



**SHASTA
LAKE** WATER
RESOURCES
INVESTIGATION



Getting to Solutions:

An Overview of Initial Alternatives



August 2004

Purpose

The Shasta Lake Water Resources Investigation (SLWRI) is a feasibility study led by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), Mid-Pacific Region, in coordination with the California Department of Water Resources (DWR). The purpose of this overview is to highlight the SLWRI progress to date, with an emphasis on development of initial alternatives. This overview summarizes the study's background, planning process, objectives, accomplishments, and future actions. Additional information on study activities, including related documents, can be accessed on-line at www.usbr.gov/mp/slwri.

SHASTA FACTS

Shasta Dam

- ◆ Concrete gravity type
- ◆ 602 feet high
- ◆ 3,460 feet long
- ◆ 487-foot-long spillway, with 3 drum gates
- ◆ 18 river outlets
- ◆ 1 powerplant, with 5 main units

Shasta Reservoir

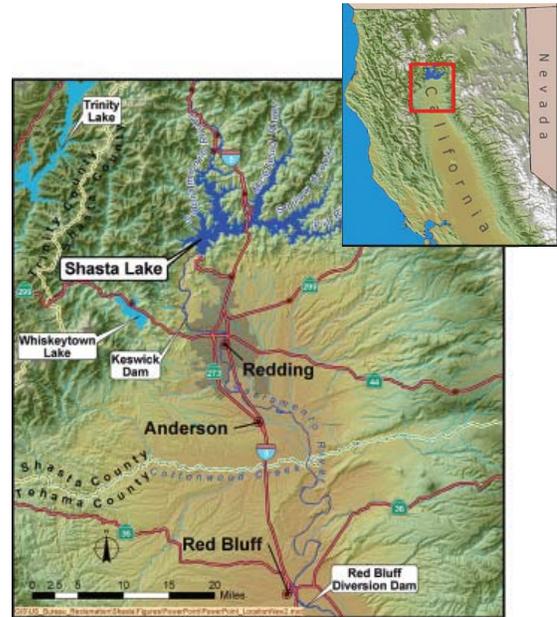
- ◆ 4,550,000 acre-feet of storage capacity
- ◆ 1,300,000 acre-feet of flood control space
- ◆ 29,500 acres of surface area
- ◆ 400 miles of shoreline
- ◆ 5,700,000 acre-feet of mean annual runoff
- ◆ 40% of total CVP storage



Background

Constructed between 1938 and 1945, Shasta Dam serves multiple purposes, including navigation, flood control, irrigation and municipal and industrial water supplies, hydropower generation, and fish and wildlife conservation. These purposes significantly contribute to California's economy. In addition, through its extensive recreational resources, Shasta Lake is a critical component of the regional economy of Northern California.

The SLWRI primary study area encompasses Shasta Dam and Reservoir; inflowing rivers and streams, including the Sacramento River, McCloud River, Pit River, and Squaw Creek; and the Sacramento River downstream to about the Red Bluff Diversion Dam. Because of the potential influence of a Shasta Dam modification on natural resources along the Sacramento River, and on programs and projects in the Central Valley, an extended study area includes the American River basin, Sacramento-San Joaquin Delta, San Joaquin River basin, and service areas of the Central Valley Project (CVP) and State Water Project (SWP).



SLWRI Primary Study Area

Authorization for the study is contained in 1980 Public Law (PL) 96-375, which directed Reclamation to conduct a feasibility study related to enlarging Shasta Dam and Reservoir. A 1988 Wrap-Up Report showed that enlarging Shasta Dam and Reservoir could significantly increase water supply reliability at lower unit costs than other projects considered, if and when water demands warranted the required financing. The 1992 Central Valley Project Improvement Act (CVPIA) and CALFED Bay-Delta Program led to reinitiation of studies to enlarge Shasta Dam. Raising Shasta Dam is one of five surface water storage projects identified in the August 2000 CALFED Record of Decision (ROD). The other four projects are North-of-Delta Off-Stream Storage, In-Delta Storage, Los Vaqueros Enlargement, and Upper San Joaquin River Basin Storage. Each surface water storage project is being developed further in separate feasibility studies.

In addition to PL 96-375, the CVPIA, and CALFED ROD, numerous Federal, State, and local laws, policies, and guidance have significant influence on the SLWRI. One important State issue is contained in 1989 California Public Resources Code (PRC) 5093, which limits the participation of State agencies in efforts that could have an adverse effect on the free-flowing condition of the McCloud River.

