YOSE
ER - 01/0713

Draft Feasibility Report
Environmental Impact Statement/
Environmental Impact Report (Separate cover)

PINE FLAT DAM FISH AND WILDLIFE HABITAT RESTORATION, FRESNO, CALIFORNIA

US Army Corps of Engineers
Sacramento District
South Pacific Division

June 2001

EIS SHELVES

EXECUTIVE SUMMARY

STUDY AREA

The study area is located primarily in Fresno County in the San Joaquin Valley. The study area is the Kings River basin, which includes parts of the valley and the western slopes of the Sierra Nevada. The largest city near the study area is Fresno.

PURPOSE

This report identifies measures, formulates, and evaluates alternative plans, and identifies a Recommended Plan to restore and protect the ecosystem for the fish and wildlife resources in Pine Flat Lake and in and along the lower Kings River from Pine Flat Dam to State Highway 180 by improving the fishery habitat, increasing the fishery survival rate, increasing riparian, shaded riverine aquatic (SRA), and oak-woodland habitats, and reestablishing native historic plant and wildlife communities.

PROBLEMS

The construction of Pine Flat Dam on the Kings River has altered the natural hydraulics and temperatures of the river, affected riparian, SRA, and adjacent vegetation, restricted native coldwater fish movements, which resulted in the decline of the fishery, affected fish and wildlife resources and aquatic wetland habitats, and further accelerated the decline of the riverine ecosystem habitat.

Due to the design and operation of Pine Flat Dam, the reservoir can experience a significant increase in water temperature at certain times of the year. When there is adequate water, water temperatures are well within the optimal range for the survival of both coldwater and warm water fish. In low-water years, however, the availability of coldwater habitat for native fisheries in the reservoir and lower Kings River can decrease dramatically.

Water releases from Pine Flat Lake influences the fishery downstream in the lower Kings River. During dry and below average precipitation years, with below average carryover storage, the coldwater reserves may be depleted from the reservoir by late summer and early fall, causing water temperatures in the reservoir and lower Kings River to exceed levels acceptable for coldwater fish growth and survival. In addition, low instream flows can adversely affect food supply, spatial habitat, and access to SRA habitat, and provide favorable habitat for nonnative warm water fishery growth, which further declines the native coldwater fishery survival rate. Finally, various land use activities have resulted in some loss of riparian, SRA, and oak-woodland habitat, which has depleted the food source to the associated wildlife and special-status species along the river.

Digitized by the Internet Archive
in 2012 with funding from
LYRASIS Members and Sloan Foundation

http://archive.org/details/draftfeasibility00usar

RESTORATION MEASURES

Ten restoration measures were considered: (1) raising Pine Flat Dam, (2) constructing a multilevel intake structure, (3) constructing a turbine bypass system, (4) constructing a new storage facility on Mill Creek, (5) constructing a water transfer pipeline, (6) restoring spawning gravels, (7) restoring Avocado side channel slough, (8) constructing small check dams at Flume Cove on Pine Flat Lake, (9) restoring habitat at a site along Byrd Slough downstream from the dam near the Friant-Kern Canal siphon, and (10) restoring lands on Westlake Farms. From these measures, eight alternative plans were formulated, including a no action plan.

ALTERNATIVE PLANS

The eight alternative plans included (1) no action; (2) constructing a multilevel intake structure on the upstream face of the dam to manage the temperature of downstream water releases to preserve the coldwater in the reservoir and promote downstream water temperatures suitable to sustain the native coldwater fishery throughout the year; (3) constructing a 10.6-mile underground pipeline between the western portion of the Fresno Irrigation District's Dry Creek Canal and the upper end of the Mendota Pool to facilitate a water transfer to augment instream flows in part of the lower Kings River; (4) reestablishing historic floodplain riparian, SRA, and wildlife habitat at Byrd Slough along the Kings River immediately south of the Friant-Kern Canal siphon; (5) a combination of alternatives 2 and 3; (6) a combination of alternatives 2 and 4, (7) a combination of alternatives 3 and 4; and (8) a combination of alternatives 2, 3, and 4.

RECOMMENDED PLAN

Based on the evaluation of the alternative plans, the Corps and the Kings River Conservation District (KRCD), the non-Federal sponsor, and its cost-sharing partner, the Kings River Water Association (KRWA), identified Alternatives 2, 4, and 6 (combination of alternatives 2 and 4) as the final alternative plans. The National Ecosystem Restoration Plan is Alternative 6, which is also the Recommended Plan. This plan would meet the objective of ecosystem restoration, maximize ecosystem restoration benefits, and would not have any significant adverse environmental effects.

Ecosystem Restoration Benefits and Costs

The Recommended Plan would restore about 13 miles of the lower Kings River, improve the native coldwater fishery in the reservoir, and restore about 143 acres of riparian and shaded riverine aquatic habitat at Byrd Slough. by increasing, improving, reestablishing, and conserving the amount and quality of habitat values for vegetation and wildlife, fisheries, and special status species.

The first cost of the Recommended Plan is $35,800,000 based on October 2000 price levels. Of the estimated project first costs, about $23,190,000 (65 percent of first

costs) would be the responsibility of the Federal Government, and about $12,610,000 (35 percent of first cost) the responsibility of the non-Federal sponsor. The annual costs are estimated to be $2,734,000, and the quantifiable environmental benefits are estimated to be 40 Weighted Usable Area (WUA) units and 84.56 Average Annual Habitat Unit's (AAHU). The estimated total investment cost is $40,093,000. The non-Federal sponsor would be responsible for annual operation, maintenance, repair, rehabilitation, and replacement of the project, currently estimated at $56,000.

Local Support

The KRCD and the KRWA have cooperated fully with the Corps in the preparation of this report and have shown strong support for an ecosystem restoration project. The KRCD supports the Recommended Plan and would seek the necessary funding to cost share in construction of the proposed project.

RECOMMENDATION

The Corps recommends that the Recommended Plan be authorized for implementation as a Federal project and that this report be approved as the basis for preparation of plans and specifications for construction of this project.

CONTENTS

TABLES

FIGURES

PLATES

APPENDIXES

Acronyms

AAHU - Average Annual Habitat Unit
Bureau - U.S. Bureau of Reclamation
°C - degrees Centigrade
°F - degrees Fahrenheit
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
cfs - cubic feet per second
Corps - Corps of Engineers
CVP - Central Valley Project
DFG California Department of Fish and Game
DWR - California Department of Water Resources
EIS/EIR - Environmental Impact Statement/Environmental Impact Report
FCSA - Feasibility Cost Sharing Agreement
FID - Fresno Irrigation District
HEP - Habitat Evaluation Procedures
HTRW - hazardous, toxic, and radioactive waste
HU - Habitat Value
IWR - Institute for Water Resources
KRCD - Kings River Conservation District
KRWA - Kings River Water Association
LERRD's - lands, easements, right-of-way, relocations, disposal areas
msl - mean sea level
OMRR&R - Operation, maintenance, repair, rehabilitation, and replacement
PCA - Project Cooperation Agreement
PMP - Project Management Plan
SRA - shaded riverine aquatic
SWP - State Water Project
USFWS - U.S. Fish and Wildlife Service
WUA - Weighted Usable Area

CHAPTER I

INTRODUCTION

BACKGROUND

Pine Flat Dam, located on the Kings River in Fresno County, California, provides local and regional flood protection for the lower San Joaquin River and contains storage capacity for about 1 million acre-feet of water (see Plate 1). Due to the design and operation of the dam, a portion of the reservoir pool can experience a significant increase in water temperature at certain times of the year. The inability to regulate water temperature in the lake threatens the lake fishery, while releases of warm water from the dam threaten the native coldwater fishery downstream. These adverse effects become even more pronounced in years of low-water storage or periods of long hot, dry weather.

The recurring problem of warm water temperatures in Pine Flat Lake and the lower Kings River, (Pine Flat Dam to State Highway 180), and the loss of some riparian, shaded riverine aquatic (SRA), and oak-woodland habitat demonstrate the need to identify and implement ecosystem fish and wildlife habitat measures to protect and restore these environmental resources.

PURPOSE AND SCOPE

This report summarizes the results of the feasibility phase of the Pine Flat Dam Fish and Wildlife Habitat Restoration study. The report describes the development of a plan to restore and protect the ecosystem for fish and wildlife resources in the Kings River basin, specifically in Pine Flat Lake and the lower Kings River from Pine Flat Dam to Highway 180.

