message begins.

- Internet home page - Provides up-to-date information on the AFRP and access to USFWS public release files. The Internet address is:

  http://www.delta.dfg.ca.gov/usfws/afrp/afrp.html

- Implementation Plan- Afford public the opportunity to receive and comment on implementation.

- Mailing lists- Will be maintained and updated as requested.

- Action implementation partnerships- The implementation program for specific actions will seek to effect public involvement in the form of action-oriented partnerships, preferably local watershed workgroups.

ACTIONS AND EVALUATIONS

The actions and evaluations that follow came from several sources, including the AFRP Working Paper, public and private organizations, and individual contributors. They were subjected to the process to determine reasonable actions described earlier in this Restoration Plan. Some actions from the Working Paper were determined to be unreasonable or in need of further evaluation, and are not included here. Some of those actions were replaced, while others were changed to evaluations rather than actions. With some actions, the language and intent were changed, perhaps reducing their potential biological benefit, to make them reasonable but still maintaining their contribution to increasing natural production of anadromous fish. Others were combined.

Actions and evaluations are categorized by stream or geographic area. Streams are categorized by basin, starting with the Sacramento River basin, moving to the lower Sacramento River and Delta tributaries, then to the San Joaquin basin, and finally the Delta. Within each basin, streams are organized geographically, generally starting upstream and moving downstream. For the Delta, which was assigned the highest priority in the watershed priority section, and for those streams that were assigned high priority, the priority is listed flush to the right margin on the same line as the header for the section on that stream or geographic area. Separate lists of actions and evaluations are presented Central Valley-wide and for the ocean. In general, actions identified in this plan are activities that will contributed to increases in natural production of anadromous fish. Evaluations are activities that generate information that may help define or contribute to development of actions for future implementation.

Under each stream or geographic area, actions and evaluations appear in separate tables. The tables consist of four columns. The first column describes the action or evaluation in one or two brief sentences. The second column lists the potential involved parties, including local watershed workgroups, and public and private organizations expected to be involved in implementation. The list of potential involved parties is not meant to limit involvement to the listed parties, rather the intention is to help start the process of partnership formation. The third column lists the CVPIA tools. The last column lists the priority for the action or evaluation in relation to others in the watershed.

Actions and evaluations with an arrow (•) preceding their description in the first column are underway or have high potential for implementation in the near future. These are actions that the USFWS and USBR, partners, or individual sponsors have indicated they are implementing or could begin to implement in the near future. In most cases, considerable design and engineering work, feasibility studies, environmental compliance documentation, or contract administration will be required prior to on-site activity.

It is important to note that the number of actions that can be implemented in the near future will be constrained by the resources available from the USFWS, USBR, and potential partners. This is true for

both flow management actions that are greatly influenced by annual rainfall, snow pack, carryover storage, and willing sellers, and other habitat actions that rely on the availability of partners and funding. The Restoration Fund, along with additional agency and other partnership funds, will support implementation of the AFRP restoration actions (See Appendix F for a brief summary of CVPIA resources available in the near future for implementation of restoration actions).

Direct benefits to fish may not be immediately observed even though implementation has begun. In addition, costs to implement, operate and maintain a specific action often are greater than envisioned. Hence, it is likely that the number of actions implemented may be fewer than desired. Greater accomplishments may be possible through cost sharing with partners.

A total of 172 actions and 117 evaluations are identified. Of these, 103 actions and 40 evaluations have high potential for implementation in the near future.

SACRAMENTO RIVER BASIN

Upper mainstem Sacramento River

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>•1. Implement a river flow regulation plan that balances carryover storage needs with instream flow needs consistent with the 1993 biological opinion for winter-run chinook salmon based on runoff and storage conditions, including the following minimum recommended flows at Keswick and Red Bluff Diversion dams.

Recommended minimum Sacramento River flows (cfs) at Keswick Dam for October 1 to April 30 based on October 1 carryover storage in Shasta Reservoir and critically dry runoff conditions (driest decile runoff of 2.5 maf) to produce a target April 30 Shasta Reservoir storage of 3.0-3.2 maf for temperature control.

<table>
<tr><th>Carryover storage (maf)</th><th>Keswick release (cfs)</th></tr>
<tr><td>1.9 to 2.1</td><td>3,250</td></tr>
<tr><td>2.2</td><td>3,500</td></tr>
<tr><td>2.3</td><td>3,750</td></tr>
<tr><td>2.4</td><td>4,000</td></tr>
<tr><td>2.5</td><td>4,250</td></tr>
<tr><td>2.6</td><td>4,500</td></tr>
<tr><td>2.7</td><td>4,750</td></tr>
<tr><td>2.8</td><td>5,000</td></tr>
<tr><td>2.9</td><td>5,250</td></tr>
<tr><td>3</td><td>5,500</td></tr>
</table>
</td><td>USFWS, USBR, NMFS, CDFG, Tehama-Colusa Canal Authority (TCCA)</td><td>3406(b)(1)(B), 3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
<tr><td>•2. Implement a schedule for flow changes that avoids, to the extent controllable, dewatering redds and isolating or stranding juvenile anadromous salmonids, consistent with SWRCB Order 90-5.</td><td>USFWS, USBR, CDFG, SWRCB, NMFS</td><td>3406(b)(9)</td><td>High</td></tr>
<tr><td>•3. Continue to maintain water temperatures at or below 56°F from Keswick Dam to Bend Bridge to the extent controllable, consistent with the 1993</td><td>USFWS, USBR, CDFG, SWRCB,</td><td>3406(b)(1)(B)</td><td>High</td></tr>
</table>

Action	Involved parties	Tools	Priority
biological opinion for winter-run chinook salmon and with SWRCB Order 90-5.	NMFS		
•4. Continue to raise the gates of the Red Bluff Diversion Dam (RBDD) for a minimum duration from September 15 through at least May 14 to protect adult and juvenile chinook salmon migrations, consistent with the 1993 biological opinion for winter-run chinook salmon and with SWRCB Order 90-5, and accommodate water delivery using appropriate pumping facilities.	USFWS, USBR, SWRCB, NMFS, CDFG, TCCA	3406(b)(6)	High[3]
•5. Construct an escape channel for trapped adult chinook salmon and steelhead from the Keswick Dam stilling basin to the Sacramento River, as designed by NMFS and USBR.	USFWS, USBR, NMFS, CDFG	3406(b)(11)	Medium
•6. Continue to implement the Anadromous Fish Screen Program.[4]	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	High[5]
•7. Implement structural and operational modifications to the Glenn-Colusa Irrigation District=s (GCID) water diversion facility to minimize impingement and entrainment of juvenile salmon.	GCID, USFWS, USBR, CDFG, NMFS, CDWR	3406(b)(20)	High[6]

[3]Although Action 4 addresses fish passage, it was assigned high priority because it significantly increases fish productivity. These findings are based on unpublished data and reports located in the Northern Central Valley Fish and Wildlife Office, USFWS, Red Bluff, California (Rich Johnson, personal communication 1995).

[4] Priorities for screening are being determined by the Anadromous Fish Screen Program.

[5]Although Action 6 addresses fish passage, it was assigned a high priority because it has a high potential to significantly increase fish production.

[6]Although Action 7 addresses solutions to impingement and entrainment of juvenile salmon, it was assigned a high priority because solutions can significantly enhance fish production on the upper mainstem Sacramento River.

Action	Involved parties	Tools	Priority
•8. Remedy water quality problems from toxic discharges associated with Iron Mountain Mine and water quality problems associated with metal sludges in Keswick Reservoir, consistent with the Comprehensive Environmental Response, Compensation, and Liability Act and the Clean Water Act.	USEPA, SWRCB USFWS, USBR, NMFS, CDFG		High
•9. Pursue opportunities, consistent with efforts conducted pursuant to Senate Bill 1086 (SB 1086), to create a meander belt from Keswick Dam to Colusa to recruit gravel and large woody debris, to moderate temperatures and to enhance nutrient input.	Upper Sacramento River Fisheries and Riparian Habitat Advisory Council (USRFRHAC), CDFG, COE, USFWS, USBR, CDWR, NMFS	3406(b)(1)(B), 3406(b)(13)	High
•10. Implement operational modifications to Anderson-Cottonwood Irrigation Districts (ACID) diversion dam to eliminate passage and stranding problems for chinook salmon and steelhead adults and early life stages; eliminate toxic discharges from the canal and implement structural modifications to improve the strength of the fish screens.	ACID, USFWS, USBR, CDFG, RWQCB, NMFS	3406(b)(17)	Medium
•11. Develop and implement a program for restoring and replenishing spawning gravel, where appropriate, in the Sacramento River.	CDFG, USFWS, USBR, NMFS, CDWR	3406(b)(13)	High

Evaluation	Involved parties	Tools	Priority
•1. Continue study to refine a river regulation program, consistent with SB 1086, that balances fish habitats with the flow regime and addresses temperatures, flushing flows, attraction flows, emigration, channel and riparian corridor maintenance.	USFWS, USBR, CDFG, SWRCB, NMFS, USRFRHAC	3406(e)(1)	High
•2. Evaluate opportunities to incorporate flows to restore riparian vegetation from Keswick Dam to Verona that are consistent with the overall river regulation plan.	USFWS, USBR, NMFS, CDFG, USRFRHAC	3406(b)(13), 3406(e)(1)	High
•3. Continue the evaluation to identify solutions to passage at RBDD, including measures to improve passage when the RBDD gates are in the raised position from September 15 through at least May 14.	USFWS, USBR, CDFG, TCCA, NMFS	3406(b)(10)	High
4. Evaluate the contribution of large woody debris and boulders in the upper mainstem Sacramento River to salmonid production and rearing habitat quality.	CDFG, USFWS, USBR, CDFG, RWQCB, NMFS	3406(e)(6)	Medium[7]
•5. Identify opportunities for restoring riparian forests in channelized sections of the upper mainstem Sacramento River that are appropriate with flood control and	USRFRHAC, The Nature Conservancy (TNC),	3406(b)(13)	High

[7]Although Action 4 contributes to natural habitat, it was assigned medium priority because of a lack of evidence of benefits to fish production.

Evaluation	Involved parties	Tools	Priority
other water management constraints.	CDFG, COE, USFWS, USBR, CDWR, NMFS		
•6. Identify and attempt to maintain adequate flows for white sturgeon and green sturgeon from February to May for spawning, emigration, egg incubation and rearing, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	USFWS, USBR, NMFS, CDFG	3406(b)(1)(B),3406(b)(2), 3406(b)(3)	High
•7. Identify and attempt to maintain adequate flows from April to June for spawning, incubation, and rearing of American shad, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	USFWS, USBR, NMFS, CDFG	3406(b)(1)(B),3406(b)(2), 3406(b)(3)	High
8. Identify and implement actions that will maintain mean daily water temperatures between 61°F and 65°F for at lease one month between April 1 and June 30 for American shad spawning below RBDD, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	USFWS, USBR, NMFS, CDFG	3406(b)(2), 3406(b)(3)	High
9. Identify the extent of entrainment of	USFWS,		Medium

Evaluation	Involved parties	Tools	Priority
juvenile sturgeon at diversions and pumps and minimize entrainment, if substantial.	USBR, CDFG, NMFS		
•10. Identify green sturgeon spawning sites and evaluate the availability, adequacy and use by adult sturgeon.	USFWS, USBR, CDFG, NMFS		High
11. Determine the effects of poaching and fishing on the number of spawning sturgeon.	USFWS, USBR, CDFG, NMFS		Low

Upper Sacramento River tributaries

- Clear Creek

Action	Involved parties	Tools	Priority
•1. Release 200 cfs October 1 to June 1 from Whiskeytown Dam for spring-, fall- and late fall-run chinook salmon spawning, egg incubation, emigration, gravel restoration, spring flushing and channel maintenance; release 150 cfs, or less, from July through September to maintain ≤60°F temperatures in stream sections utilized by spring-run chinook salmon. Both releases should be within the average total annual unimpaired flows to the Clear Creek watershed.	CDFG, USFWS, USBR, SWRCB	3406(b)(12)	High
•2. Halt further habitat degradation and restore channel conditions from the effects of past gravel mining.	CDFG, USFWS, USBR, BLM,	3406(b)(12)	High

Action	Involved parties	Tools	Priority
	Western Shasta Resource Conservation District (WSRCD), NPS NRCS		
•3. Remove sediment from behind McCormick-Saeltzer Dam and provide fish passage, either by removing the dam or improving fish passage facilities.	McCormick-Saeltzer Dam owners, CDFG, USFWS, USBR, NRCS, WSRCD	3406(b)(12)	High[8]
•4. Develop an erosion control and stream corridor protection program to prevent habitat degradation due to sedimentation and urbanization.	CDFG, USFWS, USBR, NRCS, BLM, WSRCD	3406(b)(12)	High
•5. Replenish gravel and restore gravel recruitment blocked by Whiskeytown Dam.	CDFG, USFWS, USBR, BLM, WSRCD	3406(b)(13)	High
•6. Preserve the productivity of habitat in the Clear Creek watershed through cooperative watershed management and development of a watershed management analysis and plan.	CDFG, USFWS, USBR, BLM,		High

[8]Although Action 3 address fish passage, it was assigned a high priority because implementation of other high priority actions in Clear Creek are dependent on completion of fish passage facilities over McCormick-Saeltzer Dam.

Action	Involved parties	Tools	Priority
	WSRCD		

Evaluation	Involved parties	Tools	Priority
•1. Evaluate the feasibility of reestablishing habitat for spring-run chinook salmon and steelhead; including ensuring that water temperatures five miles downstream of Whiskeytown Dam do not exceed upper temperature limits for each of the life history stages present in the creek from June 1 to November 1, ≤60°F for holding of prespawning adults and for rearing of juveniles, and ≤56°F for egg incubation.	CDFG, USFWS, USBR	3406(b)(1)(B),3406(b)(7), 3406(b)(12)	High

- Cow Creek

Action	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to provide flows for suitable passage and spawning for fall-run chinook salmon adults and adequate summer rearing habitat for juvenile steelhead.	Diverters, CDFG, USFWS, USBR, SWRCB	3406(b)(3)	High
•2. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
•3. Improve passage at agricultural diversion dams.	Diverters, CDFG, USFWS, USBR		Medium
•4. Fence select riparian corridors within the watershed to exclude livestock.	NRCS, Landowners, CDFG, USFWS, USBR		High

- Bear Creek

Action	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to allow suitable passage of juvenile and adult chinook salmon and steelhead during spring and early fall.	Diverters, CDFG, USFWS, USBR	3406(b)(3)	High
•2. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

- Cottonwood Creek

Action	Involved parties	Tools	Priority
1. Establish limits on instream gravel mining operations by working with state and local agencies to protect spawning gravel and enhance recruitment of spawning gravel to the Sacramento River in the valley sections of Cottonwood Creek.	COE, Shasta and Tehama counties, California Division of Mines, CDFG, USFWS, USBR		High
2. Restore the stream channel to prevent ACID Siphon from becoming a barrier to migration of spring- and fall-run chinook salmon and steelhead.	ACID, Gravel miners, USFWS, USBR		Medium
3. Eliminate adult fall-run chinook stranding by stopping attraction flows in Crowley Gulch or by constructing a barrier at the mouth of Crowley Gulch.	ACID, CDFG, USFWS, USBR		Medium
4. Facilitate watershed protection and restoration to reduce water temperatures and siltation to improve holding, spawning, and rearing habitats for salmonids.	Landowners, CDFG, USFWS, USBR		High
5. Establish, restore, and maintain riparian habitat on Cottonwood Creek.	ACID, Gravel miners, Landowners, USFWS, USBR		High