STUDY AUTHORITY

- ◆ **1980 PL 96-375** — Authorized feasibility study

PERTINENT RELATED AUTHORITY

- ◆ **1992 PL 102-575 (CVPIA)** — Added environmental purpose to CVP

GUIDANCE

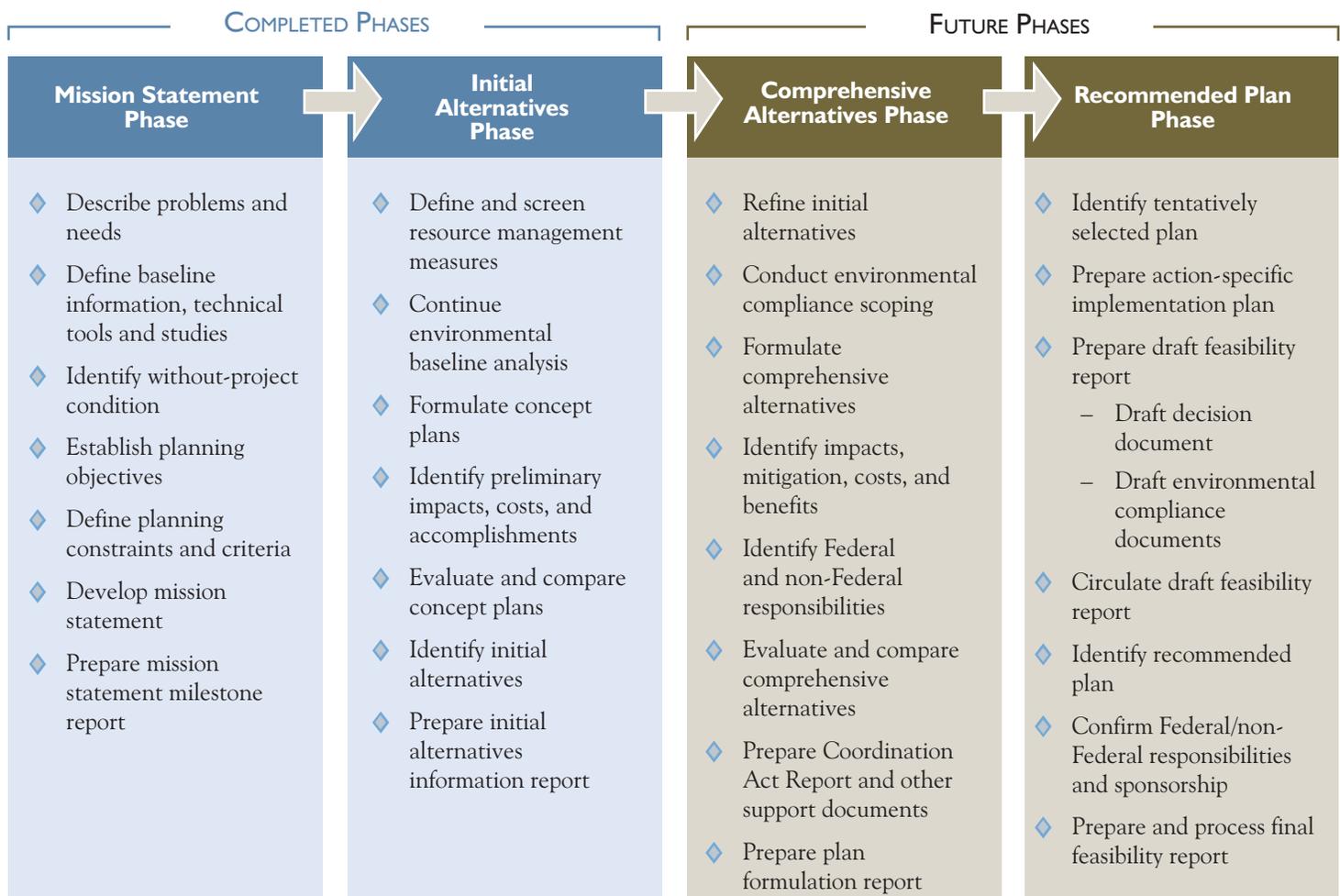
- ◆ **1988 WRAP-UP REPORT**— Defined scope & feasibility of enlarging Shasta Dam
- ◆ **1989 CALIFORNIA PRC 5093.542(c)**— Limits State participation in projects affecting the McCloud River
- ◆ **1999 APPRAISAL ASSESSMENT** — Recommended continuation of feasibility study
- ◆ **2000 CALFED ROD** — Identified enlarging Shasta Dam

SLWRI Planning Process

Implementation of a Federal project is accomplished in four basic steps: (1) establishing a Federal interest through a feasibility study, (2) obtaining Congressional authorization, (3) producing detailed designs, and (4) constructing the project. Federal feasibility studies follow procedures outlined in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies – 1983*. These procedures are commonly referred to as principles and guidelines, or P&G. The P&G describes six iterative planning steps in which public participation is a vital component.