In developing this ecosystem restoration/protection plan, the focus of this study is to:

- Assess the existing operation of the dam and its environmental effect on the ecology of the fish and wildlife downstream.

- Determine planning objectives.

- Identify potential measures and develop alternatives.

- Identify a plan that provides ecosystem benefits and is environmentally sound and acceptable.

- Define requirements to implement the plan.

STUDY AUTHORIZATION

The general authority for this study is the 1964 congressional resolution of the House Committee on Public Works, as follows:

> Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Sacramento-San Joaquin Basin Streams, California, published as House Document No. 367, 81st Congress, 1st Session, and other reports, with a view to determining whether any modification of the recommendations contained therein are advisable at this time, with particular reference to further coordinated development of the water resources in the San Joaquin River basin, California.

The Environmental Impact Statement/Environmental Impact Report (EIS/EIR) which accompanies this feasibility report includes detailed discussions of land use, agriculture, prime and unique farmland, vegetation, wildlife, fisheries, special status species, water quality, air quality, transportation, recreation, cultural resources, and overall ecosystem benefits. Issues eliminated from detailed analysis include climate, topography, geology, soils, noise, esthetics and visual setting, socioeconomic, and hazardous, toxic, and radioactive waste (HTRW).

PRIOR STUDIES AND REPORTS

Following are brief descriptions of significant studies and reports that have been prepared or are currently underway related to the construction and operation of the Pine Flat Project and its effect on flood control, water supply, conservation, and environmental resources.

U.S. Army Corps of Engineers (Corps)

"Kings River and Tulare Lake, California," House Document No. 630 (76th Congress, 3rd Session), 1940. This document recommended construction of Pine Flat Dam for flood protection and water conservation.

"Pine Flat Lake, Kings River, California, Reservoir Regulation Manual," 1953, revised 1979. This manual defined primary responsibilities for operating Pine Flat Reservoir.

"Pine Flat Lake, Kings River, California, Design Memorandum No. 7, Master Plan," October 1976. This report was a guide for the administration of all lands and water for public use and development of the Pine Flat Lake project.

"Evaluation of Planning for Fish and Wildlife at Corps of Engineer Reservoirs, Pine Flat Lake Reservoir Project, California," February 1983. This report was one in a series of documents prepared to evaluate the adequacy and predictive value of fish and wildlife measures associated with past construction of Corps reservoirs and to make planning recommendations for Corps reservoir projects throughout the United States. The study was prepared for the Office of the Chief of Engineers by the Sport Fishing Institute, Washington, DC.

"Pine Flat Dam, Kings River, California, Reconnaissance Report," August 1989. This report presented the results of a study of potential flood control and water-related opportunities from raising Pine Flat Dam. The results indicated that raising the dam for flood control and water supply would not be economically feasible.

"Pine Flat Dam Fish and Wildlife Habitat Restoration Investigation, California, Reconnaissance Report," April 1994. This report investigated preservation and restoration of fish and wildlife habitat related to the construction of Pine Flat Dam. A wide range of possible restoration measures was investigated, including raising Pine Flat Dam to create a temperature control pool, constructing a multilevel intake structure for the dam penstocks, installing a turbine bypass, constructing an off-stream storage reservoir on Mill Creek, implementing water exchanges, restoring spawning gravels, planting riparian vegetation, and creating wetland habitat.

"Pine Flat Turbine Bypass, California, Habitat Restoration, Project Modification Report and Environmental Assessment," September 1996. This report presented the results of a study to install a turbine bypass system at Pine Flat Dam. The study was conducted under the authority of the Corps' Section 1135 program.

Kings River Conservation District (KRCD)

"Master Plan for Kings River Service Area," December 1974. The purpose of this report was to balance water supply, minimize flood damages, and conserve and develop water and power resources.

"Kings River Hydroelectric Project, Environmental Impact Report," November 1978. This report was prepared by the KRCD as part of its requirements for acquiring a Federal Energy Regulatory Commission license.

“Water Temperature Modeling Study for the Multi-Level Intake Structure,” September 1998. In this report KRCD utilized a calibrated CE-QUAL-W2 computer model developed for Pine Flat Reservoir to evaluate water temperatures in the reservoir and downstream releases through a multi-level intake structure design.

“Multi-Level Intake Structure, Port Configuration Analysis,” March 1999. In this report KRCD determined the number and elevation of intake openings or withdrawal ports that would optimize the multi-level intake structures’ release temperature effectiveness and summarized the result of the analysis in selecting the most effective intake port configuration.

“Kings River Fisheries Management Program Framework Agreement,” May 1999. The Framework Agreement was entered into by CDFG, KRWA and KRCD to establish a formal partnership to complete and implement the work envisioned in the Kings River Fisheries Management Program. The Fisheries Program was developed to enhance a broad range of fish and wildlife resources in accordance with principles originally set forth by the participating parties in a Statement of Intent executed in 1994.

STUDY BACKGROUND AND PARTICIPANTS

The Corps is conducting this study with the assistance and cooperation of the KRCD, the non-Federal sponsor, and the Kings River Water Association (KRWA), an equal cost-sharing partner with KRCD in this study. The KRCD was formed as a public agency in 1951 and acts on behalf of the Kings River Service Area and its landowners on a variety of river issues and potential projects. The agency also operates and maintains the downstream levee and channel system, which is part of the Pine Flat project, and owns and operates the Pine Flat Power Plant. The KRWA was formed in 1927 to administer Kings River water rights and entitlements along with water deliveries in accordance with diversion schedules. Irrigation water is delivered to 28 member agencies in the Kings River Service Area, which encompasses about 1.1 million acres.

The reconnaissance phase of the study was initiated in April 1993. On May 13, 1993, a public workshop was held in Fresno. After the workshop, an ad hoc committee was established, composed of representatives from the Corps, U.S. Bureau of Reclamation (Bureau), California Department of Fish and Game (DFG), KRCD, KRWA, Fresno Irrigation District (FID), Lower Kings River Committee, Fresno Flyfishers for Conservation, Clovis Bass Club, Kaweah Flyfishers, landowners around the lake, and marina and whitewater rafting representatives. Members of the ad hoc committee participated in identifying problems and potential environmental restoration measures. The committee held four meetings in 1993 and two meetings in early 1994. A reconnaissance report was completed in 1994.

The feasibility study was initiated after execution of the Feasibility Cost-Sharing Agreement between the Corps and KRCD in January 1996. A notice of initiation of the feasibility study was circulated in late March 1996, and a notice of intent to prepare a draft EIS/EIR for the Pine Flat restoration study was published in the Federal Register. This notice provided information on the study and encouraged nationwide comment. A public scoping meeting was held in Fresno on April 24, 1996. At the meeting, the public was provided with information on the environmental problems in the Kings River basin, fish and wildlife restoration alternatives, and study process. A study management team composed of Corps and KRCD representatives was formed to manage the technical studies and participate in the evaluation of the alternative plans.

ONGOING ACTIVITIES

Kings River Fisheries Management Program

Beginning in 1994, a voluntary effort was undertaken to establish a fisheries management program for the Kings River. The need for such a voluntary program was to balance the fishery needs with other beneficial uses of the Kings River while maintaining established water and storage rights. Participants in the program included the DFG, KRCD, and KRWA. On May 28, 1999, the Kings River Fisheries Management Program Framework Agreement was signed by the program participants (see Appendix A). The Framework Agreement established a number of aquatic resource enhancement goals for the lower Kings River and Pine Flat Lake.

These goals include development of physical elements intended to protect or enhance fish populations or to improve aquatic habitat quality within Pine Flat Reservoir and the Kings River below

Pine Flat Dam. The adaptive management program includes several actions: establishing a 100,000 acre-foot temperature control pool within the reservoir, increasing minimum flows, balancing the beneficial uses of the Kings River, providing annual funding, stocking coldwater fish, and fishery habitat improvement, public education and involvement, public access improvements, program monitoring, and regulating fishing along the lower Kings River. An important component of this management program is to maintain support for the Corps' efforts and studies involving potential projects for fish, wildlife and ecosystem restoration on the Kings River.