- Battle Creek

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>•1. Continue to allow adult spring-run chinook salmon and steelhead passage above the Coleman National Fish Hatchery (CNFH) weir. After a disease-safe water supply becomes available to the CNFH, allow passage of fall- and late-fall-run chinook salmon and steelhead above the CNFH weir. In the interim, prevent anadromous fish from entering the main hatchery water supply by blocking fish ladders at Wildcat Canyon, Eagle Canyon, and Coleman diversion dams.</td><td>CDFG, USFWS, USBR</td><td>3406(b)(11)</td><td>High[9]</td></tr>
<tr><td>•2. Acquire water from willing sellers consistent with applicable guidelines or negotiate agreements to increase flows past PG&E's hydropower diversions in two phases to provide adequate holding, spawning and rearing habitat for anadromous salmonids.
<table>
<tr><th>Diversion</th><th>Months</th><th>Flow (cfs)[c]</th></tr>
<tr><td>Keswick ditch[b]</td><td>All year</td><td>30</td></tr>
<tr><td>North Battle Creek feeder [b]</td><td>September-November
January-April
May-August</td><td>40
40
30</td></tr>
<tr><td>Eagle Canyon [a]</td><td>May-November
December-April</td><td>30
50</td></tr>
<tr><td>Wildcat [a]</td><td>May-November
December-April</td><td>30
50</td></tr>
<tr><td>South [b]</td><td>May-November
December-April</td><td>20
30</td></tr>
<tr><td>Inskip [b]</td><td>May-November
December-April</td><td>30
40</td></tr>
<tr><td>Coleman [a]</td><td>September-April
May-August</td><td>50
30</td></tr>
</table>
[a]First phase flows required to support winter- and spring-run chinook salmon between the Coleman Powerhouse and Eagle Canyon Diversion Dams while a disease-safe water supply is being developed for CNFH.
[b]Second phase flows required to support fall-run chinook salmon and steelhead above the CNFH weir, Coleman Powerhouse and Eagle Canyon Diversion Dams, after a disease-safe water supply is available to CNFH.
[c]Flows are intended as indicators of magnitude and subject to revision based on additional analyses.</td><td>CDFG, PG&E, USFWS, USBR, NMFS, FERC</td><td>3406(b)(3)</td><td>High</td></tr>
</table>

[9]Although Action 1 addresses fish passage, it was assigned high priority because a disease-safe water supply to CNFH substantially enhances production of anadromous salmonids by allowing them unrestricted access to the upper reaches of Battle Creek.

Action	Involved parties	Tools	Priority
•3. Construct barrier racks at the Gover Diversion dam and waste gates from the Gover Canal to prevent adult chinook salmon from entering Gover Diversion.	Gover Diversion Dam owners, CDFG, USFWS, USBR	3406(b)(21)	Medium
•4. Screen Orwick Diversion to prevent entrainment of juvenile salmonids and straying of adult chinook salmon.	Orwick Diversion Dam owners, USFWS, USBR, NMFS, CDFG, CDWR, BLM	3406(b)(21)	Medium
•5. Screen tailrace of Coleman Powerhouse to eliminate attraction of adult chinook salmon and steelhead into an area with little spawning habitat and contamination of the CNFH water supply.	CDFG, PG&E, USBR, USFWS	3406(b)(21)	Medium
•6. Construct fish screens on all PG&E diversions, as appropriate, after both phases of upstream flow actions (see Action 1) are completed and fish ladders on Coleman and Eagle Canyon diversion dams are opened.	PG&E, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
•7. Improve fish passage in Eagle Canyon by modifying a bedrock ledge and boulders that are potential barriers to adult salmonids, and rebuild fish ladders on Wildcat and Eagle Canyon diversion dams.	CDFG, USFWS, USBR		Medium

Action	Involved parties	Tools	Priority
•8. Screen CNFH intakes 2 and 3 to prevent entrainment of juvenile chinook salmon and steelhead.	USFWS, USBR, CDFG, WSRCD	3406(b)(21)	Medium

Evaluation	Involved parties	Tools	Priority
•1. Evaluate the effectiveness of fish ladders at PG&E diversions.	CDFG, PG&E, USFWS, USBR	3406(e)(3)	Medium
•2. Evaluate the feasibility of establishing naturally spawning populations of winter-run and spring-run chinook salmon and steelhead through a comprehensive plan to restore Battle Creek.	CDFG, USFWS, USBR, NMFS	3406(e)(6)	High[10]
•3. Evaluate alternatives for providing a disease-safe water supply to CNFH so that winter-, spring- and fall-run chinook salmon and steelhead would have access to an additional 41 miles of Battle Creek habitat.	USFWS, USBR, CDFG, NMFS	3406(e)(6)	High
•4. Develop a comprehensive restoration plan for Battle Creek that integrates CNFH operations.	WSRCD, CDFG, USFWS, USBR		High

[10]Although action priority criteria do not directly address endangered species, Action 2 was rated high because restoration of winter-run chinook salmon requires high priority restoration actions, flow enhancement and habitat and water quality improvements.

- Paynes Creek

Action	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve spawning, rearing and migration opportunities for fall-run chinook salmon and steelhead.	Diverters, CDFG, BLM, USFWS, USBR, Tehama County RCD	3406(b)(3)	High
2. Restore and enhance spawning gravel.	CDFG, BLM, USFWS, USBR, Tehama County RCD		High

- Antelope Creek

Action	Involved parties	Tools	Priority
•1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to allow passage of juvenile and adult spring-, fall- and late-fall-run chinook salmon and steelhead.	Diverters, CDFG, USFWS, USBR, USFS	3406(b)(3)	High

Evaluation	Involved parties	Tools	Priority
•1. Evaluate the creation of a more defined stream channel to facilitate fish passage by minimizing water infiltration into the streambed and maintaining flows to the Sacramento River.	Landowners, CDFG, USFWS, USBR	3406(e)(3)	Medium

- Elder Creek

Action	Involved parties	Tools	Priority
1. Work with Tehama County to develop an erosion control ordinance to minimize sediment input into Elder Creek.	Tehama County, CDFG, USFWS, USBR, Tehama County RCD, NRCS		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the feasibility of constructing a fish passage structure over the Corning Canal Siphon.	CDFG, USFWS, USBR, TCCA	3406(e)(3)	Medium

- Mill Creek

Action	Involved parties	Tools	Priority
•1. Continue to provide instream flows in the valley reach of Mill Creek to facilitate the passage of adult and juvenile spring-, fall- and late-fall-run chinook salmon and steelhead.	Mill Creek Conservancy (MCC), Landowners, CDFG, USFWS, USBR, CDWR	3406(b)(3)	High
•2. Preserve the habitat productivity of Mill Creek through cooperative watershed management and development of a watershed strategy.	CDFG, MCC, USFWS, USBR, Vina RCD		High
•3. Improve spawning habitats in lower Mill Creek for fall-run chinook salmon.	CDFG, MCC, USFWS, USBR, USFWS, Vina RCD		High
•4. Establish, restore, and maintain riparian habitat the riparian habitat along the lower reaches of Mill Creek.	County agencies, California State University at Chico, CDFG, USFWS, USBR, MCC, Los Molinos School		High

Action	Involved parties	Tools	Priority
	District, Vina RCD		

Evaluation	Involved parties	Tools	Priority
•1. Develop and implement an interim fish passage solution at Clough Dam until such time that a permanent solution is developed and accepted by landowners.	Diverters, MCC, Los Molinos Municipal Water Company, CDFG, CDWR, USFWS, USBR, Vina RCD	3406(e)(3)	Medium

- Thomes Creek

Action	Involved parties	Tools	Priority
1. Modify gravel mining methods to reduce their effects on salmonid spawning habitats.	Gravel miners, Tehama County Planning Commission, CDFG, CDWR, USFWS, USBR		High

Action	Involved parties	Tools	Priority
2. Employ the most ecologically sound timber extraction practices by implementing the Forest Plan on federal lands within the drainage.	Landowners, USFWS, USBR, USFS, California Department of Forestry and Fire Protection, TCCA		High
3. Modify and employ the most ecologically sound grazing practices by implementing the Forest Plan on federal lands and through partnerships on private and state-owned land within the drainage.	Landowners, USFS, USFWS, USBR, Tehama Colusa RCD		High
4. Reduce use of seasonal diversion dams that may be barriers to migrating chinook salmon and steelhead.	Henleyville and Paskenta diversion dam operators, CDFG, USFWS, USBR		Medium

Evaluation	Involved parties	Tools	Priority
1. Identify and evaluate restoring highly erodible watershed areas.	CDFG, USFWS, USBR	3406(e)(6)	High
2. Monitor water quality throughout the creek and identify	CDFG,		

Evaluation	Involved parties	Tools	Priority
limiting conditions for salmon.	USFWS, USBR		High

- Deer Creek

Action	Involved parties	Tools	Priority
•1. Acquire water from willing sellers consistent with applicable guidelines or negotiate agreements to supplement instream flows in the lower ten miles of Deer Creek to ensure passage of adult and juvenile spring- and fall-run chinook salmon and steelhead over three diversion dams.	Deer Creek Watershed Conservancy (DCWC), CDFG, USFWS, USBR	3406(b)(3)	High
•2. Develop a watershed management plan to preserve the chinook salmon and steelhead habitat in Deer Creek through cooperative watershed management.	DCWC, CDFG, USFWS, USBR		High
•3. Improve spawning habitats in lower Deer Creek for fall- and late-fall-run chinook salmon.	DCWC, CDFG, USFWS, USBR, Vina RCD		High
•4. Negotiate long-term agreements to restore and preserve riparian habitats along Deer Creek.	Landowners, DCWC, CDFG, USFWS, USBR, Vina RCD		High
•5. Plan and coordinate required flood management activities with least damage to the fishery resources and riparian habitats of lower Deer Creek; and establish, restore, and maintain riparian habitat on Deer Creek.	Tehama County Flood Control, DCWC, COE, CDFG, USFWS, USBR		High

- Stony Creek

Evaluation	Involved parties	Tools	Priority
1. Determine the feasibility of restoring anadromous salmonids by evaluating water releases from Black Butte Dam, water exchanges with the Tehama-Colusa Canal, interim and long-term water diversion solutions at Red Bluff Diversion Dam, water quality improvements, spawning gravel protection and restoration, riparian habitat protection and restoration, creek channel creation, and passage improvements at water diversions.	Stony Creek Task Force, TCCA, CDFG, COE, USFWS, USBR	3406(e)(1), 3406(e)(3), 3406(e)(6)	High

- Big Chico Creek

Action	Involved parties	Tools	Priority
•1. Relocate and screen the M&T Ranch diversion.	M&T Ranch owners, Western Canal Water District (WCWD), USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	High[11]

[11]Although Action 1 addresses a diversion, it was assigned a high priority because relocating the diversion and associated water rights from Big Chico Creek to the Sacramento River results in an additional 40 cfs in the upper reaches of Butte Creek, providing a significant benefit to spring-run chinook salmon production.

Action	Involved parties	Tools	Priority
•2. Repair the Iron Canyon fish ladder.	CDFG, USFWS, USBR, Big Chico Creek Task Force (BCCTF)		Medium
•3. Replenish spawning gravel in reaches modified for flood control.	Chico Parks Department, CDFG, USFWS, USBR, BCCTF		High
•4. Repair the Lindo Channel weir and fishway at the Lindo Channel box culvert at the Five-Mile Diversion.	Chico Parks Department, CDFG, CDWR, COE, USFWS, USBR, BCCTF		Medium
•5. Improve cleaning procedures at One-Mile Pool.	City of Chico, CDFG, USFWS, USBR		High
•6. Protect spring-run chinook salmon summer holding pools by obtaining from willing sellers titles or conservation easements on lands adjacent to the pools.	Landowners, CDFG, USFWS, USBR		High
•7. Cooperate with local landowners to encourage revegetation of denuded stream reaches; and establish,	Landowners, Sacramento River		High

Action	Involved parties	Tools	Priority
restore, and maintain riparian habitat on Big Chico Creek.	Preservation Trust, CDFG, California Department of Parks and Recreation, USFWS, USBR		
•8. Preserve the productivity of the habitat on Big Chico Creek through cooperative watershed management and development of a watershed management plan.	USFS, CDFG, USFWS, USBR		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the water management operations between Big Chico Creek and Lindo Channel.	City of Chico, CDFG, CDWR, USFWS, USBR	3406(e)(6)	Medium
2. Evaluate the replenishment of gravel in the flood-diversion reach of Mud Creek.	Butte County, CDFG, CDWR, USFWS, USBR	3406(e)(6)	High

- Butte Creek

Action	Involved parties	Tools	Priority
•1. Obtain additional instream flows from Parrott-Phelan Diversion.	Diverters, Butte Creek Watershed Conservancy (BCWC), CDFG, USFWS, USBR	3406(b)(3)	High
•2. Maintain a minimum 40 cfs instream flow below Centerville Diversion Dam.	BCWC, CDFG, PG&E, USFWS, USBR	3406(b)(3)	High
•3. Purchase existing water rights from willing sellers.	Diverters, BCWC, CDFG, USFWS, USBR, SWRCB	3406(b)(3)	High
•4. Build a new high water volume fish ladder at Durham Mutual Dam.	Durham Mutual Water Company (DMWC), BCWC, CDFG, TNC, USFWS, USBR		Medium
•5. Install fish screens on both diversions at Durham	Diverters,	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
Mutual Dam.	DMWC, TNC, USFWS, USBR, NMFS, CDFG, CDWR		
•6. Remove the Western Canal Dam and construct the Western Canal Siphon.	Western Canal Water District (WCWD), BCWC, TNC CDFG, USBR, USFWS	3406(b)(21)	High[12]
•7. Remove McPherrin and McGowan dams and provide an alternate source of water as part of the Western Canal Dam removal and siphon construction.	Diverters, WCWD, BCWC, CDFG, USBR, USFWS	3406(b)(3), 3406(b)(21)	High[13]
•8. As available, acquire water rights as a part of the Western Canal Siphon project.	WCWD, BCWC, CDFG, SWRCB,	3406(b)(3)	High

[12]Although Action 6 addresses fish passage, it was assigned a high priority because the removal of Western Canal Dam and construction of the Western Canal Siphon returns the stream to natural conditions and enhances anadromous salmonid access to spawning habitats.

[13]Although Action 7 addresses fish passage, it was assigned high priority because removal of McPherrin and McGowan dams returns the stream channel to natural conditions and enhances anadromous salmonid access to spawning habitats.

Action	Involved parties	Tools	Priority
	USBR		
9. Adjudicate water rights and provide water master service for the entire creek.	Diverters, BCWC, CDFG, CDWR, SWRCB, USFWS, USBR		High
•10. Build a new high water volume fish ladder at Adams Dam.	Diverters, BCWC, CDFG, USFWS, USBR		Medium
•11. Install fish screens on both diversions at Adams Dam.	Diverters, BCWC, CDFG, CDWR, NMFS, USFWS, USBR	3406(b)(21)	Medium
•12. Build a new high water volume fish ladder at Gorrill Dam.	Diverters, CDFG, USFWS, USBR		Medium
•13. Install a fish screen on the Gorrill Dam diversion.	Diverters, BCWC, CDFG, CDWR, NMFS, USFWS, USBR	3406(b)(21)	Medium
•14. Install a fish screen at White Mallard Dam.			