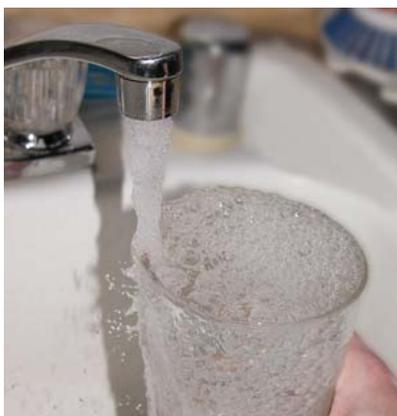
For the SLWRI, the six planning steps were grouped into four phases: Mission Statement Phase, Initial Alternatives Phase, Comprehensive Alternatives Phase, and Recommended Plan Phase. These phases are highlighted in the following process chart. The Mission Statement Phase was completed in spring 2003 and the Initial Alternatives Phase was completed in summer 2004. During these phases, problems and needs were identified, planning objectives were established, a Mission Statement was developed, and initial alternatives that identify a range of potential actions to address the planning objectives were formulated.

SLWRI FEASIBILITY STUDY PROCESS



P&G PLANNING STEPS

- ◆ Specify problems and needs
- ◆ Identify, inventory, and forecast conditions and constraints
- ◆ Formulate alternative plans
- ◆ Evaluate effects of alternative plans
- ◆ Compare alternative plans
- ◆ Select recommended plan



Mission Statement Phase

This phase included identification of problems and needs, and development of a set of primary and secondary planning objectives and a Mission Statement.

Problems and Needs

Major water and related resource problems and needs identified in the primary study area include the following:

- **Anadromous Fish Survival** – The population of Chinook salmon has declined in the Central Valley. To address this salmon decline in the Sacramento River, various actions have been taken, ranging from establishing minimum flow requirements in the river to making structural changes at Shasta Dam. However, a need still exists for additional actions to benefit anadromous fish, especially in dry and critically dry water years.
- **Water Supply Reliability** – Demand for water in California exceeds available supplies. As the population of the Central Valley grows, the need to maintain a healthy and vibrant industrial and agricultural economy will increase while the demand for an adequate water supply becomes more acute.
- **Other Resource Needs** – Other identified problems and needs include the need for environmental restoration in the Shasta Lake area and downstream along the Sacramento River; the need for additional flood control along the upper Sacramento River; and growing demands for new energy sources in California.

Planning Objectives

The problems and needs in the study area were translated into primary and secondary planning objectives.

- **Primary Planning Objectives** – Formulate alternatives specifically to address the following:
 - Increase survival of anadromous fish populations in the Sacramento River primarily upstream from the Red Bluff Diversion Dam.
 - Increase water supplies and water supply reliability for agricultural, municipal and industrial, and environmental purposes to help meet future water demands, with a focus on enlarging Shasta Dam and Reservoir.



- **Secondary Planning Objectives** – To the extent possible, through pursuit of the primary planning objectives, include opportunities to accomplish the following:
 - Preserve and restore ecosystem resources in the Shasta Lake area and along the upper Sacramento River.
 - Reduce flood damages along the Sacramento River.
 - Develop additional hydropower capabilities at Shasta Dam.

Mission Statement

A set of planning constraints and criteria was developed from the problems and needs baseline information and support studies; existing Federal, State, and local laws and policies; and planning objectives. These constraints and criteria helped define physical and institutional boundaries for the SLWRI. Through this iterative process, a Mission Statement was developed to help direct the study.