Under the fisheries management program, enhanced minimum flows were established in the Kings River in its 10-mile reach between Pine Flat Dam and the Fresno Weir. These flows were in addition to those provided by a 1964 agreement between KRWA and DFG. Voluntary flows of at least 95 cubic feet per second (cfs) to Fresno Weir and 5 cfs to the Dennis Cut Weir were provided by member water rights units of the KRWA. In addition to these enhanced minimum water flows in the river and creation of the temperature control pool in the reservoir, the fisheries management program constructed the Kings River's first artificial trout spawning and rearing channel in the spring of 2000. The channel, which is located 5 miles downstream of Pine Flat Dam, is about 2,000 feet long. The channel was named the Thorburn Spawning Gravel Project in honor of the landowners who granted an easement for the project. (Several of these actions are considered to be without-project conditions for this restoration study.)

The DFG, KRCD, and KRWA are continuing to study, and intend to implement, additional components of the fisheries management program, including additional spawning gravel and rearing channels and fish habitat restoration projects, as well as fish stocking, enforcement, public information and education, stream monitoring, and program funding.

CHAPTER II

DESCRIPTION OF STUDY AREA

STUDY AREA LOCATION

The study area is located primarily in Fresno County in the San Joaquin Valley. The study area is the Kings River basin, which includes parts of the valley and the western slopes of the Sierra Nevada. More than half of the upper basin is within the Kings Canyon National Park, Sierra National Forest, and Sequoia National Forest. The study focuses on the Pine Flat Dam and Lake and Kings River downstream of the dam (see Plate 2).

DRAINAGE BASIN DESCRIPTION

The Kings River basin encompasses about 3,445 square miles. The basin is bounded on the north by the San Joaquin River basin and on the south by the Kaweah River basin. The upper basin consists of 1,545 square miles above Pine Flat Dam. The upper basin is among the most rugged areas in the Sierra Nevada and is characterized by sharp peaks and ridges, precipitous canyons, and granite domes. Soil cover ranges from moderate in the lower elevations to nonexistent above 10,000 feet. The upper basin is suitable for grazing, lumbering, hydroelectric power generation, mining, and recreation. The area is sparsely populated.

The lower Kings River basin includes an alluvial plain of about 1,900 square miles, which ranges in elevation from about 400 feet at the foothill line to 200 feet at the edge of Tulare Lake basin and 180 feet along the Kings River North (Fresno Slough). Excellent soils, moderate climate, and availability of summer stream flow and ground water for irrigation make the lower basin a world-renowned agricultural area. The major population center is the city of Fresno.

The Kings River originates high in the Sierra Nevada and flows in a southwest direction as it leaves the foothills and enters the San Joaquin Valley. Below Pine Flat Dam, flows from the Kings River divide into numerous channels, which converge into a single channel before dividing into Kings River North and Kings River South. The Kings River North only flows into the San Joaquin River during flood operations, and Kings River South flows into the Tulare Lake basin.

CLIMATE

The climate of the lower basin is characterized by hot, dry summers and moderate winters with temperatures that vary considerably. Summer highs often exceed 100 degrees Fahrenheit (°F) (37.7 degrees Centigrade (°C)), while winter lows may drop below freezing. Observed temperature extremes in Fresno have ranged from 114 °F to 18 °F (45.5 °C to –7.7 °C). High temperatures can extend well into the fall.

At the higher elevations, the summers are cool, and the winters are severe. Temperatures in the mountains generally decrease with increasing elevation. Observed temperature extremes at Huntington Lake (elevation 7,020 feet) have ranged from 89 °F to -18 °F (31.6 °C to –27.8 °C).

Winter precipitation usually occurs as rain at elevations below 5,000 feet and as snow at higher elevations. About 90 percent of the precipitation will occur from November through April. The average annual precipitation varies greatly throughout the basin. The average ranges from about 6 inches on the valley floor to about 60 inches in the high mountain elevations. The average in Fresno is about 10.5 inches.

ENVIRONMENTAL RESOURCES

This section briefly describes some of the environmental resources in the study area. A more detailed description of these resources can be found in the EIS/EIR.

Natural Resources

Natural resources in the Kings River basin are varied due to the wide range of elevation and climate. The major ecosystems associated with the Kings River basin include riparian, SRA, foothill woodlands, grasslands, seasonal wetlands, agriculture, and urban. A variety of wildlife species inhabits the riparian and other wetland habitats in the basin, including many types of birds, reptiles, and mammals. The Kings River currently supports a wide variety of native and nonnative species of fish including native coldwater fish such as trout, hitch, roach, Sacramento sucker, Sacramento squawfish, and sculpin; and nonnative fish such as large- and small-mouth bass, catfish, and others. The Kings River basin is a broad based aquatic ecosystem that supports a variety of fish and other species including mussels, clams, many species of macro invertebrates, mammals and birds, (see Appendix B).

According to the U.S. Fish and Wildlife Service (USFWS), the Federally listed species that could occur in the study area include the American peregrine falcon, bald eagle, California red-legged frog, delta smelt, Sacramento splittail, California condor, Valley elderberry longhorn beetle, giant garter snake, giant kangaroo rat, Fresno kangaroo rat and critical habitat, Tipton kangaroo rat, San Joaquin kit fox, Aleutian Canada goose, blunt-nosed leopard lizard, Lahontan cutthroat trout, Paiute cutthroat trout, vernal pool fairy shrimp, vernal pool tadpole shrimp, California jewelflower, palmate-bracted bird's-beak, San Joaquin woolly-threads, Hartweg's golden sunburst, Mariposa pussy-paws, San Benito evening-primrose, fleshy owl's-clover, Hoover's eriastrum, San Joaquin Valley Orcutt grass, San Joaquin adobe sunburst, and Green's tuctoria. The Federally proposed species are the riparian (San Joaquin Valley) woodrat and mountain plover.

Geology and Soils

The basin is in a complex geologic area containing metamorphosed sedimentary and volcanic rocks that have been folded, faulted, and intruded by granite rocks of three different ages. In addition, volcanism and later glaciations have modified the topography to essentially the present-day landscape.

Around Pine Flat Lake, the geology is similar to that of the rest of the western slope of the Sierra Nevada, with Mesozoic granitic rocks and pre-Mesozoic metamorphic and granitic rocks predominating. Small amounts of Quaternary alluvium cover the canyon floor, and the soils are generally shallow and poorly drained. Soils in the lower Kings River are sandy loam and are ideal for farming.

Water Quality

Water quality is good in the reach of the Lower Kings River from Pine Flat Dam to Highway 180. Water quality in this 13-mile reach depends on the timing and quantities of watershed runoff and reservoir releases, and is affected primarily by low flows and warm water temperatures. The quality diminishes farther downstream, especially near the communities of Lemoore and Hanford in Kings County as a result of municipal and agricultural inflows in the lower river reaches.

Socioeconomics

The study area is primarily in Fresno County. According to the California Department of Finance, the county had a population of approximately 786,800 in 1998. The population is projected to grow to nearly 1,506,000 by the year 2020, an estimated increase from 1998 of over 90 percent. According to the California Department of Finance, the largest cities in the area as of 1998 are Fresno (411,600) and Clovis (67,700). Smaller cities include Reedley (20,200), Sanger (18,800), Selma (18,100), Mendota (7,600), and Kerman (7,400). Many Fresno County residents live in unincorporated areas (178,700), including many small communities.

Land use along the lower Kings River is primarily agricultural in the valley with grazing in the Sierra Nevada foothill region. Agricultural uses include extensive orchards, row crops, vineyards, and grain fields. As a result, nearly one in every three jobs in the county is related to agriculture. According to the California Department of Finance, the per capita personal income for Fresno County for 1998 was $20,333, as compared to $28,163 for the entire State of California for the same year.

Cultural Resources

Due to the Native American habitation in the area, especially along the Kings River, the area is sensitive for cultural resources. A 1984 study conducted by archeologists with the University of California, Los Angeles, surveyed all Pine Flat Lake parklands, and while 33 prehistoric sites were recorded, none are located near Pine Flat Dam. A records search by the Southern San Joaquin Valley Information Center was completed in 1993 for the Byrd Slough Habitat Restoration site. No prehistoric or historic archeological sites were located within the study area although three archeological sites are located one-third mile to the east.

Hazardous, Toxic, and Radiological Waste

Assessment of past land use and potential sources of contamination have identified no known soil or other contamination in the study area.

HYDROLOGY

The annual runoff from the Kings River basin averages about 1.7 million acre-feet. However, the annual runoff is unpredictable and fluctuates significantly. The lowest recorded runoff was 391,700 acre-feet in 1924; the greatest runoff was 4,476,000 acre-feet in 1983.