Action	Involved parties	Tools	Priority
	Diverters, BCWC, CDFG, CDWR, NMFS, USFWS, USBR	3406(b)(21)	Medium
•15. Eliminate chinook salmon stranding at White Mallard Duck Club outfall.	Diverters, BCWC, CDFG, USFWS, USBR		Medium
16. Rebuild and maintain existing culvert and riser at Drumheller Slough outfall.	Diverters, BCWC, CDFG, USFWS, USBR		Medium
•17. Install screened portable pumps in Butte Creek as an alternative to the Little Dry Creek diversion.	Diverters, BCWC, CDFG, CDWR, NMFS, USFWS, USBR	3406(b)(21)	Medium
18. Install a high water volume fish ladder at White Mallard Dam.	Diverters, BCWC, CDFG, USFWS, USBR		Medium
•19. Develop land use plans that create buffer zones between the creek and agricultural, urban, and industrial developments; and restore, maintain, and protect riparian and spring-run chinook salmon summer-holding habitat	City and county government agencies,	3406(e)(6)	High

Action	Involved parties	Tools	Priority
along Butte Creek.	Conservation groups, BCWC, CDFG, USFWS, USBR		
•20. Install fish screens and fish ladder at Parrott-Phelan Diversion Dam.	Diverters, BCWC, CDFG, USFWS, USBR	3406(b)(21)	Medium
•21. Develop a watershed management program.	BCWC, CDFG, USFWS, USBR		High
22. Establish operational criteria for Sanborn Slough Bifurcation.	Diverters, BCWC, CDFG, USFWS, USBR		Medium
23. Establish operational criteria for the East Barrow pit and West Barrow pit.	Diverters, BCWC, CDFG, USFWS, USBR		Medium
24. Establish operational criteria for Nelson Slough.	Diverters, BCWC, CDFG, USFWS, USBR		Medium

Evaluation	Involved parties	Tools	Priority
1. Develop and evaluate operational criteria and potential modifications to Butte Slough outfall.	Diverters, BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
2. Evaluate alternatives or build a new high water volume fish ladder at East-West Diversion Weir.	Diverters, BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
3. Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #2.	Diverters, BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
4. Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #1.	Diverters, BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
•5. Evaluate alternatives to help fish passage, including the installation of a fish screen, at Sanborn Slough Bifurcation Structure.	Diverters, BCWC, CDFG, CDWR, NMFS, USFWS, USBR	3406(e)(3)	High[14]
6. Evaluate alternatives to help fish passage, including the installation of fish screens, within Sutter Bypass where	Diverters, BCWC,	3406(e)(3)	Medium

[14]Although Evaluation 5 addresses fish passage, it was assigned a high priority because passage and screening solutions at the Sanborn Slough Bifurcation Structure can significantly enhance Butte Creek productivity.

Evaluation	Involved parties	Tools	Priority
necessary.	CDFG, CDWR, NMFS, USFWS, USBR		
7. Evaluate operational alternatives and establish operational criteria for Sutter Bypass Weir #5.	Diverters, BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
8. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #2.	BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
9. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #1.	BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
10. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #5.	BCWC, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	Medium
11. Evaluate alternatives to help fish passage, including the installation of a high water volume fish ladder, on Sutter Bypass Weir #3.	BCWC, CDFG, USFWS,	3406(e)(3), 3406(e)(6)	Medium

Evaluation	Involved parties	Tools	Priority
	USBR		
•12. Evaluate enhancement of fish passage at a natural barrier below the Centerville Diversion Dam.	BCWC, PG&E, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	High[15]
•13. Evaluate fish passage enhancement at PG&E diversion dams and other barriers above Centerville Diversion Dam.	BCWC, Spring-run Chinook Salmon Workgroup, PG&E, CDFG, USFWS, USBR	3406(e)(3), 3406(e)(6)	High[15]
•14. Evaluate the juvenile life history of spring-run chinook salmon.	BCWC, CDFG, USFWS, USBR		Medium
15. Evaluate juvenile and adult chinook salmon stranding in Sutter Bypass and behind Tisdale, Moulton, and Colusa weirs during periods of receding flows on the upper mainstem Sacramento River.	BCWC, CDFG, USFWS, USBR		Medium

[15]Although evaluations 12 and 13 address fish passage, they were assigned high priority because actions resulting from these evaluations could provide access to four miles of deep holding pools and three miles of spawning habitat for spring-run chinook salmon in the vicinity of Centerville and Butte Creek diversion dams (Holtgrieve, D.G. and G.W. Holtgrieve. 1995. Physical stream survey: upper Butte Creek, Butte County, California. The Nature Conservancy and the Spring-run Chinook Salmon Work Group).

- Colusa Basin Drain (westside tributaries)

Action	Involved parties	Tools	Priority
1. Install an adult exclusion device at the Knights Landing outfall for Colusa Basin Drain as an interim action pending completion of Colusa Basin Drain Evaluation 1.	CDFG, USFWS, USBR	3406(e)(1), 3406(e)(6)	Medium

Evaluation	Involved parties	Tools	Priority
1. Investigate the feasibility of restoring the access of anadromous fish to westside tributaries through development of defined migrational routes, sufficient flows, and adequate water temperatures.	CDFG, USFWS, USBR	3406(e)(1), 3406(e)(6)	Medium

- Miscellaneous small tributaries

Evaluation	Involved parties	Tools	Priority
•1. Evaluate the contribution of small Sacramento River tributaries as rearing areas for juvenile winter-, spring-, fall- and late-fall-run chinook salmon and steelhead.	CDFG, USFWS, USBR, Chico State University	3406(e)(6)	High

LOWER SACRAMENTO RIVER AND DELTA TRIBUTARIES

Feather River

Action	Involved parties	Tools	Priority
•1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve conditions for all life history stages of fall- and spring-run chinook salmon and steelhead.	CDWR, CDFG, USFWS, USBR	3406(b)(3)	High
2. Improve flows for American shad migration, spawning, incubation and rearing from April to June, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	Diverters, CDWR, CDFG, USFWS, USBR	3406(b)(3)	High
•3. Develop and utilize a temperature model as a tool for river management.	CDWR		High

Evaluation	Involved parties	Tools	Priority
•1. Evaluate the response of spawning salmonids to increased flows in the low-flow channel.	CDWR, CDFG		High

Evaluation	Involved parties	Tools	Priority
•2. Evaluate the quality of spawning gravel in areas used by chinook salmon, and if indicated, consider gravel renovation or supplementation to enhance substrate quality.	CDWR		High
•3. Evaluate the distribution of Feather River Fish Hatchery chinook salmon in Central Valley stocks and determine the genetic integrity of Feather River spring-run chinook salmon.	CDWR, CDFG		Low
4. Identify and attempt to maintain adequate flows and temperatures for white sturgeon and green sturgeon migration, spawning, incubation and rearing from February to May, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, CDWR		High
5. Identify and remove physical and water quality barriers that impede access for white sturgeon and green sturgeon to spawning habitat or facilitate passage around these barriers.	CDFG, CDWR		Medium
6. Identify the extent of white sturgeon and green sturgeon entrainment at diversions and pumps and reduce or eliminate entrainment if found to be substantial.	CDFG, CDWR		Medium
7. Identify white sturgeon and green sturgeon spawning sites and evaluate the availability and use by adult sturgeon of spawning habitat.	CDFG, CDWR		High
8. Determine the effects of poaching and fishing on the number of spawning white sturgeon and green sturgeon.	CDFG		Low
9. Identify and implement actions that maintain mean daily water temperatures between 61° F and 65°F for at least one month from April 1 to June 30 for American shad spawning, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, CDWR		High

Yuba River

Action	Involved parties	Tools	Priority
•1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve conditions for all life history stages of chinook salmon and steelhead.	Yuba County Water Agency (YCWA), SWRCB, CDFG, USFWS, USBR	3406(b)(3)	High
2. Improve flows for American shad migration, spawning, incubation and rearing from April to June, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	YCWA, SWRCB, CDFG, USFWS, USBR	3406(b)(3)	High
3. Reduce and control flow fluctuations to avoid and minimize adverse effects to juvenile salmonids.	YCWA, PG&E, SWRCB, CDFG		High
4. Maintain adequate instream flows for temperature control.	YCWA, CDFG, USFWS, USBR	3406(b)(3)	High
•5. Improve efficiency of screening devices at Hallwood-Cordua and Brophy-South Yuba water diversions, and construct screens at the Brown=s Valley water diversion and other unscreened diversions.	Diverters, SWRCB, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
6. Construct or improve the fish bypasses at Hallwood-	Diverters,		Medium

Action	Involved parties	Tools	Priority
Cordua and Brophy-South Yuba water diversion.	SWRCB, USFWS, USBR, NMFS, CDFG, CDWR		
•7. Facilitate passage of spawning adult salmonids by maintaining appropriate flows through the fish ladders, or by modifying the fish ladders at Daguerre Point Dam.	YCWA, CDFG, COE, USFWS, USBR	3406(b)(3)	Medium
8. Purchase streambank conservation easements to improve salmonid habitat and instream cover.	Landowners, YCWA, BLM, USFWS, USBR		High
9. Facilitate passage of juvenile salmonids by modifying the dam face of Daguerre Point Dam.	YCWA, CDFG, COE		Medium
10. Operate reservoirs to provide adequate water temperatures for anadromous fish.	Yuba River Water Temperature Advisory Committee, SWRCB		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the effectiveness of pulse flows to facilitate successful juvenile salmonid emigration.	YCWA, CDFG, USFWS, USBR	3406(e)(6)	High

Evaluation	Involved parties	Tools	Priority
2. Evaluate whether enhancement of water temperature control via shutter configuration and present management of the cold water pool at New Bullards Bar Dam is effective, and modify the water release outlets at Englebright Dam if enhancement of water temperature control via shutter configuration is effective.	YCWA, CDFG, PG&E, USFWS, USBR	3406(e)(6)	High
3. Identify and attempt to implement actions that will maintain mean daily water temperatures between 61°F and 65°F for at least one month from April 1 to June 30 for American shad, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	YCWA, CDFG, USFWS, USBR	3406(g)	High
•4. Evaluate the benefits of restoring stream channel and riparian habitats of the Yuba River, including the creation of side channels for spawning and rearing habitats for salmonids.	YCWA, PG&E, CDFG, USFWS	3406(e)(6)	High

Bear River

Action	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve conditions for all life history stages of chinook salmon and steelhead.	South Sutter Water District (SSWD), SWRCB, CDFG, USFWS, USBR	3406(b)(3)	High
2. Provide adequate water temperatures for all life-stages of chinook salmon and steelhead.	SSWD, SWRCB,		High

Action	Involved parties CDFG	Tools	Priority
3. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
•4. Negotiate removal or modification of the culvert crossing at Patterson Sand and Gravel and other physical and chemical barriers impeding anadromous fish migration.	Patterson Sand and Gravel, CDFG, USFWS, USBR		Medium

Evaluation	Involved parties	Tools	Priority
1. Determine and evaluate instream flow requirements that ensure adequate flows for all life stages of all salmonids.	SSWD, CDFG, USFWS, USBR		High
2. Evaluate the extent that white sturgeon and green sturgeon use the Bear River for spawning and rearing.	CDFG, USFWS		High
3. Monitor water quality, particularly at agricultural return outfalls, and evaluate potential effects on anadromous fish.	Diverters, CDFG		High
4. Evaluate the extent that poaching or fishing reduces the numbers of adult sturgeon.	CDFG, USFWS		Low

American River

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>•1. Develop and implement a river regulation plan that meets the following flow objectives by modifying CVP operations, using (b)(2) water, and acquiring water from willing sellers as needed.
<table>
<tr><th rowspan="2">Month</th><th colspan="4">American River minimum flow objectives[a] (cfs)</th></tr>
<tr><th>Wet[b]</th><th>Above and below normal</th><th>Dry and critical</th><th>Critical relaxation</th></tr>
<tr><td>October</td><td>2,500</td><td>2,000</td><td>1,750</td><td>800</td></tr>
<tr><td>November-February</td><td>2,500</td><td>2,000</td><td>1,750</td><td>1,200</td></tr>
<tr><td>March -May</td><td>4,500</td><td>3,000</td><td>2,000</td><td>1,500</td></tr>
<tr><td>June</td><td>4,500</td><td>3,000</td><td>2,000</td><td>500</td></tr>
<tr><td>July</td><td>2,500</td><td>2,500</td><td>1,500</td><td>500</td></tr>
<tr><td>August</td><td>2,500</td><td>2,000</td><td>1,000</td><td>500</td></tr>
<tr><td>September</td><td>2,500</td><td>1,500</td><td>500</td><td>500</td></tr>
</table>
[a] A multi-agency and interested party management team should be formed to review and adjust flows in consideration of carryover storage and hydrologic conditions as needed to provide for the long-term needs of anadromous fish. Flow objectives should be met for the entire reach of the American River downstream of Nimbus Dam.
[b] Year types should be based on an American River index, or on consideration of carryover storage and hydrologic conditions in the American River watershed.</td><td>Sacramento Area Water Forum (SAWF), CDFG, USBR, USFWS</td><td>3406(b)(1)(B), 3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
<tr><td>•2. Develop a long-term water allocation plan for the American River watershed.</td><td>SAWF, CDFG, Other water users, USFWS, USBR</td><td>3406(b)(1)(B), 3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
<tr><td>•3. Reduce and control flow fluctuations to avoid and minimize adverse effects on juvenile salmonids.</td><td>USFWS, USBR, CDFG</td><td>3406(b)(9)</td><td>High</td></tr>
<tr><td>•4. Reconfigure Folsom Dam shutters for improved management of Folsom Reservoir's cold water pool and better control over the temperature of water released downstream.</td><td>County of Sacramento, Sacramento Area Flood</td><td>3406(b)(1)(B)</td><td>High</td></tr>
</table>

Action	Involved parties	Tools	Priority
	Control Association (SAFCA), USFWS, USBR, CDFG		
5. Replenish spawning gravel and restore existing spawning grounds.	USFWS, USBR, CDFG	3406(b)(13)	High
6. Improve the fish screen at Fairbairn Water Treatment Plant.	City of Sacramento, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
7. Modify the timing and rate of water diverted from the river annually to reduce entrainment losses of juvenile salmonids.	City of Sacramento, Other water users, CDFG, USFWS, USBR	3406(b)(1)(B)	Medium
8. Develop a riparian corridor management plan to improve and protect riparian habitat and instream cover.	SAFCA, COE, USFWS, USBR, CDFG	3406(b)(13)	High
9. Terminate current programs that remove woody debris from the river channel.	County of Sacramento, City of Sacramento,		High

Action	Involved parties	Tools	Priority
	SAFCA, COE, USFWS, USBR, CDFG		
•10. Increase flows for American shad migration, spawning, incubation and rearing from April to June, by modifying CVP operations, by using dedicated water, and by acquiring water from willing sellers, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	SAWF, USFWS, USBR, CDFG	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the effectiveness of pulse flows to facilitate successful emigration of juvenile salmonids.	USFWS, USBR, CDFG		High
2. Evaluate and refine a river regulation plan that provides flows to protect all life stages of anadromous fish based on water storage at Folsom Reservoir and predicted hydrologic conditions in the American River watershed.	SAWF, CDFG, USFWS, USBR	3406(g)	High
3. Identify and implement actions that maintain mean daily water temperatures between 61°F and 65°F for at least one month from April 1 to June 30 for American shad spawning, consistent with action to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, CDWR		High

Mokelumne River

Action	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve conditions for all life history stages of chinook salmon and steelhead.	East Bay Municipal Utility District (EBMUD), SWRCB, Woodbridge Irrigation District (WID), FERC, CDFG, USFWS	3406(b)(3)	High
•2. Replenish gravel suitable for salmonid spawning habitat.	CDFG, EBMUD		High
•3. Cleanse spawning gravel of fine sediments and prevent sedimentation of spawning gravel.	CDFG, EBMUD		High
4. Reduce and control flow fluctuations to avoid and minimize adverse effects to juvenile salmonids.	CDFG, EBMUD		High
5. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, USBR, NMFS	3406(b)(21)	Medium
6. Maintain suitable water temperatures for all salmonid life stages.	EBMUD, CDFG		High
7. Enhance and maintain the riparian corridor to improve streambank and channel rearing habitat for juvenile salmonids.	Landowners, CDFG		High