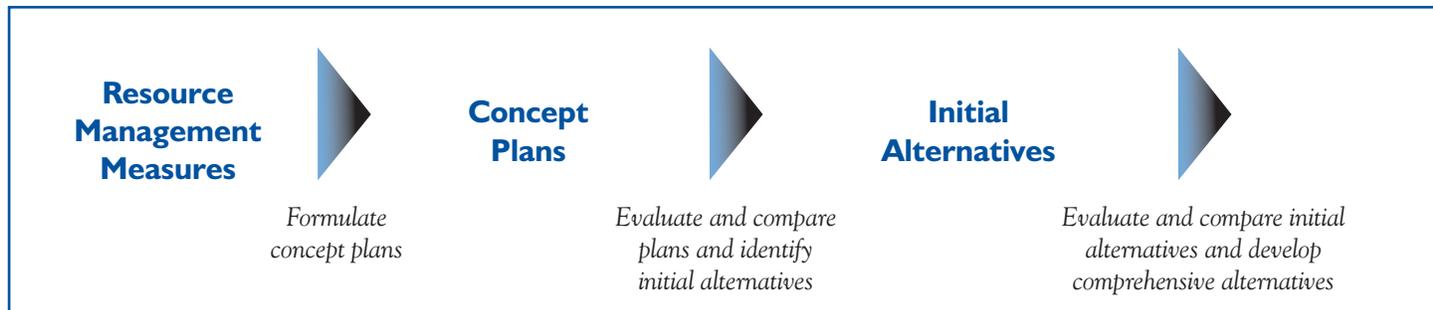
SLWRI MISSION STATEMENT

To develop an implementable plan primarily involving the enlargement of Shasta Dam and Reservoir to promote increased survival of anadromous fish populations in the upper Sacramento River and increased water supply reliability, and to the extent possible through meeting these objectives, include features to benefit other identified ecosystem, flood control, and related water resources needs.

Initial Alternatives Phase

As shown below, the plan formulation process leading to a recommended plan started with identifying a set of resource management measures that addressed the study objectives. From these measures, a set of concept plans was developed. From the concept plans, several initial alternatives were identified for further development into comprehensive alternatives. These comprehensive alternatives will be developed further in the feasibility study and ultimately lead to identification of a recommended plan. Resource management measures, concept plans, and initial alternatives for the SLWRI were described in detail in a June 2004 Initial Alternatives Information Report.

PLAN FORMULATION PROCESS



RETAINED RESOURCE MANAGEMENT MEASURES

Primary Planning Objectives

Anadromous Fish Survival

- ◆ Enlarge Shasta Lake cold water pool
- ◆ Modify temperature control device
- ◆ Increase minimum flows
- ◆ Restore upper Sacramento River spawning habitat

Water Supply Reliability

- ◆ Increase Shasta Lake conservation storage
- ◆ Reoperate Shasta Dam
- ◆ Perform conjunctive water management

Secondary Planning Objectives

Ecosystem Restoration

- ◆ Restore aquatic habitat around Shasta Lake
- ◆ Restore aquatic habitat on streams near Shasta Lake
- ◆ Restore Sacramento River riparian/floodplain habitat

Flood Damage Reduction

- ◆ Modify Shasta Dam flood control operations

Hydropower

- ◆ Modify Shasta hydropower facilities

Resource Management Measures

A resource management measure is a specific feature or activity that addresses either a primary or secondary planning objective. About 35 measures were identified to address the primary objectives and nearly 30 measures were identified to address the secondary objectives. Of these measures, seven focusing on the primary objectives and five focusing on the secondary objectives were retained for potential inclusion in concept plans.

Concept Plans

Twelve concept plans were formulated from the retained measures. In addition, a No-Action plan was developed. The concept plans represent the likely range of potential actions to address the planning objectives. The first three concept plans focused on a single primary objective, anadromous fish survival (AFS), and the next four concept plans focused on water supply reliability (WSR). The remaining five concept plans included a combination of measures that address both primary and secondary objectives, termed combined objective (CO) concept plans. Each concept plan included raising Shasta Dam by either 6.5, 18.5, or 200 feet, and each included some degree of modification to the temperature control device. Preliminary estimates of impacts, implementation costs, and resulting accomplishments were developed for each concept plan.

AFS Concept Plans – The main focus of the three AFS concept plans was on anadromous fish survival in the upper Sacramento River, with each plan contributing somewhat to water supply reliability. In developing these concept plans, it was important to determine (1) how

Comprehensive Alternatives



Evaluate and compare comprehensive alternatives and select recommended plan



RECOMMENDED PLAN

each measure addressing anadromous fish survival could be combined, and (2) how their potential benefits compared. Consequently, dam raises were not a significant factor because progressively higher raises would be expected to produce proportionally greater benefits to anadromous fish. Accordingly, each concept plan included raising Shasta Dam 6.5 feet, which would enlarge the reservoir by 290,000 acre-feet. The AFS concept plans differed only in how additional storage would be used to benefit anadromous fish survival.

WSR Concept Plans – Four concept plans focused on the primary objective of water supply reliability while also benefiting anadromous fish. Unlike the

formulation strategy for the three AFS concept plans, the most important factor for the WSR concept plans was the magnitude of a potential enlargement of Shasta Dam and Reservoir. Accordingly, the WSR concept plans were formulated based on different dam raise options: 6.5 feet, 18.5 feet, and 200 feet. One WSR concept plan included conjunctive water management with an 18.5-foot raise.

CO Concept Plans – Five concept plans were formulated to represent a reasonable balance between the two primary objectives while also including components to address the secondary objectives, as appropriate. Dam raise options of 6.5 feet and 18.5 feet were considered for the five CO concept plans.