A snow pack normally accumulates in the mountains during the winter and reaches its peak in depth and water content in late March and early April when temperatures are warm enough to begin melting the snow. About 75 percent of the annual runoff into Pine Flat Lake normally occurs between April 1 and July 31.

Runoff results from rainfall events and seasonal snowmelt. Runoff from rainfall occurs very rapidly because 22 percent of the basin is above an elevation of 10,000 feet and consists of bare granite. Warm storms occasionally produce enormous downpours of rain over the foothills and mountains over a brief duration, resulting in very rapid runoff and very high peaks. The largest rain flood of record on the Kings River was in December 1955. The 1955 flood had a 16-day volume of about 400,000 acre-feet.

High-recorded regulated floodflows from Pine Flat Dam and Reservoir are shown in Table II-1.

Table II-1. Regulated Peak Floodflows from Pine Flat Dam and Reservoir

Peak Flow (cfs)	Year	Runoff Type
17,000	July 1969	Snowmelt
13,500	July 6, 1983	Snowmelt
12,000	June 5, 1986	Snowmelt
13,100	July 11, 1995	Snowmelt
13,200	January 2, 1997	Rainfall (local runoff below dam)
8,000	February 9, 1997	Rainfall
11,800	July 12, 1998	Snowmelt

Minimum flood damages were reported along the Kings River below Pine Flat Dam in all these events. However, these Kings River floodflows contributed to the overall flooding in the San Joaquin River main stem and the Tulare Lakebed.

EXISTING WATER RESOURCES PROJECTS

Several water resources projects influence flow in the Kings River. These projects help regulate flows by controlling releases to obtain the maximum practicable reduction in flood damage and to provide water for urban, agricultural, and environmental use. Several of the larger projects are described below.

Federal

Pine Flat Dam Project. The Corps completed pine Flat Dam in 1954 for flood control and water conservation. The dam is a concrete-gravity structure. It is 429 feet high and 1,820 feet long at the crest.

The reservoir has a storage capacity of about 1 million acre-feet at gross pool, all of which is available for flood control when required. In addition to the dam, the project included penstocks for hydropower, downstream improvements to control flooding, and diversion of flows between the Kings River North and Kings River South. Downstream channel clearing and construction of levees and weirs were completed in 1976.

The project provides flood protection to about 80,000 acres of agricultural land along the Kings River and 260,000 acres of agricultural land in the Tulare Lakebed (in conjunction with other projects on the Kaweah, Tule, and Kern Rivers). Recreation is an incidental benefit of the project. A non-Federally owned hydroelectric power plant was completed below the dam by KRCD in 1984.

Army Weir. The Army Weir, which is located about 55 miles downstream of the dam, is a diversion structure completed by the Corps in 1943 to regulate flows between the Kings River North and Kings River South. The KRWA operates the weir in accordance with agreements among the members of the association. The Corps maintains the weir and directs its operation during floods.

Friant-Kern Canal. The Friant-Kern Canal was constructed and is operated by the Bureau as part of the Central Valley Project (CVP). The canal extends 152 miles from Friant Dam (Millerton Lake) on the San Joaquin River south to the Kern River near Bakersfield. The canal provides irrigation water to users along the lower east side of the San Joaquin Valley. The canal crosses the Kings River upstream from Centerville Bottoms.

State

California Aqueduct. The California Aqueduct was constructed in the 1960's and is operated by the State Department of Water Resources as part of the State Water Project (SWP). The aqueduct extends 444 miles from the Banks pumping plant at the Sacramento-San Joaquin Delta south to Lake Perris in southern California. The aqueduct passes along the western edge of the Tulare Lake basin and provides water to the Tulare Lake Basin Water Storage District and Empire West Side Irrigation District (both members of the KRWA).

WATER SUPPLY

Overall, the water rights within the Kings River basin are governed by a collective agreement executed in 1927 by members of the KRWA. The agreement was modified in 1949 and 1963, and is administered by KRWA for the 28 members who collectively own all the water rights in the basin. The water is diverted downstream of Pine Flat Dam and distributed through many canals, channels, ditches, and pipelines, and is used primarily for irrigation and ground-water recharge in the 1.1 million–acre Kings River service area.

Some water from the Tule and Kaweah Rivers (on average about 19,000 and 15,000 acre-feet, respectively) is also used each year for irrigation in the Tulare Lake basin. About 93,000 acre-feet of CVP water from the San Joaquin River is imported annually into the service area through the Friant-Kern Canal. The City of Fresno has a CVP contract for 60,000 acre-feet of Class 1 water (firm supply), and

FID has a CVP contract for 75,000 acre-feet of Class 2 water (only available after Class 1 water deliveries are satisfied).

FLOOD CONTROL

Floods on the Kings River are of two types: winter rain floods and spring snowmelt floods. Winter rain floods, which generally occur from November through March, are caused by heavy rains and sometimes are augmented by melting snow at intermediate elevations. These winter rain floods may have large peak flows, but are usually of short duration and comparatively small volume. A major portion of the winter precipitation is snow, which generally remains in the mountains above 5,000 feet until spring. Snowmelt floods have comparatively moderate peaks, but very large volumes extending over 2 to 4 months. About 75 percent of the annual runoff occurs from April through July.

The flood control capacity of Pine Flat Dam was designed on the basis of an analysis of the 1906 flood, the largest known snowmelt flood prior to authorization of the project. A reservoir capacity of 1 million acre-feet was required to minimize damage in the Tulare Lake basin from the Kings River. Operating criteria require 475,000 acre-feet of vacant storage be maintained for flood control from December 1 through February 1. Subject to legal and operational constraints, additional vacant space is provided in Wishon and Courtright Reservoirs upstream from Pine Flat Dam. These reservoirs are owned and operated by the Pacific Gas and Electric Company. The watershed is monitored daily for water content of the snow pack. Required additional flood control space is adjusted by the Corps as conditions warrant.

HYDROELECTRIC POWER

The Kings River basin has four major hydroelectric power projects licensed by the Federal Energy Regulatory Commission. The Pacific Gas & Electric Company owns and operates three: Haas-Kings River Project, Balch Project, and Helms Pumped Storage Project. The KRCD owns and operates the fourth; that is, the Pine Flat Power Plant located at the base of Pine Flat Dam.

Haas-Kings River Project

The Haas-Kings River project is owned and operated by the Pacific Gas and Electric Company. The project consists of Courtright Lake (123,300 acre-feet), Lake Wishon (129,100 acre-feet), and the Haas Power House (144,000 kilowatts), which are located on the North Fork of the Kings River, and the Kings River Power House (52,000 kilowatts), which is located at the upper end of Pine Flat Lake.

Balch Project

The Balch project, located on the north fork of the Kings River, is owned and operated by the Pacific Gas & Electric Company. The project consists of a diversion dam and a tunnel leading to the Balch Power House No. 1 (34,000 kilowatts) and Balch Power House No. 2 (105,000 kilowatts).

Helms Pumped Storage Project

The Helms project is owned and operated by the Pacific Gas & Electric Company. The project consists of the Helms Pumped Storage Power House (1,212,000 kilowatts), which is located on the North Fork of the Kings River between Courtright Lake and Lake Wishon.

Pine Flat Power Plant

The Pine Flat Power Plant is owned and operated by KRCD. The agency completed the power plant in 1984 in order to use flood control and irrigation releases from the reservoir for power generation. Since the power plant is located at the base of a Corps dam, the plant is operated and maintained in accordance with a memorandum of agreement between the Corps and KRCD dated March 25, 1993. The operation of the power plant is incidental to the operation of the dam for flood control and water conservation, and flow releases are not modified for power generation. The power plant is operated in compliance with a license issued by the Federal Energy Regulatory Commission, with a permit issued by the State Water Resources Control Board, and in compliance with agreements with the DFG and KRWA. The California Department of Water Resources (DWR) purchases all of the power produced by the Pine Flat Power Plant for use in operating the SWP. Facilities owned by the Pacific Gas & Electric Company transmit the power to the statewide power system grid.