Action	Involved parties	Tools	Priority
8. Establish and enforce water quality standards to provide optimal water quality for all life history stages of salmonids.	CDFG		High
9. Eliminate or restrict gravel mining operations in the Mokelumne River flood plain to prevent damage to potential spawning areas and encroachment of vegetation.	Gravel miners, CDFG		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the effectiveness of pulse flows to facilitate successful emigration of juvenile salmonids in the spring, and determine the efficacy in all water year types.	EBMUD, CDFG, USFWS, USBR	3406(e)(6)	High
2. Evaluate and facilitate passage of spawning adult salmonids in the fall and juvenile salmonids in the spring past Woodbridge Irrigation District Diversion Dam and Lodi Lake.	WID, City of Lodi, EBMUD, CDFG, USFWS	3406(e)(3)	Medium
3. Evaluate the incidence of predation on juvenile salmonids emigrating past Woodbridge Dam, and investigate potential remedial actions if necessary.	WID, EBMUD, CDFG, USFWS, USBR	3406(e)(6)	Medium
4. Evaluate the effects of extending the closure of the fishing season from 31 December to 31 March (and possibly to 1 June) to protect juvenile salmonids and adult steelhead and prevent anglers from wading on redds.	CDFG		Low

Cosumnes River

Action	Involved parties	Tools	Priority
1. Acquire water from willing sellers consistent with applicable guidelines or negotiate agreements to reduce water diversions or augment instream flows during critical periods for salmonids.	Diverters, CDFG, USFWS, USBR	3406(b)(3)	High
2. Pursue opportunities to purchase existing water rights from willing sellers consistent with applicable guidelines to ensure adequate flows for all life stages of salmonids.	CDFG, The Nature Conservancy (TNC), USFWS, USBR	3406(b)(3)	High
•3. Enforce Fish and Game Codes that prohibit construction of unlicensed dams.	CDFG		Medium
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, USBR, NMFS, TNC	3406(b)(21)	Medium
5. Establish a riparian corridor protection zone.	TNC, Landowners, CDFG		High
6. Rehabilitate damaged areas and remedy incompatible land practices to reduce sedimentation and instream water temperatures.	TNC, Landowners, CDFG		High

Evaluation	Involved parties	Tools	Priority
1. Determine and evaluate instream flow requirements that	Diverters,	3406(e)(6)	High

Evaluation	Involved parties	Tools	Priority
ensure adequate flows for all life stages of all salmonids.	TNC, CDFG, USFWS, USBR		
2. Evaluate and facilitate passage of adult and juvenile salmonids at existing diversion dams and barriers.	Diverters and dam builders, TNC, CDFG, USBR, USFWS	3406(e)(3)	Medium
3. Evaluate the feasibility of restoring and increasing available spawning and rearing habitat for salmonids.	TNC, CDFG, USBR, USFWS	3406(e)(6)	High

Calaveras River

Action	Involved parties	Tools	Priority
1. Supplement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements to improve conditions for all life history stages of chinook salmon.	Calaveras County Water District, Stockton East Water District (SEWD), CDFG, COE, USFWS, USBR	3406(b)(3)	High
2. Provide flows of suitable water temperatures for all salmonid life stages.	CDFG, USFWS, USBR	3406(b)(3)	High
3. Facilitate passage of adult and juvenile salmonids at existing diversion dams and barriers.	Diverters, CDFG		Medium
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, CDFG, CDWR, USFWS, NMFS, USBR	3406(b)(21)	Medium

Evaluation	Involved parties	Tools	Priority
1. Monitor sport fishing and evaluate the need for regulations to protect salmonids.	CDFG		Low

Evaluation	Involved parties	Tools	Priority
2. Evaluate instream flow, water temperature and fish habitat use in the Calaveras River to develop a real-time management program so that reservoir operations can maintain suitable habitat when fish are present.	CDFG, Diverters, USFWS		High

SAN JOAQUIN BASIN

Merced River

Action	Involved parties	Tools	Priority
•1. Supplement flows provided pursuant to the Davis-Grunsky Contract Number D-GGR17 and FERC License Number 2179 with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements as needed to improve conditions for all life history stages of chinook salmon.	Merced Irrigation District (MID), Diverters, CDFG, CDWR, USFWS, USBR	3406(b)(3)	High
2. Reduce adverse effects of rapid flow fluctuations.	MID, CDFG, USFWS, USBR		High
3. Improve watershed management to restore and protect instream and riparian habitat, including consideration of restoring and replenishing spawning gravel.	Landowners, Merced County, NRCS, CDFG, USFWS, USBR		High

Action	Involved parties	Tools	Priority
4. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
5. Establish a streamwatch program to increase public participation in river management.	Public, CDFG, USFWS		Low

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to provide suitable water temperatures for all life stages of chinook salmon; establish maximum temperature objectives of 56°F from October 15 to February 15 for incubation and 65°F from April 1 to May 31 for juvenile emigration.	Dam operators, CDFG, USFWS, USBR	3406(g)	High
•2. Evaluate and implement actions to reduce predation on juvenile chinook salmon, including actions to isolate Aponded@ sections of the river.	CDFG, USFWS, USBR	3406(e)(6)	Medium
3. Evaluate fall pulse flows for attraction and passage benefits to chinook salmon and steelhead.	Dam operators, CDFG, USFWS, USBR		High

Tuolumne River

Action	Involved parties	Tools	Priority
•1. Implement a flow schedule as specified in the terms of the FERC order resulting from the New Don Pedro Project (FERC Proceeding P-2299-024). Supplement FERC agreement flows with water acquired from willing sellers consistent with applicable guidelines or negotiate agreements as needed to improve conditions for all life history stages of chinook salmon.	City and County of San Francisco, Turlock Irrigation District (TID), Modesto Irrigation District (MID), Lower Tuolumne River Technical Advisory Committee (LTTAC), FERC, USFWS, USBR	3406(b)(3)	High

Action	Involved parties	Tools	Priority
•2. Improve watershed management and restore and protect instream and riparian habitat, including consideration of restoring and replenishing spawning gravel and performing an integrated evaluation of biological and geomorphic processes.	Landowners, NRCS, CDFG, USFWS, USBR, LTTAC		High
3. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, LTTAC, CDFG, CDWR, NMFS, USFWS, USBR	3406(b)(21)	Medium
4. Support the Tuolumne River Interpretive Center.	CDFG, LTTAC		Low
5. Establish a streamwatch program to increase public participation in river management.	Public, LTTAC, CDFG, USFWS		Low
6. Coordinate the AFRP with appropriate activities supported by the Riparian and Recreation Improvement fund that was established by the New Don Pedro Settlement Agreement.	LLTAC, USFWS, USBR		Low

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to provide suitable water temperatures for all life stages of chinook salmon; establish maximum temperature objectives of 56°F from October 15 to	Dam operators, CDFG,	3406(g)	High

Evaluation	Involved parties	Tools	Priority
February 15 for incubation and 65°F from April 1 to May 31 for juvenile emigration.	USFWS, USBR, LTTAC		
•2. Evaluate and implement actions to reduce predation on juvenile chinook salmon, including actions to isolate ponded sections of the river.	TID, MID, LTTAC, CDFG, USFWS, USBR	3406(e)(6)	Medium
3. Evaluate the effects of flow fluctuations established by the guidelines of the FERC Settlement Agreement on spawning, incubation, and rearing of chinook salmon, and if substantial adverse effects are indicated, modify guidelines to reduce effects.	Diverters, Hydropower operators, LTTAC, CDFG, USFWS, USBR		High
4. Evaluate fall pulse flows for attraction and passage benefits to chinook salmon and steelhead.	Diverters, Hydropower operators, LTTAC, CDFG, USFWS, USBR		High

Stanislaus River

<table>
<tr><th>Action</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>•1. Implement an interim river regulation plan that meets the following flow schedule by supplementing the 1987 agreement between USBR and CDFG[a], through reoperation of New Melones Dam, use of (b)(2) water, and acquisition of water from willing sellers as needed.
<table>
<tr><th rowspan="2">Month</th><th colspan="5">Stanislaus River flow schedules (cfs) by year type[b]</th></tr>
<tr><th>Wet</th><th>Above normal</th><th>Below normal</th><th>Dry</th><th>Critical</th></tr>
<tr><td>October</td><td>350</td><td>350</td><td>250</td><td>250</td><td>200</td></tr>
<tr><td>November-March</td><td>400</td><td>350</td><td>300</td><td>275</td><td>250</td></tr>
<tr><td>April</td><td>1,500</td><td>1,500</td><td>300/1500[c]</td><td>300/1500[d]</td><td>300/1500[e]</td></tr>
<tr><td>May</td><td>1,500</td><td>1,500</td><td>1500/300[c]</td><td>1500/300[d]</td><td>1500/300[e]</td></tr>
<tr><td>June</td><td>1,500</td><td>800</td><td>250</td><td>200</td><td>200</td></tr>
<tr><td>July-September</td><td>300</td><td>300</td><td>250</td><td>200</td><td>200</td></tr>
<tr><td>Total (taf)</td><td>468</td><td>410</td><td>313</td><td>257</td><td>247</td></tr>
<tr><td>Baseline (taf)</td><td>1,015</td><td>722</td><td>406</td><td>242</td><td>269</td></tr>
<tr><td>Unimpaired (taf)</td><td>1,772</td><td>1,291</td><td>920</td><td>631</td><td>449</td></tr>
</table>
[a] Existing flow requirements are 98 to 302 taf, based on the 1987 agreement between CDFG and USBR (CDFG and USBR 1987); actual schedule is determined on an annual basis and depends on available yield, carryover storage, and hydrologic conditions.
[b] Year type based on San Joaquin basin 60-20-20 index. Flow schedules are releases from Goodwin Dam.
[c] In a below normal water year, April-May flow would be maintained for 45 days at 1500 cfs and 16 days at 300 cfs.
[d] In a dry water year, April-May flow would be maintained for 30 days at 1500 cfs and 31 days at 300 cfs.
[e] In a critical water year, April-May flow would be maintained at 1500 cfs for 30 days and at 300 cfs for 31 days.</td><td>CDFG, USFWS, USBR, Oakdale Irrigation District, South San Joaquin Irrigation District, Stockton East Water District, Central San Joaquin Water Conservation District, South Delta Water Agency (SDWA), COE</td><td>3406(b)(1)(B), 3046(b)(2), 3406(b)(3)</td><td>High</td></tr>
<tr><td>•2. Improve watershed management to restore and protect instream and riparian habitat, including consideration of restoring and replenishing spawning gravel.</td><td>Landowners, CDFG, NRCS, COE, USFWS, USBR</td><td>3406(b)(13)</td><td>High</td></tr>
</table>

Action	Involved parties	Tools	Priority
3. Screen all diversions to protect all life history stages of anadromous fish.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium

Evaluation	Involved parties	Tools	Priority
•1. Identify and implement actions to provide suitable water temperatures for all life stages of chinook salmon, consistent with efforts to maintain adequate flows to provide fish habitat. Establish maximum temperature objectives of 56°F from October 15 to February 15 for incubation and 65°F from April 1 to May 31 for juvenile rearing and emigration.	Dam operators, CDFG, USFWS, USBR, COE	3406(g)	High
•2. Evaluate and implement actions to reduce predation on juvenile chinook salmon, including actions to isolate ponded sections of the river.	CDFG, USFWS, USBR, COE	3406(e)(6)	Medium
•3. Evaluate and refine a river regulation plan that provides adequate flows to protect all life stages of anadromous fish based on water storage at New Melones Reservoir, predicted hydrologic conditions, and current aquatic habitat conditions.	USFWS, USBR, CDFG, COE		High
4. Develop a carryover storage target for New Melones Reservoir to ensure Vernalis flow standards are met during the 30-day pulse flow period during the third year of a dry or critical period. This will protect at least one of three year classes of chinook salmon during emigration.	USFWS, USBR, CDFG, SEWD	3406(g)	High

Evaluation	Involved parties	Tools	Priority
5. Evaluate use of the Stanislaus River by American shad and consider increasing flows and maintaining mean daily water temperatures between 61°F and 65°F from April to June when hydrologic conditions are adequate to minimize adverse effects to water supply operations and in a manner consistent with actions to protect chinook salmon.	Dam operators, CDFG, USFWS, USBR	3406(g)	High
6. Evaluate fall pulse flows for attraction and passage benefits to chinook salmon and steelhead.	USFWS, USBR, CDFG, COE, SEWD		

Mainstem San Joaquin River

Action	Involved parties	Tools	Priority
•1. Coordinate with CDFG and others and acquire water from willing sellers consistent with applicable guidelines as needed to implement a flow schedule that improves conditions for all life stages of San Joaquin chinook salmon migrating through, or rearing in, the lower San Joaquin River.	River and tributary water managers and diverters, CDFG, SWRCB, USFWS, USBR	3406(b)(1)(B), 3406(b)(2), 3406(b)(3)	High
2. Develop an equitable, integrated San Joaquin Basin plan that will meet outflow:export objectives identified under Sacramento-San Joaquin Delta Operational Target 4 and Supplemental Actions Requiring Water 7, 8, and 9.	River and tributary water managers and diverters, CDFG, SWRCB, CDWR, USFWS, USBR		High
•3. Reduce or eliminate entrainment of juvenile chinook salmon at Banta-Carbona, West Stanislaus, Patterson, and El Soyo diversions by implementing the Anadromous Fish Screen Program in conjunction with other programs.	Diverters, USFWS, USBR, NMFS, CDFG, CDWR	3406(b)(21)	Medium
4. Reduce or eliminate entrainment of juvenile chinook salmon at smaller riparian pumps and diversions on the mainstem San Joaquin River.	Diverters, USFWS, USBR, NMFS,	3406(b)(21)	Medium

Action	Involved parties	Tools	Priority
	CDFG, CDWR		
5. Maintain the 6 mg/L dissolved oxygen standard during September through November in the San Joaquin River between Turner Cut and Stockton, as described in the SWRCB=s 1995 Water Quality Control Plan.	CDFG, CDWR, COE, City of Stockton, Port of Stockton		High
6. Establish a basin-wide conjunctive water use program.	River and tributary water managers and diverters, CDFG, CDWR, USBR, USFWS		High

Evaluation	Involved parties	Tools	Priority
1. Identify and implement actions to improve watershed management to restore and protect instream and riparian habitat.	Landowners, CDFG		High
2. Identify and implement actions to maintain suitable water temperatures or minimize length of exposure to unsuitable water temperatures for all life stages of chinook salmon in the San Joaquin River and Delta.	River and tributary water managers and diverters, CDFG,	3406(g)	High

Evaluation	Involved parties	Tools	Priority
	USFWS, USBR		
3. Identify and implement actions to reduce predation on juvenile chinook salmon.	CDFG, USFWS		Medium
4. Identify and attempt to maintain adequate flows for migration, spawning, incubation and rearing of white sturgeon and green sturgeon from February to May, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	River and tributary water managers and diverters, CDFG, CDWR		High
5. Identify and attempt to implement actions that will maintain mean daily water temperatures between 61°F and 65°F for at least one month from April 1 to June 30 for American shad, consistent with actions to protect chinook salmon and steelhead and when hydrologic conditions are adequate to minimize adverse effects to water supply operations.	CDFG, USFWS, USBR	3406(g)	High
6. Evaluate the potential to develop and implement a strategy of coordinating a variety of specific actions, such as coincident pulse flows on San Joaquin tributaries, reduced Delta exports, hatchery releases, and gravel cleaning to stimulate outmigration and reduce predation and entrainment.	River and tributary water managers and diverters, CDFG, USFWS, USBR		High
7. Identify, evaluate the need for, and, if needed, attempt to maintain adequate flows for migration of steelhead, consistent with efforts to maintain adequate flows for chinook salmon.	River and tributary water managers and	3406(b)(3)	High

Evaluation	Involved parties	Tools	Priority
	diverters, CDFG, USFWS, USBR		

SACRAMENTO-SAN JOAQUIN DELTA

Improvements to aquatic habitat in the Delta are essential to restore the natural production of anadromous fish in the Central Valley because habitat in the Delta is highly degraded and all species and races of fish use the Delta at some stage in their life history.