SUMMARY OF CONCEPT PLAN FEATURES*

Features	Anadromous Fish Survival Focus			Water Supply Reliability Focus				Combined Objective Focus				
	AFS-1	AFS-2	AFS-3	WSR-1	WSR-2	WSR-3	WSR-4	CO-1	CO-2	CO-3	CO-4	CO-5
Raise Shasta Dam (feet)	6.5	6.5	6.5	6.5	18.5	200	18.5	6.5	18.5	18.5	6.5	18.5
Enlarge Cold Water Pool	X	●	●	●	●	●	●	X	X	X	X	X
Increase Water Conservation Storage	●	●	●	X	X	X	X	X	X	X	X	X
Increase Minimum Flows		X	X							X		
Increase Spawning Habitat			X					X	X	X	X	X
Perform Conjunctive Water Management							X				X	X
Restore Aquatic/Riparian Habitat											X	X
Increase Flood Control and Hydropower	●	●	●	●	●	●	●	●	●	●	●	●

* All plans considered modifications to temperature control device.

X = Primary Focus ● = Incidental Benefit

COMPARISON CRITERIA

- ◆ **COMPLETENESS** – Inclusion of all necessary elements in an alternative to realize planned effects.
- ◆ **EFFECTIVENESS** – Extent of achieving planning objectives.
- ◆ **EFFICIENCY** – Greatest cost-effectiveness in addressing objectives.
- ◆ **ACCEPTABILITY** – Workability and viability of the alternative plan.

Initial Alternatives

The concept plans were evaluated using four criteria: completeness, effectiveness, efficiency, and acceptability. On the basis of that comparison, five concept plans were recommended as initial alternatives for further development. Specific measures and combinations of measures in the initial alternatives will likely change in future studies and some may be combined with others or dropped from further development. In addition, other measures and combinations of measures may emerge and warrant development into alternatives. For example, alternatives with other dam raises up to 18.5 feet could be developed. Efforts will continue on further defining the No-Action Plan. The five initial alternatives are as follows:

- **WSR-1—Increase Water Supply Reliability with Shasta Enlargement (6.5 feet).** The primary purpose of this initial alternative is to be consistent with the goals of the CALFED ROD, which focus on increasing CVP and SWP water supply reliability while contributing to increased anadromous fish survival. WSR-1 includes raising Shasta Dam by about 6.5 feet, which would increase storage space in Shasta Reservoir by 290,000 acre-feet. The increased pool depth and volume also could contribute to incidental benefits for flood control and hydropower.
- **WSR-2—Increase Water Supply Reliability with Shasta Enlargement (18.5 feet).** The primary purpose of this initial alternative is similar to WSR-1; however, WSR-2 includes raising Shasta Dam by about 18.5 feet, which would increase storage space by 636,000 acre-feet.
- **WSR-4—Increase Water Supply Reliability with Shasta Enlargement (18.5 feet) and Conjunctive Water Management.** The primary purpose of this initial alternative is to increase CVP and SWP water supply reliability through a combination of enlargement of Shasta Dam and Reservoir and conjunctive water management, consistent with the goals of the CALFED ROD. This plan is similar to WSR-2 and includes raising Shasta Dam by about 18.5 feet. It also includes implementing a conjunctive water management component consisting primarily of contract agreements between Reclamation and Sacramento River basin water users.

- CO-2—Increase Anadromous Fish Habitat and Water Supply Reliability with Shasta Enlargement (18.5 feet).** The primary purpose of this initial alternative is to address both primary objectives with a focus on increasing anadromous fish habitat and enlarging Shasta Reservoir by about 18.5 feet, similar to WSR-2. In addition to increasing the cold water pool in Shasta Lake, this alternative includes restoring inactive gravel mines along the Sacramento River to help benefit anadromous fish.
- CO-5—Multipurpose with Shasta Enlargement (18.5 feet).** This initial alternative consists of raising Shasta Dam by about 18.5 feet, similar to WSR-2. To address the primary objectives, it also includes conjunctive water management and restoring inactive gravel mines and floodplain habi-