FUTURE WITHOUT-PROJECT CONDITIONS

Future without-project conditions are the conditions expected in the study area assuming that the Corps does not participate in this ecosystem restoration project at Pine Flat Dam. These conditions are used to evaluate the long-term effectiveness of the alternative plans. These conditions are based on existing conditions and assumptions regarding likely future actions under consideration at this time. The future without-project conditions for this study are summarized below:

- Fisheries – Periods of low-water storage and warm water temperatures will continue occasionally in the reservoir, threatening the survival and limiting the abundance of the native coldwater fishery including some species of trout, hitch, roach, sculpins, Sacramento Sucker, and Sacramento Squawfish. Conditions for a native coldwater fishery below Pine Flat Dam will continue to be good in wet years, but would decline in below average and dry years due to the high temperatures and low volumes of releases from Pine Flat Dam. This will continue to limit the abundance of fish and wildlife and the quality of the aquatic ecosystem resources along the lower Kings River.

- Spawning Area – Some new areas of spawning gravel for trout (indicator species) and other fishes have been established by the KRCD in the lower Kings River as one component of the comprehensive Kings River Fisheries Management Program. However, without the modification of the Pine Flat Dam to provide optimum temperature releases downstream and the downstream ecosystem restoration site to provide habitat for wildlife and riparian and SRA habitat for fish, this and other spawning areas would not provide an increase in the fishery survival rate.

- Special-Status Species – Riparian and SRA habitat at the Byrd Slough Habitat Restoration site will continue to be degraded due to cattle grazing. This will contribute to limit the number, abundance, and quality of associated special-status species along the lower Kings River. The special-status species will further decline or become extinct if the proposed restoration site is converted to residential, commercial, and/or industrial development.

- Vegetation and Wildlife – Riparian and SRA habitat at the Byrd Slough Habitat Restoration site will continue to be degraded due to cattle grazing. This will contribute to limitations on the diversity, abundance, and quality of fish and wildlife and their survival rate, food resources, and shelter along the lower Kings River.

- Land Use of the Byrd Slough Habitat Restoration Site – The potential future land use of the Byrd Slough habitat restoration site might continue to be cattle grazing. The potential loss due to cattle grazing would be the loss of scares ecosystem habitat for the survival of fish and wildlife in the Central Valley area.

- Fishery within the lake and in the river below the dam will continue to decline due to lack of optimum temperature range for fishery survival.

- The existing temperature control pool of about 100,000 acre-feet will be maintained in Pine Flat Lake as part of the ongoing Kings River Fisheries Management Program.

- Several environmental resources and conditions will remain basically the same: climate, hydrology, flood control, hydroelectric power, geology and soils, socioeconomics, cultural resources, and HTRW. The less-than-optimum conditions related to water quality, water supply, vegetation and wildlife, fisheries, special status species, and recreation will likely continue to decline.

- Water quality – Continued periods of low water storage, low dissolved oxygen levels, and warm water temperatures will occur occasionally in the reservoir. Downstream conditions related to low flow and warm temperatures following the summer irrigation season will continue. The unpredictable water quality issues will continue to limit the abundance and quality of fish and wildlife resources in the Kings River basin.

- Pine Flat Dam will continue to be operated by the Corps for flood control and water conservation throughout the expected project life in accordance with the existing reservoir control manual.

- A turbine bypass facility similar to the one proposed in the "Pine Flat Dam Turbine Bypass, California, Habitat Restoration, Project Modification Report and Environmental Assessment," September 1996, will be in place at Pine Flat Dam. Construction is scheduled to be completed by 2002. The period of analysis for this project was assumed to be 50 years.

- Water Supply - Land use in the study area will remain predominantly agricultural, and the demand for surface irrigation water will continue to be similar to the historic irrigation demand since construction of the dam. Adequacy of the Kings River water supply to meet surface water irrigation demands within the Kings River Service Area varies depending on the quantity of Kings River watershed runoff and the availability of supplemental Statewide water supplies.

- Recreation – Pine Flat Lake and the lower Kings River will continue to be favorite locations for many recreation and outdoors enthusiasts. Without the project, rainbow trout and the coldwater fishery habitat could continue to degrade, which could affect recreational fishing. Water quality could continue to degrade and will affect the enjoyment of all water-based recreational activities.

CHAPTER III

PROBLEMS AND OPPORTUNITIES

PROBLEMS

The existing water resources problems in the study area are (1) decline of the native coldwater fishery due to poor water temperature regimes in the lake and in the river below the dam, and (2) decline of riparian and SRA habitat and the adjacent flood plain due to cattle grazing and other land uses in the historic floodplain.

Limitations of Dam Operation

Pine Flat Dam blocks the upstream migration of rainbow trout and other cold water fish to colder water areas conducive to spawning. In below-average water years, the temperatures in the lower Kings River can be too warm to support the native coldwater fishery. The habitat conditions in the lower Kings River are related to the physical and operational constraints of Pine Flat Dam. Plate 3 shows the upstream face and cross-sectional diagrams of the dam.

High instream water temperatures below Pine Flat Dam in late summer and fall are considered a major factor limiting the survival of the coldwater fishery in the lower Kings River. The temperature of releases from Pine Flat Lake directly influence the instream water temperatures below the dam, while other influencing factors include climate, vegetative cover, stream bed substrate, stream depth, physical habitat, and flow rate. Under existing conditions, the flexibility to manage the coldwater reserves in the lake is limited. There currently is no mechanism to withdraw water through the dam penstocks when the power plant is shut down, or to make selective withdrawals from various levels within the reservoir.

Pine Flat Lake becomes thermally stratified during warm months, usually from March through September. The uppermost 30 feet of the lake are typically well mixed and warm in the summer, sometimes exceeding 25 °C (77 °F). This warm, upper layer of water overlies a 10- to 20-foot-thick layer where the temperature changes rapidly from 25 °C (77 °F) to about 15 °C (59 °F). All of the water below this layer is cold, and a secondary layer with extremely cold water is sometimes present in the lowermost 30 to 50 feet of the lake.

In the Kings River downstream of the dam, instream water temperatures above 21°C (69.8°F) are considered stressful and reduce the survival rate of the coldwater fishery and can be deadly to the fishery if the temperature remains high for a prolonged period. In above average water years, the coldwater reserve in the reservoir provides release temperatures at or below 21°C (69.8°F). Frequently, the combination of the thermal stratification of the lake and the existing location of the outlet ports makes it impossible to provide 21°C (69.8°F) optimum temperature releases.

Temperatures were taken at two different locations in the river below the dam. Plates 4, 5, and 6 show the daily average water temperatures for the years 1988 (dry), 1992 (critically dry), and 1994 (normal). The first point was taken from a bridge 0.5 mile below the dam (see Figure 1), and the second point is the Fresno Weir that is 9.7 miles downstream from the dam (see Figure 2). (Fresno Weir is an

irrigation diversion structure owned, operated, and maintained by the FID.) As shown on the plates, temperatures in the river increase from July to October, with the peak temperature in September. Average annual precipitation varies greatly throughout the basin. Summers are typically dry while runoff results from rainfall events and seasonal snowmelt. Precipitation also varies greatly from year to year, resulting in years that range from critically dry to wet, with only a few years producing average runoff. Temperatures were taken for 3 years in order to obtain an accurate representation for critically dry, dry, and normal conditions.

igure 1. First temperature measurement location at ridge 0.5 mile below dam.

Figure 2. Second temperature location at Fresno Weir

At Pine Flat Dam, there are four outlet locations (levels) used to make flow releases. These locations include the spillway gates, the midlevel sluice gates, the low-level sluice gates, and the penstocks when the power plant is in operation. For the purpose of managing the coldwater reserves in the lake, the spillway operation is not a significant factor. For flows between about 600 cfs and 8,000 cfs, releases are typically made through the power plant via the penstocks. Additional releases can be made via the mid- or lower-level sluice gates depending on pool elevation.

Use of the sluiceways as a means to manage the coldwater reserve is limited. Because of hydraulic and mechanical factors, the operational range of each set of sluice gates is restricted. Lake elevations must be between 924 feet and 751 feet to make releases through the midlevel sluiceways. Releases from the low-level sluiceways can be made when the lake elevation is below 751 feet. During the late summer in below average, low storage years, water at the midlevel sluice gate is usually above 21°C (69.8°F). Releases through the low-level sluiceway would quickly deplete the small reserve of the coldest waters, resulting in warmer release temperatures later in the year.

Plate 7 shows two graphs of 100 years of record between 1896 and 1996. The first graph shows the runoff in acre-feet, and the second graph shows the runoff as a percentage of average, which is 1,721,200 acre-feet. These graphs indicate how widely the runoff can fluctuate. There are only 27 years having an annual runoff ranging from 80 to 120 percent of average. Plate 8 shows the maximum Pine

Flat Reservoir storage from 1955 through 1998. From the data, the mean maximum storage is 782,700 acre-feet, and the median maximum storage value is 888,800 acre-feet. Plate 9 shows the years and the number of days in each of those years when the reservoir storage was greater than 800,000 acre-feet, roughly 12 percent of the time for an average of 44 days per year. Plate 10 is a graph showing the storage above 600,000 acre-feet.