Recent actions to improve fish habitat in the Delta are described in the 15 December 1994, Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government (Bay-Delta Agreement) and in the State Water Resources Control Board=s May, 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (1995 WQCP). The AFRP assumes that those actions will continue to be implemented in the future. Should changes occur in the 1995 WQCP objectives or the Bay-Delta Agreement, the AFRP will need to determine if new restoration actions in the Delta beyond those described below are needed in light of those changes.

Both the Bay-Delta Agreement and 1995 WQCP require operational flexibility of state and federal water projects to provide protection for anadromous fish. As described in the Bay-Delta Agreement, initial deliberation and operational decisions to achieve this flexibility will be made by the California Water Policy Council and Federal Ecosystem Directorate (CALFED) Coordination Group (Ops Group) in consultation with water users, environmentalists and fishery representatives. The Ops Group develops ways to use the operational flexibility of the State Water Project (SWP) and Central Valley Project (CVP) such that species using the estuary receive more protection than they would have received by strict adherence to 1995 WQCP standards.

Operational flexibility allows the Ops Group to meet operational targets that contribute to doubling natural production of anadromous fish, and the Bay-Delta Agreement=s criterion to maintain water quality conditions which, together with other measures in the watershed, would be sufficient to achieve a doubling of production of chinook salmon. The operational targets listed in the first table below are the AFRP recommendations to the Ops Group. These targets allow variability in the timing and nature of operations to meet requirements in the 1995 WQCP.

A second table lists supplemental actions requiring water that may involve changes in operations beyond the authority of the Ops Group that further contribute to meeting the AFRP goal. In this table, some supplemental actions are identical to operational targets because their full implementation may be beyond the authority of the Ops Group. Supplemental actions can be met through a combination of project reoperation (Section 3406(b)(1)), management of 800,000 acre-feet of CVP yield (Section 3406(b)(2)), and acquisition of water from willing sellers (Section 3406(b)(3)). The best combination of these three tools for achieving the actions will be determined through the preparation of annual implementation plans along with guidance from the long-term water management plan, which will seek to maximize the biological benefits of the actions while minimizing their water supply impacts. In some years, the three tools may not be sufficient to fully implement all actions, resulting in partial implementation of some actions. Sub-priorities are provided as guidance for partial implementation for some actions.

These supplemental actions (some in slightly modified form) are being used to develop an implementation plan in the form of the CVP operational forecast for water year 1997 and to develop a long-term CVP Water Management Plan that integrates these supplemental actions with upstream flow actions and Delta operational targets.

In addition, these supplemental actions requiring water formed the basis for the nine priorities that were provided to the PEIS team for their use in developing alternatives for the PEIS in a letter to interested parties dated October 25, 1996 announcing an AFRP workshop on proposed fish flow and habitat objectives for selected Central Valley rivers and the Delta.

Supplemental actions not requiring water include screens at diversions and a channel barrier. Some of these actions are not under the direct authority of the Ops Group or addressed by the 1995 WQCP, however, some actions may be addressed by Category III of the Bay-Delta Agreement.

In developing this Restoration Plan, Interior has made an initial programmatic-level determination of the reasonableness of the restoration actions included in the following tables. As USFWS and USBR move towards specific plans for implementation based on this Restoration Plan, they will continue to examine the reasonableness of a particular mix of restoration actions. The final decision to implement any action will be done through the implementation process and described in the implementation plans.

The following operational targets, supplemental actions, and evaluations are intended to be consistent with and supportive of the CALFED Bay-Delta process, the Bay-Delta Agreement=s criterion to maintain conditions sufficient to achieve a doubling of production of chinook salmon, and with the narrative water quality objective in the 1995 WQCP to maintain water quality conditions and other

measures sufficient to achieve a doubling of natural production of chinook salmon from the average production of 1967-1991, consistent with the provisions of State and federal law.

Operational target	Involved parties	Tools	Priority
•1. Close Delta Cross Channel (DCC) up to 45 days in the November through January period, when juvenile salmon enter the Delta or flow or turbidity changes trigger salmon migration. The DCC gates are to be closed within 24 hours when any of the following triggers occur: 1) daily average flow or turbidity of the Sacramento River at Freeport increases by 20% from the previous 3 day running average; 2) capture of at least one juvenile chinook salmon of spring-run size in the Sacramento River tributaries and in the Sutter Bypass, or in the Sacramento River at or below Knights Landing; 3) capture of at least two juvenile chinook salmon of any race in the Sacramento River at or below Knights Landing at any Interagency Ecological Program (IEP) sampling station in one day. The gate closure period will be for 10, 15 and 20 consecutive days in November, December and January, respectively, and will remain closed for another 10 consecutive days if any of the above triggers are met after the initial closure for that month.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High[1]
•2. When the DCC is closed during the November through January period, limit the average SWP and CVP exports to no greater than 35% of Delta inflow if Evaluation 3	CALFED agencies	WQCP, Bay-Delta Agreement,	High

[1]Although Operational target 1 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

Operational target	Involved parties	Tools	Priority
determines that a relatively high ratio of Delta export to inflow limits juvenile salmon survival through the Sacramento River Delta. Sub-priorities: 1) January, 2) December, 3) November.		3406(b)(1)(B)	
•3. Maximize DCC closure from May 21 through June 15 when chinook salmon and other anadromous species are abundant in the lower Sacramento River, but keep open when the net benefit to striped bass and other sensitive species in the lower San Joaquin River is great.	CALFED agencies, United States Coast Guard, Boating interests	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High[2]
•4. Maintain an average export to inflow ratio of no more than 45% during February in dry years by increasing the ratio to ~55% in early February and decreasing the ratio to ~35% in late February, when winter-run chinook salmon smolts are present.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	High
•5. Minimize fish losses and predation at facilities by operating state and federal pumps interchangeably when this operation achieves a net benefit to anadromous fish production.	CALFED agencies	WQCP, Bay-Delta Agreement, 3406(b)(1)(B)	Medium

Supplemental action requiring water	Involved parties	Tools	Priority
•6. In conjunction with operation of a barrier at the head of Old River and consistent with efforts to conduct evaluations 1 and 2,	CALFED agencies	3406(b)(2), 3406(b)(3)	High

[2]Although Operational target 3 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

<table>
<tr><th>Supplemental action requiring water</th><th>Involved parties</th><th>Tools</th><th>Priority</th></tr>
<tr><td>maximize the difference between flows and export rates at levels greater than those required under the Delta smelt biological opinion during the 30-day April and May pulse flow period.</td><td></td><td></td><td></td></tr>
<tr><td>•7. When a barrier at the head of Old River is not operational, limit the combined SWP and CVP exports to 1,500 cfs or maintain a Vernalis inflow to total export ratio of 5 to 1 during the 30-day April through May pulse flow period.</td><td>CALFED agencies</td><td>3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
<tr><td>•8. Increase the level of protection targeted by the May and June X2 requirements to a 1962 level of development (LOD), as described below, where the number of days when X2 is required at Chipps Island in Table A of the 1995 WQCP is shown to the right of the requirements to meet a 1962 LOD and where PMI is the previous months eight river index in acre feet.
<table>
<tr><th></th><th colspan="2">1962 LOD</th><th colspan="2">IN WQCP</th></tr>
<tr><th>PMI</th><th>MAY</th><th>JUNE</th><th>MAY</th><th>JUNE</th></tr>
<tr><td>≤1500</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1750</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>2000</td><td>4</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>2250</td><td>13</td><td>1</td><td>3</td><td>0</td></tr>
<tr><td>2500</td><td>24</td><td>3</td><td>11</td><td>1</td></tr>
<tr><td>2750</td><td>29</td><td>7</td><td>20</td><td>2</td></tr>
<tr><td>3000</td><td>30</td><td>12</td><td>27</td><td>4</td></tr>
<tr><td>3250</td><td>31</td><td>18</td><td>29</td><td>8</td></tr>
<tr><td>3500</td><td>31</td><td>23</td><td>30</td><td>13</td></tr>
<tr><td>3750</td><td>31</td><td>26</td><td>31</td><td>18</td></tr>
<tr><td>4000</td><td>31</td><td>28</td><td>31</td><td>23</td></tr>
<tr><td>4250</td><td>31</td><td>29</td><td>31</td><td>25</td></tr>
<tr><td>4500</td><td>31</td><td>29</td><td>31</td><td>27</td></tr>
<tr><td>4750</td><td>31</td><td>30</td><td>31</td><td>28</td></tr>
</table></td><td>CALFED agencies</td><td>3406(b)(2),</td><td>High</td></tr>
<tr><td>•9. During May, maintain at least 13,000 cfs daily flow in the Sacramento River at the I Street Bridge and 9,000 cfs at Knights Landing to improve transport of eggs and larval striped bass and other young anadromous fish and to reduce egg settling and mortality at low flows. Sub-priorities: 1) 13,000 cfs at I Street Bridge, 2) 9,000 cfs at Knights Landing.</td><td>CALFED agencies</td><td>3406(b)(2), 3406(b)(3)</td><td>High</td></tr>
<tr><td>•10. During the last half of May, ramp (linearly) the total SWP</td><td>CALFED</td><td>3406(b)(2),</td><td>High</td></tr>
</table>

Supplemental action requiring water	Involved parties	Tools	Priority
and CVP export level from what it is at the end of the 30-day April and May pulse flow period to that export level proposed by the SWP and CVP to meet the requirements of the 1995 WQCP on June 1.	agencies	3406(b)(3)	
•11. Close the DCC during the November through January period beyond the 45-day limit defined under Operational Target 1 should meeting one of the triggers stipulated in Operational Target 1 require additional closure.	CALFED agencies	3406(b)(2), 3406(b)(3),	High[1]
•12. Limit the average SWP and CVP exports to no greater than 35% of Delta inflow in July. Sub-priorities: 1) July 1 to July 14, 2) July 16 to July 31.	CALFED agencies	3406(b)(2), 3406(b)(3)	High
13. Supplement Delta outflow for migration and rearing of white sturgeon, green sturgeon, striped bass, and American shad by modifying CVP operations and using water available under the CVPIA (sections 3406(b)(2) and (3)), consistent with actions to protect chinook salmon and steelhead.	CALFED agencies	3406(b)(2), 3406(b)(3)	High
•14. When the DCC is closed during the November through January period, limit the average SWP and CVP exports to no greater than 35% of Delta inflow if Evaluation 3 determines that a relatively high ratio of export to inflow limits survival of juvenile chinook salmon migrating through the Sacramento River Delta. Sub-priorities: 1) January, 2) December, 3) November.	CALFED agencies	3406(b)(2), 3406(b)(3)	High

Supplemental action not requiring water	Involved parties	Tools	Priority
•15. Implement actions to reduce losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions in the Sacramento-San Joaquin Delta and	Diverters, CDFG, CDWR,	3406(b)(21)	Medium

[1]Although Supplemental action 11 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

Supplemental action not requiring water	Involved parties	Tools	Priority
Suisun Marsh, if Evaluation 12 determines significant benefits to juvenile anadromous fish can be achieved by screening.	USFWS, USBR, NMFS, SWRCB, COE		
•16. Construct and operate a barrier at the head of Old River to improve conditions for chinook salmon migration and survival if Evaluation 1 determines that a barrier can be operated to improve conditions for salmon with minimal adverse effects on other Delta species.	CALFED agencies	3406(b)(2), 3406(b)(3), 3406(b)(15)	High[2]

[2]Although Supplemental Action 16 addresses fish passage, it was assigned high priority because potential to increase fish production is great.

Evaluation	Involved parties	Tools	Priority
•1. In conjunction with Evaluation 2, evaluate whether a temporary rock barrier at the head of Old River can be operated during the 30-day April through May pulse flow period to improve conditions for chinook salmon migration and survival with minimal adverse effects on other Delta species, consistent with the COE=s permit (PN 199600027) to the CDWR and USFWS=s Biological Opinion on delta smelt for the Temporary Barriers Project.	IEP agencies	3406(b)(15)	High[1]
•2. Evaluate in conjunction with Evaluation 1 the impacts of San Joaquin River Delta inflow and SWP and CVP export rates on salmon smolt survival through the San Joaquin Delta. This evaluation is intended to be consistent with the proposed adaptive management plan for the San Joaquin River and Delta that is being considered by involved parties.	IEP agencies	3406(b)(1), 3406(b)(2), 3406(b)(3)	High
•3. Evaluate the effect of a low (~35%) versus a high (~65%) SWP and CVP export to Delta inflow ratio on the survival of coded-wire-tagged, late-fall-run chinook salmon smolts migrating through the Delta when the DCC is closed.	IEP agencies	3406(b)(1), 3406(b)(2), 3406(b)(3)	High
•4. Evaluate potential benefits of and opportunities for increasing salmonid and other anadromous fish production through improved riparian habitats in the Delta.	SWP and CVP contractors, TNC, IEP agencies	3406(e)(1)	High
•5. Evaluate opportunities to provide modified operations and a new or improved control structure for the DCC and Georgiana Slough or other methods at those locations to assist in the successful migration of anadromous salmonids.	SWP and CVP contractors, IEP agencies	3406(b)(14), 3406(e)(5)	High[2]

[1]Although Evaluation 1 addresses fish passage, it was assigned high priority because resulting information is needed before Supplemental Action 16 can be implemented.

Evaluation	Involved parties	Tools	Priority
•6. Evaluate benefits of and opportunities for additional tidal shallow-water habitat as rearing habitat for anadromous fish in the Delta.	SWP and CVP contractors, TNC, IEP agencies		High
7. Evaluate the benefit of and opportunities for new technologies to improve water quality and to guide migrating fish.	SWP and CVP contractors, IEP agencies		Medium
•8. Evaluate the benefits of short-term pulsed Delta inflows (five days or less) on the migration rate and survival of anadromous fish.	SWP and CVP contractors, IEP agencies		High
•9. Continue to evaluate the effects of Delta hydraulic conditions such as net reverse flows on anadromous fish migration and distribution.	SWP and CVP contractors, IEP agencies	3406(g)	High
10. Evaluate the potential effects of reductions in food chain organisms in the Delta and Suisun Bay on anadromous fish production.	SWP and CVP contractors, IEP agencies	3406(g)	High
•11. Evaluate whether Delta inflow and export rates and other Delta hydrodynamic parameters effect juvenile salmon survival when the DCC is closed.	SWP and CVP contractors, IEP	3406(g)	High

[2]Although Evaluation 5 addresses fish passage, it was assigned high priority because the potential to increase fish production is great.