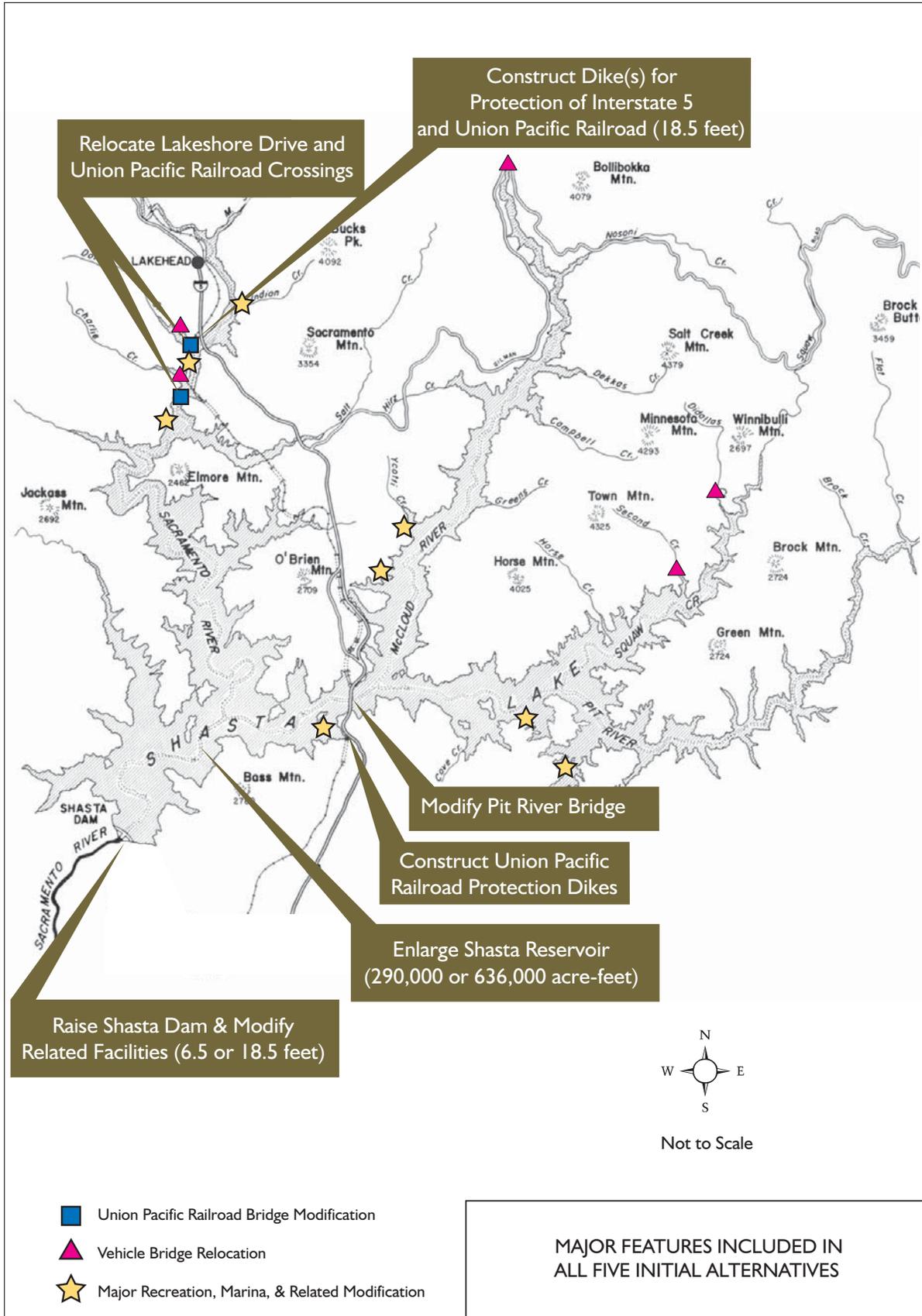
tat along the upper Sacramento River. In addition, features that address the secondary objectives include constructing warm water fish habitat in the Shasta Lake area, restoring one or more riparian habitat areas between Redding and Red Bluff on the Sacramento River, and reoperating Shasta Dam for increased flood control.