Decline of Fisheries Due to Temperature Fluctuations

Pine Flat Lake Fishery. Fishery problems in Pine Flat Lake primarily concern unsuitable temperature range for native coldwater fish survival, lack of adequate dissolved oxygen, and lack of spatial habitat. These problems result largely from the inability to make selective withdrawals from the reservoir pool. Thermal stratification in the reservoir affects native coldwater fish and creates fisheries problems. In most years, the lake stratifies into an epilimnion (top level), metalimnion (mid-level), and hypolimnion (bottom level).

When there is adequate water in the reservoir, such as during high-runoff years, water temperatures in much of the reservoir are well within the optimal range for native cold water fish (11°C to 18°C (51.8°F to 64.4°F)). However, in low-water years there is inadequate cool water for the coldwater fishery.

Reservoir release temperature problems in low- to normal-runoff years are aggravated by dam operation criteria. For example, early season irrigation releases are made through the power plant penstocks, depleting the cooler water from the lower layer of the reservoir and leaving warmer water from the reservoir's upper layer. The upper layer quickly warms further from the hot summer air temperatures and becomes too hot to support the native coldwater fishery.

In low-runoff years, this leaves native coldwater fish with a smaller volume of cold water and thus less suitable habitat. Furthermore, if cool water is released from the epilimnion/metalimnion interface, which has adequate dissolved oxygen, fish may be subjected to both the warmer-than-optimal epilimnion layer above and the cool, but deoxygenated hypolimnion layer below, which further reduces their survival rate.

Lower Kings River Fishery. Construction of Pine Flat Dam modified the downstream river environment for native coldwater fisheries. Before the dam and excluding the rain flood for the winter season (November through March), the highest flows were in May and June, followed by April, July, and then August. Since construction of the dam, stream flows at Piedra are higher in June, July, and August, and flows are substantially reduced from mid-September through February. The overall effect has been to provide relatively high, stable stream flows for irrigation from March through September and reduced flows in the fall and winter months.

Prior to construction of Pine Flat Dam, many miles of the lower river would have been subject to significant warming in most years, particularly in late summer and early fall as snowmelt runoff receded. The historic coldwater fishery in the lower river was very likely seasonal, with most of the spawning and rearing in the cooler, upstream tributaries, now inaccessible due to the dam. The coldwater fish population probably recolonized the lower river quickly as a result of migration from upstream. As such, the range of the usable habitat for the coldwater fishery varied seasonally and from year to year. In the

wettest years, however, there could have been suitable temperatures and flows to allow trout and other coldwater fish to survive, at least as far downstream as the riffle and run sections upstream from Reedley. The warm water species typical of the lower river (Sacramento sucker, Sacramento squawfish, and others) probably moved to the warmer downstream reaches or the smaller, warmer tributaries in these wetter years.

The fishery conditions in the lower Kings River changed significantly due to the construction of Pine Flat Dam, which has made possible delivery of year-round coldwater releases, depending on lake storage. In the wetter years (defined for this study as years with a late summer and fall lake storage greater than 315,000 acre-feet), coldwater reserves in the lake are maintained throughout the year, and the water temperature of the dam releases are suitable for coldwater fish species. Late summer and fall lake storage has been greater than 315,000 acre-feet in about 50 percent of the years since the dam was constructed. The coldwater fishery in the lower Kings River has been good in these wetter years, particularly after several consecutive years of sustained cooler temperatures.

During dry and below average water years, the coldwater reserves in the lake may be used by the end of summer or early fall (depending on carryover storage), and dam release temperatures from July through October can exceed acceptable limits for coldwater fish growth and survival, resulting in possible reproductive failure and/or mortality of the coldwater fish population. High water temperatures in the late summer and fall can affect coldwater fish egg and sperm production, reducing the reproduction success rate during the following spring. As a result, recovery of the coldwater fishery after dry or below-average water years has become dependent on stocking with hatchery fish, which take a year or more to reach reproductive maturity and which experience relatively low survival and spawning success. Although stocked coldwater fishing in the lower river has been excellent at times since the dam was constructed, it is rare to catch native coldwater fish. Currently, conditions necessary for a "wild" coldwater fishery in the lower river do not exist except in average or above-average water years.

Within the lower Kings River below Pine Flat Dam, Sacramento sucker, Sacramento squawfish, California roach, hardhead, and other native species are known to have coexisted with rainbow trout both before and after construction of the dam. Before the dam, the lower river supported a variety of introduced and native species, and several more were stocked after the dam was constructed in an effort to improve the fishery. Large-mouth bass were introduced into Tulare Lake and remain today in the lower Kings River. Other game fish in the area prior to dam construction included Chinook salmon, small-mouth bass, and rainbow trout (both resident and anadromous or “steelhead” forms), in addition to the usual complement of native suckers and minnows.

Today, the lower Kings River from the dam downstream to the town of Reedley supports many species typical of cooler waters such as trout, small-mouth bass, and spotted bass, and species associated with warmer waters like Sacramento sucker, Sacramento squawfish, green sunfish, carp, and catfish. Only warm water species are consistently found below Reedley.

Decline of Riparian and SRA Habitat

In the early 1800’s, the Central Valley contained over an estimated 950,000 acres of riparian forest, woodland, and SRA habitat, including 400,000 acres in the San Joaquin basin and 60,000 in the Tulare basin. Recent estimates indicate that only about 4 percent of this historic riparian and SRA habitat

remains, and at least half of this habitat is disturbed or degraded. The further decline of riparian and SRA habitat would result in further loss of habitat for fish and wildlife and increase the inbalance of the fragile ecosystem in the Central Valley.

SRA vegetation and its associated exposed riverbank tree roots, snags, and undercut banks provide protective cover for fish. Fallen trees and larger woody debris in the river also provide fish cover. Overhanging vegetation supplies as much as 90 percent of the nutrients used by instream aquatic organisms in the form of fallen leaves, branches, other detritus, and falling insects. SRA habitat also shades the stream environment, providing significant cooling for the fishery.

Riparian vegetation serves an important role in the life cycles of many aquatic insects and provides feeding, resting, and breeding areas during specific life stages. The fishery has been affected by the loss of SRA habitat in the Kings River ecosystem as a result of cattle grazing along the stream banks, urban development encroachment, agricultural encroachment, inundation, channelization, and separation of the river channel from riparian vegetation due to lower instream flow.

The loss of riparian and SRA habitat affects the many wildlife species that use it. With high species diversity, diversity in plant heights, dense cover, high plant productivity, and ample water, riparian and SRA habitat areas are probably the most important habitat for wildlife in the West. A great variety of wildlife, including many threatened and endangered species, depends on this habitat. Overall, about 25 percent of terrestrial mammal species, 50 percent of reptile species, and 75 percent of amphibians in California depend on riparian and SRA habitat. More species of birds depend on riparian and SRA habitat than any other habitat in California.

Riparian and SRA zones provide critical movement and migration corridors for mammals, migratory birds, and other wildlife species. Riparian and SRA systems also have important hydrologic functions with social and economic values. As part of the natural flood plain, riparian and SRA systems function as water filters and help to maintain and improve water quality. They also detain and gradually release floodwaters, reducing flood flows and associated flood damages downstream. They provide bank stabilization and erosion control. Economic benefits include increased property values for land adjacent to these natural areas and lowered costs for storm water management, flood protection, and water treatment.

Although agriculture encroached on wildlife habitat before construction of the dam and downstream levees, the reduction in flooding and regulation of irrigation water deliveries have facilitated further agricultural development. Additional water for irrigation brought native lands not in agriculture into production and intensified existing agricultural land use.

Cattle grazing along the river has also resulted in degradation of riparian and SRA vegetation. Cattle tend to congregate near water and trample delicate riparian and SRA vegetation needed by fish and wildlife. Cattle grazing can also prevent woody vegetation such as oaks from regenerating.

OPPORTUNITIES

Opportunities in the study area include (1) restore the fishery along the Kings River by modifying the dam to improve the coldwater release to the river below the dam and increase the fishery survival rate, (2) exchanging water to increase streamflows, and (3) restoring the historic floodplain, aquatic and riparian habitat ecosystem below the dam by re-establishing riparian, slough, and SRA habitat to improve fish and wildlife survival rates.