Evaluation	Involved parties	Tools	Priority
	agencies		
12. Evaluate the benefits to juvenile anadromous fish of and opportunities for screening diversions and re-locating riparian diversions in the Delta and Suisun Marsh.	SWP and CVP contractors, IEP agencies	3406(b)(21)	Medium
•13. Evaluate the potential effect of Delta export rate during the fall on the upstream migration of adult San Joaquin chinook salmon.	SWP and CVP contractors, IEP agencies	3406(b)(1)(B)	High

CENTRAL VALLEY-WIDE

Action	Involved parties	Tools	Priority
•1. Support programs to provide educational outreach and local involvement in restoration, including programs like Salmonids in the Classroom, Aquatic Wild, and Adopt a Watershed and school district environmental camps.	Local schools, CDFG, USFWS, NMFS		Low
2. Develop programs to educate the public about anadromous fish issues, such as the effects of poaching and environmental contaminants, especially contaminants in urban runoff.	CDFG, USFWS, NMFS, Water Education Foundation, California Teachers Association		Low
3. Reduce toxic chemical and trace element contamination.	CDFG,		High

Action	Involved parties	Tools	Priority
	USFWS, SWRCB, RWQCBs		
•4. Provide additional funding for increased law enforcement to reduce illegal take of anadromous fish, stream alteration, and water pollution and to ensure adequate protection for juvenile fish at pumps and diversions.	CDFG, USFWS, USBR, CDWR		High

Evaluation	Involved parties	Tools	Priority
1. Evaluate the need to revise harvest regulations to increase spawning escapement of naturally produced chinook salmon.	CDFG, Pacific Fisheries Management Council (PFMC), NMFS, USFWS		Low
2. Evaluate the potential to modify hatchery procedures to benefit native stocks of salmonids.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
3. Evaluate and avoid potential competitive displacement of naturally produced juvenile salmonids with hatchery-produced juveniles by implementing release strategies for hatchery-produced fish designed to minimize detrimental interactions.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
•4. Evaluate and implement specific hatchery spawning protocols and genetic evaluation programs to maintain genetic diversity in hatchery and natural stocks.	CDFG, CDWR, USFWS, USBR	3406(e)(2)	Low
5. Evaluate the transfer of disease between hatchery and	CDFG,	3406(e)(2)	Low

Evaluation	Involved parties	Tools	Priority
natural stocks.	CDWR, USFWS, USBR		
6. Evaluate effects of trace elements and organic contaminants, especially selenium and PCBs, on the health of adult white sturgeon and green sturgeon, the viability of their gametes, and development of their offspring.	CDFG, USFWS		High
•7. Evaluate a program to tag and fin-clip all or a significant portion of hatchery-produced fish as a means of collecting better information regarding harvest rates on hatchery and naturally produced fish and effects of hatchery-produced fish on naturally produced fish.	CDFG, CDWR, USFWS, USBR, NMFS, EBMUD	3406(e)(2)	Low
8. Evaluate the direct and indirect effects of contaminants on production of anadromous fish.	CDFG, USFWS, RWQCBs, SWRCB		High
9. Evaluate the ability of streams for which target production levels exist for chinook salmon but not for steelhead to support natural production of steelhead.	CDFG, USFWS	3406(e)(6)	High
10. Evaluate the effects of exotic species on production of anadromous fish.	IEP agencies		Low
11. Encourage the restoration of small tributaries by evaluating the feasibility of screening or relocating diversions, switching to alternative sources of water for upstream diversions, restoring and maintaining a protected riparian strip, limit excessive erosion, enforcing dumping ordinances, removing toxic materials or controlling their source, replacing bridge and ford combinations with bridges or larger culverts and installing siphons to prevent truncation of small streams at irrigation canals.	CDFG, USFWS, USBR	3406(e)(6)	High

OCEAN

Evaluation	Involved parties	Tools	Priority
1. Evaluate the need to revise harvest regulations on both sport and commercial fishers to increase spawning escapement of naturally produced chinook salmon.	PFMC, CDFG, NMFS, USFWS		Low
2. Evaluate the effects of sea lion predation on chinook salmon production.	PFMC, CDFG, NMFS, USFWS		Low
3. Evaluate the effects of foreign, open-ocean harvest on Central Valley chinook salmon and steelhead stocks.	PFMC, NMFS, CDFG, USFWS		Low

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APPENDICES

A. AFRP Position Paper

Presented in its entirety below is the "Position Paper for Development of the Central Valley Anadromous Fish Restoration Program". The Position Paper was developed by the AFRP Core Group to guide program development. It was released to the public on July 18, 1994 and was slightly revised and re-released in Volume 2 of the Working Paper on Restoration Needs (USFWS 1995). Only the phone number and address to request copies has been revised since the last release.

POSITION PAPER FOR DEVELOPMENT OF THE CENTRAL VALLEY ANADROMOUS FISH RESTORATION PROGRAM

INTRODUCTION

The Plan of Action (POA) for the Central Valley Anadromous Fish Restoration Program (Program) identifies the steps necessary to develop the Program (USFWS 1994). One of the steps included the preparation of a Position Paper to be developed by the Core Group. This document is a draft of the Position Paper described in the POA.

This Position Paper is a reference document for use by the Core Group and the technical teams to guide Program development. Because it was impossible to anticipate all issues prior to drafting the Position Paper, this paper will be amended and supplements added as needed. To determine if your copy is current and to request copies of the Position Paper, contact the Public Information Officer, Central Valley Fish and Wildlife Restoration Program, 3310 El Camino Avenue, Sacramento, California 95821, (916) 979-2760.

The paper is divided into three sections: (1) Program goal and definitions, (2) Intent of Title 34, and (3) Implementation criteria. The first section states the Program goal and develops general definitions for each of the terms used in the Program goal. The second section presents and interprets the intent of Title 34 and reexamines some of the definitions presented in the first section. These first two sections lay the foundation for the last section.

In the last section, implementation criteria are discussed for the 1967-1991 (baseline) period and for the future. Discussions of implementation criteria are separated because the two periods require different criteria. As discussed later in this paper, limitations are imposed by the type or quantity of data collected during the baseline period. Future monitoring programs may be designed to avoid these limitations.

PURPOSE OF POSITION PAPER

The purposes of the Position Paper are two-fold: (1) to explain or clarify the Core Group's position on issues related to developing the Program and (2) to document reasons used to develop these positions.

PROGRAM GOAL AND RELATED DEFINITIONS

Title 34 requires that "...natural production of anadromous fish in Central Valley rivers and streams be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991..." (Section 3406[b][1]). Several terms need to be clearly defined before the program can be designed to meet this requirement: natural production, anadromous fish, Central Valley rivers and streams, sustainable, long-term basis, and average levels.

Natural Production

Title 34 defines natural production as: "... fish produced to adulthood without direct human intervention in the spawning, rearing, or migration processes" (Section 3403[h]). To apply this definition, we must develop an understanding of the meaning of each of the components of the definition. Important components that have been identified to date are the following: production, adulthood, and direct human intervention.

Production

Ricker (1958) defined production as "the total elaboration of new body substance in a stock in a unit of time, irrespective of whether or not it survives to the end of that time." Although Ricker's definition includes changes in mass as well as numbers of fish, Title 34 specifies "... fish produced to adulthood..." and therefore production will refer to numbers of fish produced.

Because a fish can only be "...produced to adulthood..." once in its lifetime, an individual fish should not be counted twice. In addition, production should be measured over a discrete time interval. Because all stocks under consideration are seasonal spawners, **a direct and simple approach will be to count the first-time spawners each spawning season**.

Ricker's definition also states that a fish is counted toward production for the time period over which production is being measured "...irrespective of whether or not it survives to the end of that time". Using Ricker's definition, juvenile fish that did not

survive to adulthood would be counted. The definition of natural production in Title 34 specifies "... fish produced to adulthood..." and therefore does not count juvenile fish. On the other hand, Title 34 does not discriminate between adult fish that return to spawn and those taken in recreational and commercial fisheries. Because Ricker's definition includes fish that do not survive to the end of the time period, and because the definition of natural production in Title 34 specifies fish produced to adulthood, **all naturally produced, adult fish shall be counted, including those that are harvested prior to spawning**.

Including harvested fish is consistent with the definition of production in the California Salmon, Steelhead Trout and Anadromous Fisheries Program Act. The California Act defines production as "the survival of fish to adulthood as measured by abundance of the recreational and commercial catch together with the return of fish to the states spawning streams." Because both the Federal and State acts have similar purposes and goals, and because implementation of both acts should be coordinated, it is convenient that the definitions of production being implemented for both acts are similar.

Whether or not a fish attains adulthood is key to determining whether or not to count that fish toward the production goal. Adulthood is defined below.

Adulthood

Section 3403(h) includes the phrase "...fish produced to adulthood..." as part of the definition of natural production. Adulthood is not defined within Title 34. Adulthood is generally defined as the state, condition or quality of being fully developed and mature. Applying this definition to fish is complicated by the fact that most fish continue to grow throughout life (i.e., cessation of growth can't be used to indicate full development) and may become sexually mature several times during their lifetime (i.e., although developed gonads can be used to indicate maturity, lack of developed gonads cannot be used to indicate immaturity). Because the presence or absence of external characters can't always be used to identify adult fish, and because sexual maturity (i.e., developed gonads) is a transitory state, fishery managers often use size or age criteria to indicate maturity.

An adult fish will be defined as one that is capable of reproduction. Ability to reproduce should be based on some external characteristic, such as size. Because Title 34 requires that production be compared between baseline and goal periods, the same criteria for determination of adulthood will be applied to both periods.

Direct Human Intervention

The definition of natural production precludes "...direct human intervention..." in the spawning, rearing, or migration processes of an individual, naturally produced fish. A definition of direct human intervention is key to understanding the definition of natural production. Humans have pervasively intervened in the structure and function of the Sacramento-San Joaquin system. All anadromous fish that spawn in the system have been impacted by this intervention. Indeed, Title 34 has as one of its purposes "...to address impacts of the Central Valley Project on fish, wildlife, and associated habitats..." (Section 3402[b]). But not all human intervention is direct. The word direct is an important component of the phrase "...direct human intervention...".

Direct human intervention is any action taken in the absence of intervening elements. Any form of intervention that requires handling of fish is direct intervention due to a lack of intervening elements. Any action that includes one or more intervening elements would be considered indirect intervention.

Hatchery and artificial propagation, including supplementation and out-planting of eggs or any other life-stage, requires handling of fish by humans during the spawning and rearing processes and therefore are forms of direct intervention. Transporting fish, including truck and barge transport, and fish salvage require capture and handling of fish during the rearing or migration process and therefore are forms of direct intervention. Hatchery and artificial propagation, transport and salvage of fish, or any process that requires handling of any life-stage of fish will be considered direct human intervention.

Title 34 clearly states that fish produced with direct human intervention should not be included in counts of natural production. In developing the Program, we will avoid counting hatchery-produced fish or fish produced with any other form of direct human intervention in counts of natural production. The Core Group has determined that there will be one exception to this rule: the progeny of naturally spawning fish salvaged at the John E. Skinner Delta Fish Protective Facility and the Tracy Fish Protective Facility, if they reach adulthood, will be counted as naturally produced.

An example of a form of intervention that does not fit the definition of direct intervention is flow manipulation. When we manipulate flow to benefit fish, flow acts as the intervening element. Humans directly alter flows and flows alter fish spawning, rearing, or migration processes. Therefore, flow manipulation is not a direct but an indirect form of intervention. Construction of fish ladders, screens and barriers are forms of indirect intervention because each of these structures act as the intervening element. Reservoir or flow manipulations (including Delta flows and flows to maintain desired stream temperatures), ladders, screens, barriers, and other forms of habitat alteration and enhancement activities will not be considered direct human intervention because each of these is or has an intervening element and does not require handling of fish.

Because the definition of natural production in Title 34 includes the phrase "...produced to adulthood...", fish that are not subject to direct human intervention until after they reach adulthood would still be considered naturally produced. For example, a naturally produced fish that returned to a hatchery and was spawned in the hatchery would be considered naturally produced. Obviously, its progeny would not be considered naturally produced because they were produced in a hatchery. Similarly, naturally produced adult fish whose migration was subject to direct human intervention would still be considered naturally produced, although their progeny would not be considered naturally produced.

Anadromous Fish

Title 34 defines anadromous fish as "...those stocks of salmon (including steelhead), striped bass, sturgeon, and American shad that ascend the Sacramento and San Joaquin rivers and their tributaries and the Sacramento-San Joaquin Delta to reproduce after maturing in San Francisco Bay or the Pacific Ocean" (Section 3403[a]). This definition identifies five groups or species of fish: salmon, steelhead, striped bass, sturgeon, and American shad. The American Fisheries Society recognizes steelhead as the common name for the anadromous form of *Oncorhynchus mykiss* and striped bass and American shad as the common names for *Morone saxatilis* and *Alosa sapidissima* (AFS 1991). Clearly, Title 34 includes these species in the definition of anadromous fish. The names salmon and sturgeon both include multiple species of fish and the meaning of these terms in relation to Program development needs clarification. The term"stocks" in the definition of anadromous fish also needs clarification.

Salmon - Salmon is a common name for at least six species of fish. Five species of salmon have been observed in the Sacramento River: chinook (*O. tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon (Moyle 1976, Fry 1973). Chinook salmon are common in the Sacramento-San Joaquin system, the other four species are rare. Based on observations of adults during 1949 through 1958, Hallock and Fry (1967) concluded that sockeye, pink, and chum salmon entered the Sacramento River regularly enough to be regarded as very small runs, but that coho salmon were so scarce and irregular that they should be regarded as strays. Juvenile coho salmon were planted in Mill Creek in 1956, 1957, and 1958, but by 1963 coho salmon were almost as scarce as they had been before the introductions (Hallock and Fry 1967). During the baseline period, there is no evidence that coho, sockeye, pink, or chum salmon maintained self-sustaining spawning runs in the Central Valley (Fisher pers. comm.). Because the definition of anadromous fish specifies "...salmon... that ascend the Sacramento and San Joaquin rivers...to reproduce..." and because chinook salmon is the only salmon known to reproduce in the system on a

regular basis during the baseline period, the use of the word salmon in the definition will be interpreted to mean chinook salmon.

Sturgeon - Two species of sturgeon are found in the Sacramento-San Joaquin system: white sturgeon (*Acipenser transmontanus*) and green sturgeon (*A. medirostris*) (Moyle 1976). Because both species of sturgeon reproduce in the Sacramento-San Joaquin system, the word sturgeon will be interpreted to include white and green sturgeon.

In summary, **the species of anadromous fish identified by Title 34 that reproduce in the Sacramento-San Joaquin system include chinook salmon, steelhead, striped bass, white sturgeon, green sturgeon, and American shad**. The Program will be designed to double the natural production of the anadromous forms of these six species.

Other anadromous fish - Title 34 does not identify several species of anadromous fish that spawn in Central Valley rivers and streams. These include threespine stickleback, brown trout, and two species of lamprey and smelt (Fry 1973). The Program will not establish restoration goals specific to these species.

Stocks

For purposes of the Program, **a stock is defined as a group of individuals which are more likely to mate with each other than with individuals not included in the group**. The term stock describes a fish population that spawns in a particular stream, or stream reach, at a particular season and that do not interbreed to a substantial degree with any group spawning in a different place, or in the same place at a different time. This definition does not rely upon absolute reproductive barriers. In fisheries management, stocks are recognized to maintain and improve the genetic basis for management.

Several stocks which meet this definition are already recognized. For example, chinook salmon are divided into several races based on the season during which they enter the rivers to begin their upstream spawning migrations as follows: fall, late-fall, winter, and spring runs. Others stocks which might be recognized in the future will likely become stocks of special concern.

Good evidence exists for salmon and steelhead that these species return to their natal streams to spawn. There is some evidence and little reason not to expect that the same relationship holds for some of the other anadromous species. As stated in the POA for the Program, the objective of the Program will be to double the natural production of all

species and races within specific individual streams, and to preserve genetic stocks. If it proves unfeasible to double the natural production of a species or race within a specific stream, the unmet production increment will be transferred to other individual streams in the following order of priority: (1) another stream within the same drainage system, (2) another stream within the larger basin, such as the Sacramento River Basin, and (3) any stream within the Central Valley.