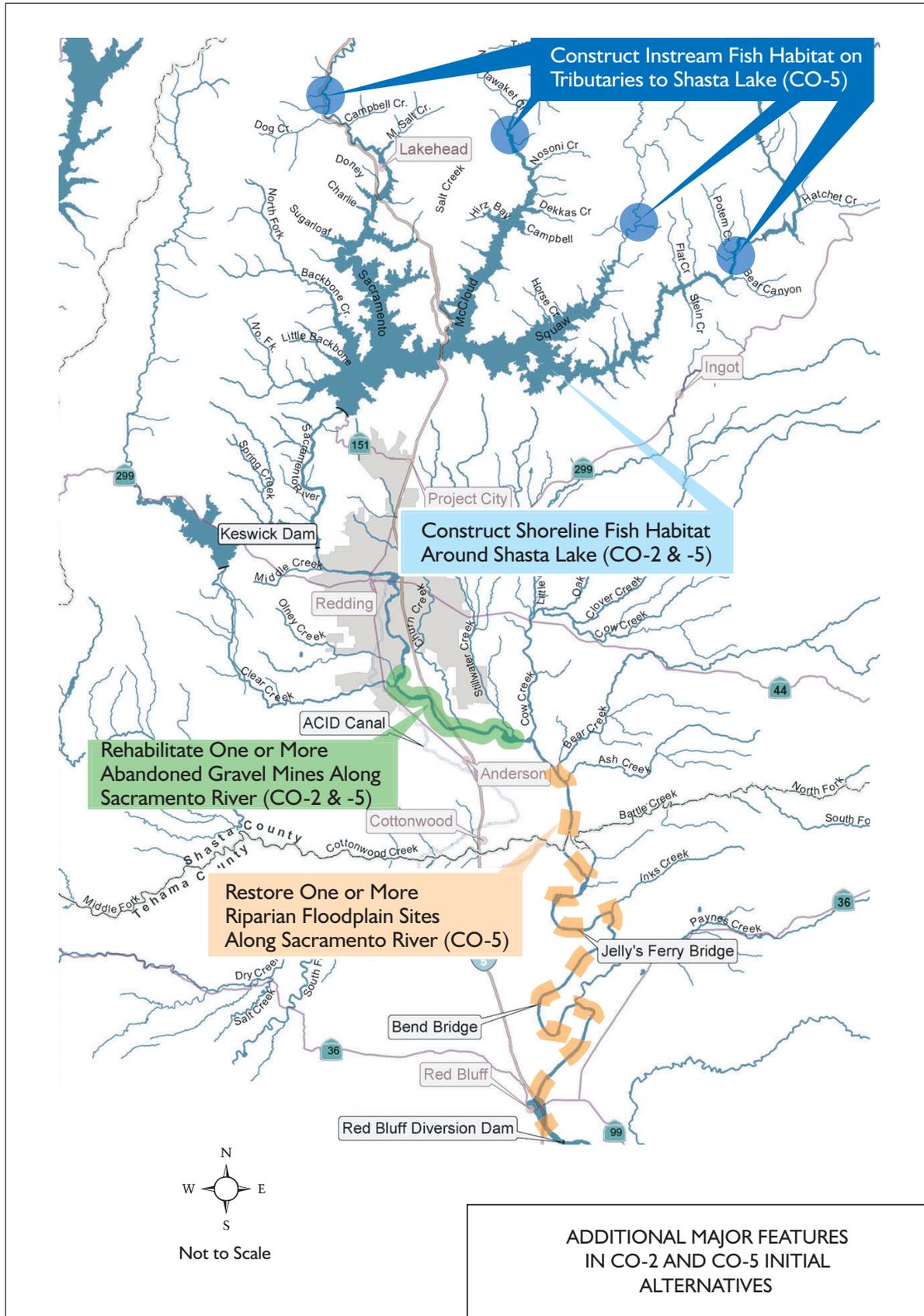
Following is a summary of potential accomplishments and costs of the five initial alternatives. This preliminary information will help identify which initial alternatives, or elements of initial alternatives, should be considered in future studies. Also, it can be used to assist in defining the relationships of the CALFED surface water storage projects to help meet future California water supply needs.

SUMMARY OF ACCOMPLISHMENTS AND COSTS FOR INITIAL ALTERNATIVES¹

Initial Alternative	Primary Objectives			Secondary Objectives			Cost ³
	Increase Water Supply Reliability (1,000 acre-feet/yr) ²	Increase Average Annual Salmon	Increase Spawning Habitat (acres)	Ecosystem Restoration	Flood Control	Hydropower (gigawatt hours/year)	First Cost (\$ millions)
WSR-1	72	410	-	-	Incidental	15	280
WSR-2	125	1,110	-	-	Incidental	44	410
WSR-4	146	1,110	-	-	Incidental	44	460
CO-2	125	1,110	150	-	Increase	44	420
CO-5	146	1,110	150	500+ acres	Increase	44	480

- Initial estimates for comparison purposes only.
- Drought year conditions, and Banks Pumping Plant capacity at 6,680 cubic feet per second. Yield increases by about 20 percent with pumping capacity at 8,500 cubic feet per second.
- October 2003 price levels, 5-5/8 percent interest, and 100-year period of analysis.





MAJOR FINDINGS TO DATE

To date, major SLWRI findings include the following:

- Need continues for actions to help increase the survival of anadromous fish populations in the upper Sacramento River and increase water supply reliability to the CVP and SWP.
- A significant need exists to help restore ecosystem resources and reduce flood damages along the upper Sacramento River and to increase renewable energy supplies in the State.
- Of numerous water resource management measures identified, and various concept plans formulated to address the identified problems and needs, five initial alternatives are recommended for further development in the SLWRI feasibility study.
- The five initial alternatives recommended for further development include raising Shasta Dam from 6.5 feet to about 18.5 feet; higher raises would require major increases in relocations and costs.
- All five initial alternatives would benefit the anadromous fishery in the upper Sacramento River and water supply reliability, and to an incidental extent, flood control and hydropower.
- Two of the five initial alternatives include additional features to further benefit the anadromous fishery and other ecosystem resources in the primary study area.
- All five initial alternatives would contribute to the four main CALFED objectives.
- Increasing CVP, and possibly SWP, water supply reliability through raising Shasta Dam by about 18.5 feet is highly cost-efficient compared to developing other new water sources.
- It is estimated that none of the initial alternatives would result in major impacts to existing flow conditions or other resources of the McCloud River.