Opportunities to help alleviate environmental problems in the Kings River system include the following measures that support the goals and objectives of the Kings River Fisheries Management Program. These measures allow for better management of the coldwater reserves in Pine Flat Lake and improvement of the coldwater fisheries in both the lake and the lower Kings River. These measures appear to be viable options to increase instream flows, to increase the operational flexibility to better manage the coldwater reserves, and to restore the ecosystem of the Kings River below the Pine Flat Dam.

Modify Dam and Operation

Modifying the dam could improve the ability to release blended water from various port levels in the reservoir to achieve optimum temperature ranges for coldwater fishery survival downstream. The installation of a multilevel intake structure would enable colder water at the elevation of the penstocks to be conserved for use later in the season when release of colder temperatures is critical for coldwater fishery survival. Later in the irrigation season when storage has decreased, water could be withdrawn from various elevations to achieve optimum release water temperatures. Using water from higher elevations, while withdrawing water at the elevation of the penstocks only when necessary, would facilitate the maintenance of coldwater reserves to be used later in the year when the cooler water is needed for the fishery downstream. The multi-level intake structure will facilitate withdrawing reservoir water from various levels with release of the water through the penstocks and turbine bypass line late in the year after the power plant shuts down.

Drawing water from higher reservoir elevations could also result in an improvement in dissolved oxygen concentrations released from the power plant into the river below the dam. Usually, water withdrawn from the reservoir at the elevation of the penstocks when the power plant is operating is lower in dissolved oxygen than water located at higher elevations, and as it is routed through the penstocks, it is not reoxygenated prior to release to the river. Withdrawing water from higher reservoir elevations at suitable temperature ranges as part of multilevel intake operations would facilitate the release of water through the power plant that could contain increased dissolved oxygen concentrations.

Exchange Water to Increase Streamflows

Usually, irrigation releases from Pine Flat Reservoir are at their minimum later in the year during the fall and winter months. One way to increase these flows to provide longer periods of cooler water for coldwater fishery survival would be through an "out-of-basin" water transfer or exchange. This could involve an exchange of water between a Kings River water rights holder and another water user located near, but outside, the Kings River Service Area. However, there would be no net water change resulting

from the out-of-basin transfer. The exchange would provide a return of the water to the Kings River Service Area through a KRWA member with available means to receive water from another source such as the CVP and/or the SWP. The exchange would allow Kings River water to remain in Pine Flat Reservoir during the summer months and be released for delivery during the fall months to increase the flows in the river downstream of the dam.

Improve and Restore Fisheries

The water temperature and quality problems discussed previously could be greatly reduced by modifying the dam structure and its operations in order to make selective withdrawals from various levels in the reservoir pool. Water temperature and water quality problems could also be improved through a water transfer or exchange which would substantially increase flows in the lower Kings River during periods when these flows are usually at a minimum.

Pine Flat Lake Fishery . A structural modification to the dam such as a multilevel intake structure could benefit the fishery in Pine Flat Lake by managing coldwater in the reservoir. Since it would not be necessary to release water from the level of the penstocks, the cooler water at the lower layer of stratification would not be depleted. This would prevent fish from being stressed between the warm upper layer and the cool, deoxygenated lower layer.

A water transfer or exchange could also indirectly benefit the fishery in Pine Flat Lake. The exchanged water which would remain in Pine Flat Reservoir during the summer months and be released for delivery later during the fall months could improve dissolved oxygen concentrations and spatial habitat in the reservoir for the fish.

Lower Kings River Fishery . A structural modification to the dam could also benefit the fishery below the dam. The tailwater pool below the dam provides habitat refuge for coldwater fish in stress years and allows for avoidance of extinction episodes. The multi-level intake structure will promote maintenance of sustainable temperatures in the tailwater pool and facilitate healthier fish going into stressful episodes and increase survival and sustainability of the Kings River coldwater fishery. Problems associated with warm water temperatures and dissolved oxygen could be avoided by making selective withdrawals from various levels in the reservoir pool. Improving water temperatures and stream flows in the Kings River below the dam would increase suitable habitat and survival rate for a variety of fish.

A water transfer or exchange could allow water to remain in Pine Flat Reservoir during the summer months and then be released for delivery downstream later during the fall months. This could improve water temperatures and provide increased stream flows for spatial habitat in the lower Kings River for fish survival.

Restore Riparian and SRA Habitat

Public interest is high in ecosystem restoration for fish and wildlife through revegetation of degraded riparian, wetland, and SRA habitat along the lower Kings River. Such ecosystem restoration could improve riparian and SRA habitat values and could facilitate public education and access to the river system. There are potential restoration areas along the river that are currently in public ownership and that are contiguous to other areas with high habitat value.

Ecosystem restoration of riparian and SRA habitat along the lower Kings River immediately below the dam could offset the past loss of riparian and SRA habitat as a result of the dam construction. A variety of species stack up against the first dam on a river system and riparian and SRA habitat near the dam is critical to the total ecosystem habitat value. Restoration of riparian and SRA habitat would benefit fish and wildlife downstream of the dam and link the historical flood plain to the river. Riparian and SRA vegetation could provide feeding and breeding areas for insects and instream aquatic organisms, which are required as food by the mammal, reptile, amphibian, and bird species that inhabit and use both the riparian and SRA areas. Additional riparian and SRA vegetation would also help to improve water quality due to its capacity to filter water. Riparian and SRA vegetation also reduces flow velocities along the banks of the river and slough. The root systems of riparian and SRA vegetation help to stabilize the soil and prevent soil erosion.

A great variety of terrestrial mammal, reptile, amphibian, and bird species depend on riparian and SRA habitat for foraging, resting, breeding, and a water source. Therefore, increasing the amount of available riparian and SRA habitat would increase the populations of wildlife and fish in the area. Near the Friant-Kern Canal siphon crossing of the Kings River, the Bureau owns a 700-acre parcel, and to the north it owns a 120-acre parcel on which it plans to restore riparian and SRA habitat. Another possible restoration site is a 143.5-acre parcel owned by the County of Fresno. This parcel is situated adjacent to the parcels owned by the Bureau. If developed, these three parcels would provide a large contiguous parcel of land, which could provide optimal riparian and SRA habitat values to fish and wildlife populations for feeding and breeding.

CHAPTER IV

PLAN FORMULATION

Plan formulation is the process of developing and evaluating alternative plans to meet the needs and desires of society, as expressed in specific planning objectives, and identifying the plan that best satisfies the objectives. During plan formulation for the habitat restoration study, the following procedures were used to formulate a plan: (1) establishing planning objectives, (2) developing formulation criteria, (3) identifying management measures, and (4) formulating and evaluating alternative plans.

PLAN FORMULATION PROCESS

The plan formulation process consists of these basic tasks:

- Establish specific objectives for implementing a plan to restore and protect the downstream fishery and wildlife habitat.

- Define constraints and criteria for formulating an implementable plan.

- Identify, document, and evaluate ecosystem restoration measures to improve local environmental resources.

- From the most workable measures, assemble and evaluate alternatives, consistent with planning constraints and criteria, to address the study objectives.

- Evaluate and compare the alternatives and identify a plan recommended for implementation.

PLANNING OBJECTIVES

The decline of fisheries in Pine Flat Lake and in the Kings River downstream from Pine Flat Dam along with the decline of riparian and SRA habitat are serious concerns for the Corps, KRCD, KRWA, and the general public. To improve environmental conditions, steps are needed to increase the fish survival rate and to restore/protect the riparian and SRA habitat. Based on these problems and needs, the following planning objectives were used in the formulation of environmental restoration and protection alternatives:

- Improve the coldwater fishery survival rate in Pine Flat Lake and in the Kings River downstream of the dam.

- Improve sustainability of the coldwater fishery in Pine Flat Lake and in the Kings River downstream of the dam for wet, normal, dry, and critically dry years.

- Improve optimum water temperatures for the coldwater fishery in Pine Flat Lake and in the Kings River downstream of the dam.

- Improve riparian, wetland, SRA, and historic flood plain habitat along the lower Kings River.

- Restore the ecosystem by reestablishing native historic plant and wildlife communities along the lower Kings River.