Central Valley Rivers and Streams

For the purposes of the Program, **Central Valley rivers and streams are defined as all rivers, streams, creeks, sloughs and other watercourses, regardless of volume and frequency of flow, that drain into the Sacramento River basin, the San Joaquin River basin downstream of Mendota Pool, or the Sacramento-San Joaquin Delta upstream of Chipps Island**.

Sustainable

Sustainable means capable of being maintained or kept in existence. In Title 34, sustainable refers to natural production, which is defined as "... fish produced to adulthood without direct human intervention...." Elimination of direct human intervention as a legitimate alternative requires reliance on restoration and maintenance of habitat conditions that allow anadromous fish populations to sustain themselves at levels consistent with numeric restoration goals. Therefore, in the context of Title 34, **sustainable is defined as capable of being maintained at target levels without direct human intervention in the spawning, rearing or migration processes**. Production levels specified by numeric go als will be considered sustainable when they are maintained under the entire range of conditions resulting from legal human activities, as superimposed on natural variability inherent in the system. Human activities shall include, but not be limited to, agricultural diversion and discharge, exports, flow manipulation, water pollution, dredge and fill, channel modification and damming.

There is an element of time implicit in sustainability. Therefore, if natural production is to be sustainable, modifications to system operations as well as improved physical habitat and water quality must be provided into the future. Title 34 requires that "...natural production...be sustainable, on a long-term basis" and provides for annual funding without a specified expiration date. The intent of Title 34 is that numeric restoration goals continue to be realized or exceeded in perpetuity.

Long-Term Basis

Long-term will encompass at least several generations of fish (not less than 5) over a variety of hydrologic conditions (to allow for natural variation in production) and will continue indefinitely.

Average Levels

As stated in Title 34, the goal is to sustain natural production "...at levels not less than twice the average levels attained during the period of 1967-1991..." To attach numeric values to this goal, we need to estimate average levels of production. One problem is that average is not a precise statistical term. In statistics, the term average can apply to several measures of central tendency (Langley 1971). The most commonly used measure of central tendency is the arithmetic mean (Lapin 1975). Consequently, the public generally understands average to mean arithmetic mean and it is reasonable to assume that this was the intent of the authors of Title 34. Therefore, **the definition of average will be the arithmetic mean**

INTENT OF TITLE 34

Habitat Restoration

Of the six purposes of Title 34, three are particularly germane to discussion of the intent of Title 34 as it relates to the Program. These three purposes are listed below:

(1) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California (3402[a]);

(2) to address impacts of the Central Valley Project on fish, wildlife and associated habitats (3402[b]);

(3) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (3402[e]);

In addition, Section 3406(b)(1)(A) states that the Program "...shall give first priority to measures which protect and restore natural channel and riparian habitat values through habitat restoration actions, modifications to Central Valley Project operations, and implementation of the supporting measures mandated by this subsection..." Because Title 34 directs that the Program shall emphasize habitat restoration, **emphasis will be placed on restoring habitat**.

Natural versus Hatchery Production

Title 34 requires that "...natural production of anadromous fish in Central Valley rivers and streams be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991..." (Section 3406[b][1]). The requirement that natural production be sustainable on a long-term basis suggests that the intent of Title 34 is for the definition of natural production to extend between generations of fish. Natural production should be self-sustaining. **The Program should not depend on hatchery-produced fish to sustain populations of naturally spawning fish.**

In addition, Title 34 requires investigations of "...opportunities for additional hatchery production to mitigate the impacts of water development and operations on, or enhance efforts to increase Central Valley fisheries; Provided, That additional hatchery production shall only be used to supplement or to re-establish natural production while avoiding adverse effects on remaining wild stocks" (Section 3406[e][2]). This section provides insight into the intent of Title 34 as it relates to the roles of natural and hatchery production and emphasizes avoiding adverse effects of hatchery production on wild (naturally produced) stocks. Under Title 34, **hatchery production should only be used as a last resort to supplement or to re-establish natural production, and then only after investigations on the desirability of developing and implementing additional hatchery production.**

Adverse effects of hatchery production on natural stocks can include reductions in population size caused by competition, predation, disease or other factors (Sholes and Hallock 1979, Waples 1991). A large potential for negative interaction exists when these stocks interbreed (Hindar et al. 1991, Taylor 1991, Waples 1991). The adverse effects of interbreeding increase as hatchery-produced fish become more prevalent in the naturally spawning population. Interbreeding reduces interpopulation diversity and may lead to a reduction in overall productivity and a greater vulnerability to environmental change (Waples 1991). Outbreeding depression may also result from interbreeding. In addition, large populations of hatchery-produced fish that are indistinguishable from naturally produced fish may intensify effects of harvest on naturally produced fish (Wright 1993). The simplest way to avoid adverse effects on naturally produced stocks is to minimize the opportunities for interaction between naturally and hatchery-produced fish. **The Program should be designed to avoid adverse effects of hatchery production on natural stocks.**

Harvest

Title 34 does not directly address harvest. Title 34 defines natural production as: "... fish produced to adulthood..." (Section 3403[h]) and requires that natural production be increased. Inclusion of the term production, and especially production to adulthood, suggests that **Title 34 does not intend for restriction of harvest to be used as a means of achieving Program goals**. As stated in the definition of production, harvested fish should be included in counts of production. Sound harvest management is designed to harvest only excess production, allowing for enough fish to escape harvest to maintain production at the highest level the habitat can support.

Title 34 requires that natural production be increased. There are two mechanisms by which natural production can be increased: (1) increasing the productivity of the existing habitat, and (2) increasing the amount of habitat. These mechanisms are consistent with the emphasis Title 34 places on habitat restoration. Doubling productivity of existing habitat would provide more offspring from the same number of spawners. If existing spawning habitat is being fully utilized, then increasing the number of spawners by reducing harvest would not increase production. If production of naturally produced fish is doubled and escapement is held to present levels, then harvest of naturally produced fish could more than double.

The second mechanism, doubling the amount of habitat, would accommodate twice the number of spawners. This would also provide twice the number of offspring. Under this scenario, harvest of naturally produced fish could double. Under either mechanism, barring other harvest restrictions, we would expect at least a doubling of harvest of naturally produced fish. To meet the Intent of Title 34, **harvest should be maintained at levels that allow sufficient numbers of naturally produced fish to spawn to meet goals for at least doubling natural production**

IMPLEMENTATION CRITERIA

As stated earlier, criteria for determination of natural production will conform to the definition of natural production and intent of Title 34, including definitions and interpretations of intent discussed and refined in this Position Paper. Because determination of natural production in the past will require different criteria than in the future, criteria for these time periods will be discussed separately.

Criteria for the baseline period

In the past, data collection efforts have not focused on estimating natural production and existing data may not provide direct estimates of natural production. In order to

establish numerical goals for the Program, average levels of natural production must be estimated for the baseline period. Estimates will require assessing existing data and developing criteria to determine which data are germane. Criteria may not strictly conform to the definitions in and intent of Title 34 but are a compromise necessitated by a lack of data on natural production.

As explained in the POA, the Core Group and technical teams are responsible for developing these criteria. Technical teams are asked to develop initial criteria and estimates of average levels of natural production for the baseline period.

Where data are lacking, technical teams will make assumptions to expand existing data, or put existing data in perspective. For example, run-size estimates for American shad exist for only two years. In addition, young American shad abundance has been sampled during the fall emigration each year since 1967, except for 1974 and 1979 (Mills and Fisher, in preparation). The American shad technical team could look at young American shad abundance data to determine if run-size estimates for adults are representative of the abundance of shad for the baseline period. This approach has assumptions (chief among these is that abundance of young American shad can tell us something about average adult run-sizes) which are probably violated to some degree and is only presented as an example of what might be considered. Technical teams will document options considered for estimating natural production in issue papers that will be appended to the Program Plan if not in the text. Data quantity and applicability toward estimating natural production varies between species and drainage. Each technical team will need to address these issues for each species and drainage separately. Criteria for determining natural production during the baseline period will be applicable to existing data.

Because there is a relative wealth of data for chinook salmon and because several Teams deal with chinook salmon, specific criteria are proposed for them. Most of the data necessary to estimate production of each stock of chinook salmon for the baseline period are compiled in Mills and Fisher (1994). The proposed procedure for estimating yearly production of each race of chinook salmon for each stream during the baseline period follows.

In the following explanations and formulas, P is for production, E is for escapement, H is for harvest, and *h* is for the portion of total production not produced naturally. Subscripted letters following the normal letters and prior to the first comma represent different races of chinook salmon as follows: F for fall, L for late-fall, W for winter, S for spring, and C for all races combined. Subscripted letters following the first comma represent the following: O for ocean, D for downstream, I for instream, N for natural, H for hatchery, and T for total. Subscripted letters following the second comma represent

the following: CV for Central Valley, SF for San Francisco, M for Monterey, and other letter combinations correspond to specific streams (e.g., AM for American River). Subscripted letters following a third comma refer only to ocean harvest and are C for commercial and R for recreational. In all cases, a subscripted X acts as a "wildcard" place holder for an unspecified subscript.

1. A portion of production returns to spawn in each stream, both naturally and in the hatchery. Some of these fish are captured before spawning. These fish are counted toward production for the stream in which they spawned or were harvested according to the following:

   a. To determine the total spawning escapement ($E_{X,T,XX}$) for each race in each individual stream, sum the estimated number of each race of chinook salmon returning to spawn naturally ($E_{X,N,XX}$) and in hatcheries ($E_{X,H,XX}$) for each individual stream.

$$E_{X,T,XX} = E_{X,N,XX} + E_{X,H,XX}$$

   b. To determine the portion of production for each race returning to each stream (in-river run-size, $P_{X,I,XX}$), add $E_{X,T,XX}$ to the estimated number of each race of chinook salmon harvested in each stream ($H_{X,I,XX}$). Estimates of $H_{X,I,XX}$ do not exist for all streams and all years. Where estimates are not available or are inadequate, best professional judgement must be used. Technical Teams should document options considered for estimation of $H_{X,I,XX}$ in the Program Plan or in issue papers that will be appended to the Program Plan.

$$P_{X,I,XX} = E_{X,T,XX} + H_{X,I,XX}$$

   c. To determine the total number of each race of chinook salmon returning to the Central Valley ($P_{X,I,CV}$), sum $P_{X,I,XX}$ for all streams in the Central Valley ($\lesssim P_{X,I,XX}$) .

$$P_{X,I,CV} = \lesssim P_{X,I,XX}$$

   d. To determine the total number of chinook salmon (all races combined) returning to the Central Valley ($P_{C,I,CV}$), sum $P_{X,I,CV}$ for all races of chinook salmon ($\lesssim P_{X,I,CV}$) .

$$P_{C,I,CV} = \lesssim P_{X,I,CV}$$

2. A portion of production is harvested in the ocean and downstream of areas in rivers where the stream responsible for this production is not easily identified. To assign these harvested salmon to individual streams, the total number of salmon falling into this category is summed and subdivided to race and stream, proportional to the portion of production attributed to each race and returning to each stream, according to the following:

a. To determine the Central Valley component of ocean harvest ($H_{C,O,CV}$), sum commercial catch at San Francisco ($H_{C,O,SF,C}$) and Monterey ($H_{C,O,M,C}$), sum recreational catch at these same ports ($H_{C,O,SF,R} + H_{C,O,M,R}$), and add these together. This estimate of $H_{C,O,CV}$ is based on the Central Valley Index (CVI), where harvest of Central Valley stocks equals landings at major ports south of Point Arena (San Francisco and Monterey). Use of CVI to estimate the Central Valley component of ocean harvest assumes that the number of Central Valley chinook salmon harvested from ports north of San Francisco is balanced by the number of chinook salmon from drainages north of the Central Valley harvested from San Francisco and Monterey. To carry $H_{C,O,CV}$ forward in subsequent calculations, assume that each chinook salmon harvested in the ocean fishery is equivalent to an adult salmon returning to spawn.

$$H_{C,O,CV} = H_{C,O,SF,C} + H_{C,O,M,C} + H_{C,O,SF,R} + H_{C,O,M,R}$$

b. To account for that portion of inland harvest that occurs downstream of streams for which production is being estimated, estimate portion of inland recreational harvest captured downstream of spawning streams ($H_{C,D,CV}$). Information necessary to estimate $H_{C,D,CV}$ may not be available. If an estimate exists, use it. If an estimate of inland harvest for the entire Central Valley exists ($H_{X,I,CV}$), then sum all assignable inland harvest ($\lesssim H_{X,I,XX}$) and subtract it from $H_{X,I,CV}$ to determine $H_{C,D,CV}$. If other options exist, these should be explored. $H_{C,D,CV}$ could be assumed to be small and therefore left out of the calculations or could be included in $H_{X,I,XX}$, in which case it would already to assigned to an individual stream.

c. To determine ocean and downstream inland harvest for the Central Valley ($H_{C,O+D,CV}$), sum $H_{C,O,CV}$ and $H_{C,D,CV}$.

$$H_{C,O+D,CV} = H_{C,O,CV} + H_{C,D,CV}$$

d. To assign portions of $H_{C,O+D,CV}$ to specific races, subdivide $H_{C,O+D,CV}$ to each race, proportional to the portion of production for each race returning to the entire Central Valley ($P_{X,I,CV}$) to the portion of production for all races combined returning to the entire Central Valley ($P_{X,I,CV}$).

$$H_{X,O+D,CV} = H_{C,O+D,CV} \bullet (P_{X,I,CV}/P_{C,I,CV})$$

e. To assign portions of $H_{X,O+D,CV}$ to specific streams, subdivide $H_{X,O+D,CV}$ to each stream, proportional to the portion of production for that race returning to each stream ($P_{X,I,XX}$) to the portion of production for that race returning to the entire Central Valley ($P_{X,I,CV}$).

$$H_{X,O+D,XX} = H_{X,O+D,CV} \bullet (P_{X,I,XX}/P_{X,I,CV})$$

3. To determine total production for each race and stream ($P_{X,T,XX}$), sum $P_{X,I,XX}$ and $H_{X,O+D,XX}$.

$$P_{X,T,XX} = P_{X,I,XX} + H_{X,O+D,XX}$$

4. A portion of the total production was not produced naturally (*h*). For the baseline period, only hatchery-produced salmon will be considered to be produced by other than natural means. To determine the natural production for each individual stream ($P_{X,N,XX}$), multiply $P_{X,T,XX}$ by (1-*h*). Technical Teams should document options considered and chosen for estimation of *h* in issue papers that will be appended to the Program Plan or in the text for the Program Plan.

$$P_{X,N,XX} = P_{X,T,XX} \bullet (1-h)$$

Numeric restoration goals for chinook salmon in each stream will be calculated as at least double the average of $P_{X,N,XX}$ for each of the years during the baseline period.

Criteria for the future

In the future, opportunities exist to improve estimates of natural production. These range from augmenting historic data collection activities with efforts to estimate the proportion of fish that are naturally produced, to designing new data collection to better account for natural production. The Core Group and technical teams are responsible for designing future monitoring programs.

The Core Group and technical teams have and will identify deficiencies in the baseline data. Future monitoring activities will be designed to address and avoid deficiencies. For example, monitoring programs should focus on estimating production, including harvest, on a consistent and regular basis, preferably yearly, in all of the streams in the Central Valley.