CONTRIBUTION OF SLWRI INITIAL ALTERNATIVES TO CALFED OBJECTIVES

Water Quality

Direct contribution by reducing water temperatures for anadromous fish

Water Supply Reliability

Direct contribution by increasing drought period reliability from 75,000 to 150,000 acre-feet/year

Ecosystem Restoration

Direct contribution by helping restore habitat along upper Sacramento River

Levee System Integrity

Indirect contribution by reducing flood flows in Sacramento River

FUTURE ACTIONS

While substantial progress has been made in the SLWRI, much remains to be done. In the next phase, emphasis will be on hydraulic and hydrologic system modeling, designs and cost estimates, and environmental impact evaluations and documentation. These efforts will focus on refining the initial alternatives and formulating comprehensive alternatives. The comprehensive alternatives will be evaluated and compared with the planning criteria, and Federal and non-Federal responsibilities will be defined. Also, major emphasis will be placed on continued communication with other agencies, identified stakeholder groups, Tribal interests, and involved groups and individuals.

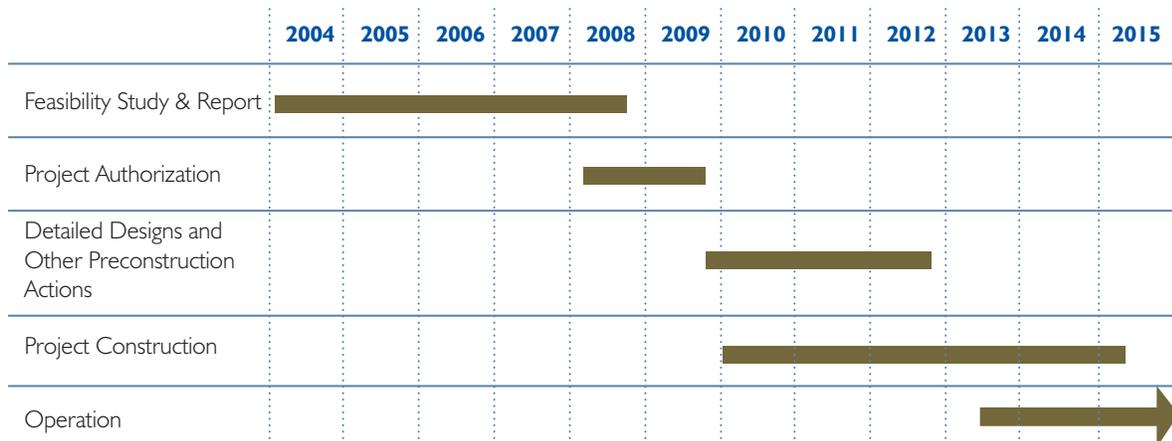
As mentioned, following completion of the Comprehensive Alternatives Phase, which includes preparation of a Plan Formulation Report, the Recommended Plan Phase of the SLWRI will begin. This final planning phase of the SLWRI will focus on identifying a tentatively selected plan for the draft feasibility report and then fully developing the plan to be included in the final feasibility report to support a recommendation to Congress. The feasibility report will be an integrated report, which will include a Federal decision document and a joint Federal Environmental Impact Statement (EIS) and State Environmental Impact Report (EIR). Formal environmental analysis begins with publication of a Notice of Intent and Notice of Preparation.

Timing for completing of the feasibility report and implementing a project will depend on Congressional and State authorization, and adequate funding from Federal and non-Federal sources. Construction could begin several years after project authorization and take about 4 years to complete, as shown in the project schedule below.

SLWRI FEASIBILITY STUDY AND REPORT SCHEDULE

- ◆ **Early 2005** – Initiate environmental scoping process
- ◆ **Spring 2006** – Plan formulation report
- ◆ **Winter 2007** – Draft feasibility report consisting of a draft decision document and draft EIS/EIR
- ◆ **Fall 2008** – Final feasibility report consisting of a final decision document and final EIS/EIR

PROJECT SCHEDULE



SLWRI Mission Statement

To develop an implementable plan primarily involving the enlargement of Shasta Dam and Reservoir to promote increased survival of anadromous fish populations in the upper Sacramento River and increased water supply reliability, and to the extent possible through meeting these objectives, include features to benefit other identified ecosystem, flood control, and related water resources needs.



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