Monitoring programs should also estimate natural production, requiring some means of separating naturally produced fish from fish produced by other than natural means. At the very least, natural production must be discernable from hatchery production. Several methods can be used to separate naturally produced fish from hatchery-produced fish, including use of scale (Scarnecchia and Wagner 1980) or otolith (Paragamian et al. 1992) characteristics and constant fractional (Hankin 1982) or complete marking of hatchery-produced fish (Wright 1993), including incorporation of genetic markers (Waples 1991), inducement of otolith banding patterns (Volk et al. 1990), and more standard methods such as clipping fins. In addition, recommendations for the future should include managing naturally and hatchery-produced fish separately.

In addition, better estimates of harvest of Central Valley salmon in the ocean and of all anadromous fish in the Bay, Delta, and in each individual river and stream in the Central Valley should be developed. Harvest should be monitored continually.

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B. Production targets for chinook salmon in each stream

Preliminary estimated production targets for chinook salmon. Data for rivers without a race designation are for fall-run chinook salmon.

Race and river	Production targets
All races combined[a]	990,000
Fall run	750,000
Late-fall run	68,000
Winter run	110,000
Spring run	68,000
Sacramento River	
Fall run	230,000
Late-fall run	44,000
Winter run	110,000
Spring run	59,000
Clear Creek	7,100
Cow Creek	4,600
Cottonwood Creek	5,900
Battle Creek	
Fall run	10,000
Late-fall run	550
Paynes Creek	330
Antelope Creek	720
Mill Creek	
Fall run	4,200
Spring run	4,400
Deer Creek	
Fall run	1,500
Spring run	6,500
Miscellaneous creeks	1,100
Butte Creek	
Fall run	1,500
Spring run	2,000
Big Chico Creek	800
Feather River	170,000
Yuba River	66,000
Bear River	450
American River	160,000
Mokelumne River	9,300
Cosumnes River	3,300
Calaveras River	2,200*
Winter run	
Stanislaus River	22,000
Tuolumne River	38,000
Merced River	18,000

[a]Targets for each of the races of chinook salmon may not add up to the target for all races combined due to rounding.

*Production target no longer valid as winter-run is not native production for fall-run chinook salmon yet to be determined.

C. Contacts and sources of information.

For information on the Anadromous Fish Restoration Program, contact:

Martin A. Kjelson, Program Manager
U.S. Fish and Wildlife Service
Anadromous Fish Restoration Program
Sacramento-San Joaquin Estuary Fishery Resource Office
4001 North Wilson Way
Stockton, CA 95205
(209) 946-6400
E-mail address: martin_kjelson@fws.gov

For information on the Central Valley Fish and Wildlife Restoration Program, including information on other sections of the CVPIA that contribute to fish and wildlife restoration, contact:

James J. McKevitt, Program Manager
U.S. Fish and Wildlife Service
Central Valley Fish and Wildlife Restoration Program
3310 El Camino Avenue
Sacramento, CA 95821
(916) 979-2760
E-mail address: jim_mckevitt@fws.gov

For information on the CALFED Bay-Delta Program=s near-term efforts to restore anadromous fish in the Central Valley, especially funding for restoration actions, contact:

Cindy Darling or Kate Hansel, Restoration Coordinators
CALFED Bay-Delta Program
Restoration Coordination Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814
(916) 657-2666 or 653-1103
E-mail address: cdarling@water.ca.gov or hanselk@water.ca.gov

For information on the CALFED Bay-Delta Program=s long-term plan for ecosystem restoration, contact:

Dick Daniel, Assistant Director or
Terry Mills, Ecosystem Restoration Program Plan Manager
CALFED Bay-Delta Program
Ecosystem Restoration Program Plan
1416 Ninth Street, Suite 1155
Sacramento, CA 95814
(916) 657-2666
E-mail address: ddaniel@water.ca.gov

For information on the California Department of Fish and Game=s efforts to restore anadromous fish in the Central Valley, contact:

Alan Baracco
California Department of Fish and Game
Inland Fisheries Division
1416 Ninth Street
Sacramento, CA 95814
(916) 653-4729

Copies of Conservation Partnership: A Field Guide to Public-Private Partnering for Natural Resource Conservation may be obtained from:

U.S. Fish and Wildlife Service
Office of Training and Education
4401 North Fairfax Drive
Arlington, VA 22203
(703) 358-1711

or

National Fish and Wildlife Foundation
1120 Connecticut Avenue, NW, Suite 900
Washington, DC 20036
(202) 857-0166

Copies of California Coordinated Resource Management and Planning Handbook may be obtained from:

CRMP Coordinator
California Association of Resource Conservation Districts
801 K Street, Suite 1318
Sacramento, CA 95814
(916) 447-7237
FAX (916) 447-2532

D. Template for organization of detailed information on specific actions

The AFRP has developed a draft template containing the following information for each of the actions listed in the Restoration Plan.

Watershed or geographic area: Identifies the drainage or geographic area under which the action or evaluation description appears in the Restoration Plan. *(Where)*

Watershed priority: Lists the priority as designated in the Restoration Plan for the watershed or geographic area, if applicable.

Action (or evaluation): Includes the text for the action or evaluation as it appears in the Restoration Plan, including the number assigned to the action or evaluation. *(What)*

Location: Identifies the specific location(s), if applicable, of the action or evaluation. Include the stream mile(s), city(ies) and county(ies) in which the action or evaluation would be taken. *(Where)*

AFRP action (or evaluation) priority: Lists the priority relative to other actions and evaluations in the drainage, as it appears in the Restoration Plan.

Objective: Briefly states the objective(s) of the action or evaluation. Identifies species or race(s) of anadromous fish primarily affected and problem(s) solved by or intended effect(s) of the action or evaluation. *(Why).*

Description: Describes the action or evaluation in detail, including how the action or evaluation will be implemented. Cites any literature that may provide further detail. *(More detail on what and a description of how.)*

Background: Describes the existing information leading up to development of the action or evaluation, including discussion of alternative actions and of work done to date. Cites any literature that may provide further detail. *(More detail on why.)*

Justification: Describes the reasons for implementing the action or evaluation. Cites any literature that may provide further detail. *(More detail on why.)*

Monitoring needs: Identifies activities, including variables to observe, needed to evaluate the effectiveness of the action or to complete the evaluation.

Predicted biological benefits: Identifies anticipated biological benefits, preferably in quantitative terms, focusing on anadromous fish and their habitat.

Issues: Identifies factors potentially influencing initiation and completion of the action or evaluation. These issues may include design constraints, potential impacts of the action or evaluation on the economy or on other segments of the ecosystem, ability to evaluate the success of the action or evaluation, or the inability of partners to secure funding. This section will also include identification and discussion of actions or evaluations that may increase or decrease the effectiveness of the action or evaluation described here.

Involved parties: Lists parties involved in implementing the action or evaluation. *(Who)*

Environmental documentation: Lists environmental documentation and permitting necessary to complete the action or evaluation. For example, list should include whether or not an EA and negative declaration or FONSI, an EIR, an EIS, or Biological Opinion is required. It will also list any county or municipal permits that may be required.

Deliverables: Lists products (e.g., initial design and feasibility reports, environmental documentation, progress reports, physical structures, and monitoring reports) that have been or will be completed as part of implementation and monitoring.

Schedule: Lists time frame for key events (e.g., start and completion dates for deliverables and other major activities necessary for implementation and monitoring) in chart format. Potential for schedule revisions should be identified. *(When)*

Estimated cost to completion: Lists total costs from planning to completion, including permits, environmental documentation, and monitoring. Potential for schedule and budget revisions will be identified. Both one-time and continuing annual costs will be identified.

Funding: Identifies funding sources (e.g., CVP Restoration Fund, Category III, Four Pumps Mitigation Agreement, specific public or private group, or individual) and funds committed each year to completion. Sources of both one-time and continuing annual funds will be identified, as available.

Status: Describes stage of development and accomplishments, and future activities and milestones, and impediments.

CVPIA implementation tools: Identifies applicable section(s) of the CVPIA.

Action coordinators: Identifies the coordinator(s) designated as an action manager or point of contact for each of the involved parties. If a lead coordinator exists, then it will note which coordinator is assigned lead. *(Who)*

Sources of information: Lists literature cited and additional sources of information on the action.

Report date: Lists date that the information was last updated.

E. Summary of information used to prioritize watersheds.

Table E-1. Production target for chinook salmon, presence of CVP flow control structures or facilities, and race or species present in each of the watersheds[1] for which actions are listed in the Restoration Plan.

River	Chinook salmon production target	CVP influence	Winter run	Spring run	Steelhead	Late-fall run	San Joaquin fall run	Fall run	Green sturgeon	White sturgeon	Striped bass	American shad
Sacramento River	990,000	X	X	X	X	X		X	X	X	X	X
Clear Creek	7,100	X			X			X				
Cow Creek	4,600			X[2]	X			X				
Cottonwood Creek	5,900			X	X	X		X				
Battle Creek	10,550	X	X[3]	X	X	X		X				
Paynes Creek	330				X			X				
Antelope Creek	720			X	X	X		X				
Mill Creek	8,600			X	X	X		X				
Deer Creek	8,000			X	X	X		X				
Misc. creeks	1,100				X			X				
Butte Creek	3,500			X	X	X		X				
Big Chico Creek	800			X	X	X		X				
Feather River	170,000			X[4]	X			X	X	X	X	X

[1]The presence of races or species in each of the watersheds is derived from CDFG's document titled Restoring Central Valley Streams: A Plan for Action, dated November 1993, and authored by F.L. Reynolds, T.J. Mills, R. Benthin, and A. Low. Exceptions are footnoted.

[2]Although spring-run chinook salmon are sporadically observed in the Cow Creek watershed, there is no current potential for sustaining their production because of natural barriers and lack of over-summering holding pool habitat.

[3]Winter-run chinook salmon on Battle Creek are of hatchery origin.

[4]The present Feather River Hatchery spring-run chinook salmon is a combination of fall-run and spring-run chinook salmon races (An evaluation of the Feather River Hatchery as mitigation for construction of the California State Water Project's Oroville Dam, Brown and Greene, Environmental Services Office, CDWR, 1995).

River	Chinook salmon production target	CVP influence	Winter run	Spring run	Steelhead	Late-fall run	San Joaquin fall run	Fall run	Green sturgeon	White sturgeon	Striped bass	American shad
Yuba River	66,000			X	X			X				X
Bear River	450				X			X	X	X		
American River	160,000	X			X			X			X	X
Mokelumne River	9,300				X			X			X	X
Cosumnes River	3,300							X				
Calaveras River	2,200		X					X				
Merced River	18,000				X	X	X					
Tuolumne River	38,000				X[5]	X	X					
Stanislaus River	22,000	X			X	X	X				X	X
San Joaquin River	---	X					X		?	X	X	X
Sacramento-San Joaquin Delta	---	X	X	X	X	X	X	X	X	X	X	X

River	Chinook salmon production target	CVP influence	Winter run	Spring run	Steelhead	Late-fall run	San Joaquin fall run	Fall run	Green sturgeon	White sturgeon	Striped bass	American shad
Sacramento River Joaquin Delta	---	X	X	X	X	X	X	X	X	X	X	X

[5]Steelhead were observed in the Tuolumne River in 1983 (Bill Loudermilk, CDFG Senior Fishery Biologist, personal communication, and In CDFG, Steelhead restoration and management plan for California, D. McEwan and T.A. Jackson, 1996).

F. Projected funding resources.

The CVP Restoration Fund, along with additional agency and other partner funds, if available, will be used to implement the AFRP restoration actions. Funds available from the CVP Restoration Fund to the AFRP for actions, evaluations, monitoring and assessment during the 1997 federal fiscal year (FY97) totaled $10 million, and is expected to continue at about $8 to $10 million for each of the years in FY98 to FY2002. Additional Restoration Fund dollars carried over from previous years are also available to supplement AFRP funds, if needed. In addition, the Restoration Fund provides sufficient flexibility to move funds to areas of greatest need, subject to certain limitations. Specific funding allocations and estimates are described each year in annual work plans for the AFRP and in similar work plans for each of the other programs conducted pursuant to the CVPIA.

G. List of acronyms and abbreviations.

Acronym or abbreviation	Description
af	acre-feet
AFRP	Anadromous Fish Restoration Program, established by Section 3406(b)(1) of the CVPIA
AFS	American Fisheries Society
(b)(2) water	Water managed pursuant to 3406(b)(2), sometimes referred to as the 800,000 af or dedicated water
Bay-Delta	San Francisco Bay and Sacramento-San Joaquin Delta Estuary
BCWC	Butte Creek Watershed Conservancy
Bay-Delta Agreement	15 December 1994, Principles of Agreement on Bay-Delta Standards between the State of California and the Federal Government
BLM	Bureau of Land Management
CALFED	A California and federal multi-agency partnership
CALFED agencies	California California Environmental Protection Agency State Water Resources Control Board The Resources Agency Department of Fish and Game Department of Water Resources Federal Department of Commerce National Marine Fisheries Service Department of the Interior Bureau of Reclamation Fish and Wildlife Service Environmental Protection Agency
CAMP	Comprehensive Assessment and Monitoring Program, established by Section 3406(b)(16) of the CVPIA
CCRMP	California Coordinated Resource Management and Planning
CCWD	Calaveras County Water District
CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources

Acronym or abbreviation	Description
CEQA	California Environmental Quality Act
CNFH	Coleman National Fish Hatchery
COE	Corps of Engineers
Core Group	AFRP Core Group
CSLC	California State Lands Commission
cfs	cubic feet per second
CVFWRP	Central Valley Fish and Wildlife Restoration Program
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DCWC	Deer Creek Watershed Conservancy
DCC	Delta Cross Channel
Delta	Sacramento-San Joaquin Delta
EBMUD	East Bay Municipal Utility District
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
GCID	Glenn-Colusa Irrigation District
IEP	Interagency Ecological Program for the Sacramento-San Joaquin Estuary
IEP agencies	California California Environmental Protection Agency State Water Resources Control Board The Resources Agency Department of Fish and Game Department of Water Resources Federal Department of Commerce National Marine Fisheries Service Department of Defense Army Corps of Engineers Department of the Interior

Acronym or abbreviation	Description
	Bureau of Reclamation Fish and Wildlife Service Geological Survey Environmental Protection Agency
Interior	Department of the Interior
maf	million acre-feet
MCC	Mill Creek Conservancy
MID	Modesto Irrigation District
MIEB	Management Institute for Environment and Business
MOU	Memorandum of Understanding
NEPA	National Environmental Protection Act
NMFS	National Marine Fisheries Service
NPS	National Park Service
NRCS	Natural Resources Conservation Service
PCB	Polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
PFMC	Pacific Fishery Management Council
PG&E	Pacific Gas and Electric
POA	Plan of Action for the Central Valley Anadromous Fish Restoration Program
Position Paper	Position Paper for Development of the Central Valley Anadromous Fish Restoration Program (Appendix A)
RBDD	Red Bluff Diversion Dam
RCD	Resource Conservation District
Restoration Fund	CVP Restoration Fund, established by Section 3407 of the CVPIA
Restoration Plan	AFRP Restoration Plan
RWQCB	Regional Water Quality Control Board
SAFCA	Sacramento Area Flood Control Association
SB 1086	Senate Bill 1086

Acronym or abbreviation	Description
SAWF	Sacramento Area Water Forum
Secretary	Secretary of the Interior
SEWD	Stockton East Water District
SSWD	South Sutter Water District
SWP	State Water Project
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
TCCA	Tehama-Colusa Canal Authority
TID	Turlock Irrigation District
TNC	The Nature Conservancy
USBR	U.S. Bureau of Reclamation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USRFRHAC	Upper Sacramento River Fisheries and Riparian Habitat Advisory Council
WCWD	Western Canal Water District
WID	Woodbridge Irrigation District
Working Paper	Working Paper on Restoration Needs
WQCP	Water Quality Control Plan
WRCB	Water Resources Control Board
YCWA	Yuba County Water Agency