PLANNING CONSTRAINTS AND CRITERIA

Constraints

Fundamental to the plan formulation process is an understanding of the constraints within which plan formulation can be accomplished. Major constraints for this project are described below.

Past Congressional Direction. Specific congressional direction was provided in the June 11, 1992, report of the House of Representatives Committee on Appropriations, which accompanied the Fiscal Year 1993 Energy and Water Development Appropriations Bill. This report stated in part:

"The study will be conducted in close coordination with local water rights holders and will take into account existing agreements governing the operation of the Kings River. The study will not propose actions which would (1) interfere with existing Kings River water rights, storage rights or operations or (2) require any involuntary acquisition of water rights, storage rights or land."

To be consistent with this guidance, alternative plans must be formulated using resources available from willing sellers. The alternatives must not interfere with existing water, storage, or land rights.

Existing Water Resources Projects. Pine Flat Dam and other water resources projects have been constructed in the Kings River basin. These projects provide long-standing services including flood control, water supply, hydropower generation, and ground-water recharge. The alternatives for this study must not significantly affect the operations and functions of these existing projects and must work in conjunction with existing physical structures.

Laws, Regulations, and Policies. Numerous laws, regulations, Executive Orders, and policies must be considered. Among these are the National Environmental Policy Act, Endangered Species Act, Clean Water Act, and the National Historic Preservation Act. These and other applicable requirements are discussed in the EIS/EIR.

Criteria

Five criteria have been established to lend more specificity to the planning objectives and to provide a uniform set of guidelines for further formulation and evaluation. The first four criteria are required by the Economic and Environmental Principles and Guidelines for Water and Related Land

Resources Implementation Studies (P&G). The fifth criteria, environmental effects, is based on the P&G Federal objective of water resources project planning - "to contribute to national economic development consistent with protecting the Nation's environment...."

Completeness. Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planning objectives. To satisfy this criterion, each alternative should:

- Address one or more of the planning objectives.
- Be capable of consistently and reliably providing for restoration and protection of the ecosystem.
- Need no further actions to ensure complete fulfillment of plans for restoring and protecting fishery and wildlife habitat.
- Be capable of being physically implemented.
- Mitigate unavoidable adverse environmental effects as fully as is found to be reasonable and justified.

Effectiveness. Effectiveness is the extent to which an alternative plan alleviates the identified problems and primarily achieves the planning objectives. Several important factors in measuring effectiveness are:

- Improving water temperatures in Pine Flat Lake and downstream from Pine Flat Dam.
- Improving fishery habitat in the lower Kings River.
- Restoring riparian and SRA habitats along the lower Kings River.

Efficiency. Efficiency is the measure of the extent to which an alternative plan is the most cost-effective means of alleviating the identified problems while realizing the specified objectives, consistent with protecting the environment. It is measured by comparing estimated monetary costs and quantifiable benefits of the alternatives. Efficiency is demonstrated by:

- Obtaining the maximum habitat values for the least cost.

Acceptability. Acceptability is a the workability and viability of the alternative plans with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies. Two measures of acceptability are:

- Degree to which an alternative plan is supported by other Federal and non-Federal agencies, organizations, and the public.
- Be feasible from technical, environmental, economic, financial, political, legal, institutional, and social perspectives.

Environmental Effects. Two measures of environmental effects are:

- Minimizing disturbance to existing environmental resources.
- Increasing the amount and quality of the ecosystem restoration habitat.

RESTORATION MEASURES

During the reconnaissance phase of the study, the Corps, non-Federal sponsor, other agencies and organizations, and the general public identified a wide range of possible restoration measures. The reconnaissance report identified 10 potentially feasible measures to help restore the ecosystem habitat in the Kings River basin. Six measures provided fishery habitat restoration; one included both fishery and wildlife habitat restoration; and three measures would mainly provide wildlife habitat restoration. The measures included:

1. Raise Pine Flat Dam
2. Construct a multilevel intake structure
3. Construct a turbine bypass system
4. Construct a new storage facility on Mill Creek
5. Construct a water transfer pipeline
6. Restore spawning gravels
7. Restore Avocado Side Channel Slough
8. Construct small check dams at Flume Cove in Pine Flat Lake
9. Restore Byrd Slough Riparian and SRA Habitat
10. Restore lands on Westlake Farms

Through coordination with the Corps' South Pacific Division and the non-Federal sponsor, a systematic approach to investigate these measures was developed and incorporated into the Project Study Plan. The following paragraphs briefly describe each measure as well as the status of further consideration as potentially feasible measures.

Measure 1. Raise Pine Flat Dam

This measure consists of raising the Pine Flat Dam and spillway by 7 feet in order to benefit fish and wildlife. Raising the dam would increase the reservoir pool by about 15 feet. The increased reservoir pool would provide 93,000 acre-feet for a minimum pool. Water to fill the 93,000 acre-foot pool would be provided by the water rights holders from water that would otherwise be released during Corps-directed flood control releases.

Raising the gross pool would benefit the warm water fishery by increasing the reservoir surface area for greater spatial distribution, particularly in the spring and summer months. The increased storage area in the lake would improve the ability to maintain cooler temperatures for the coldwater fishery. Maintaining a minimum pool would also provide downstream habitat values in terms of spatial habitat and cooler water temperatures. Incidental hydropower generation would also increase as a result of holding a minimum pool.

While raising Pine Flat Dam would have environmental benefits, there would also be several adverse effects. First, riparian and SRA habitat upstream of the reservoir would be flooded about three-fourths mile up the Kings River for about 1 month in 20 percent of the years. Five recreation sites at Pine Flat Lake would be periodically inundated. About 295 acres of oak woodland, oak savannah, and nonnative valley grassland would be periodically inundated. Finally, the hydroelectric power plant that the Pacific Gas & Electric Company operates at the upstream limit of the reservoir would need to be modified to accommodate the increased reservoir elevation.

In addition, Pine Flat Dam is located in seismic zone 3, in which the potential hazard (damage capability) is considered to be major. The dam is currently scheduled to be evaluated for seismic integrity under a nationwide dam safety program.

This measure would partially meet the planning objectives of this study. However, because of the uncertainty regarding the safety of the dam at an increased lake level, study and construction costs, and significant adverse effects, the Corps and non-Federal sponsor agreed prior to initiation of the feasibility phase that this measure would not be pursued at this time. Therefore, this measure was not carried forward for further evaluation.

Measure 2. Construct a Multilevel Intake Structure

This measure consists of constructing a multilevel intake structure to fit over the three penstock intakes, which are located on the upstream face of the dam. The intake structure would provide the flexibility to withdraw water from various water levels within the reservoir to increase the survival rate for coldwater fish both in the lake and in the Kings River downstream of the dam. This would allow flexibility in managing and preserving the very cold water 10°C (50 °F) in the reservoir and prolonging the duration of suitable downstream water temperatures for coldwater fishery habitat. By withdrawing water from a higher elevation, the colder water at or near the elevation of the penstocks could be reserved for later in the irrigation season when reservoir water levels are lower and high downstream water temperatures are a limiting factor to the native coldwater fishery. This measure would also relieve problems in the lake associated with thermal stratification and depletion of the coldest water.

This measure would partially meet the planning objectives and was carried forward for further evaluation.

Measure 3. Construct a Turbine Bypass System

This measure consists of constructing a conduit system to the existing penstocks at Pine Flat Dam to allow for low flows to bypass the power plant turbines. This measure would allow greater flexibility in making releases at various water elevations by allowing releases through the penstocks when flows are less than the 500 to 600 cfs necessary to run the power plant.

This measure was recommended for investigation separately under Section 1135 of the Water Resources Development Act of 1986, as amended. Section 1135, as amended, states:

"(a) The Secretary [of the Army] is authorized to review the operation of water resources projects constructed by the Secretary to determine the need for modifications in the structures and operations of such projects for the purpose of improving the quality of the environment in the public interest.

"(b) The Secretary is authorized to carry out a program for the purpose of making such modifications in the structures and operations of water resources projects constructed by the Secretary which the Secretary determines (1) are feasible and consistent with the authorized project purpose, and (2) will improve the quality of the environment in the public interest . . . . " The water resources project which was reviewed was the Pine Flat Dam.

The Pine Flat Turbine Bypass, California, Habitat Restoration, Project Modification Report and Environmental Assessment" was completed in September 1996. On August 17, 1999, President Clinton signed the Water Resource Development Act of 1999. Title I, Section 105(b) of the Act states: "Pine Flat Dam, Kings River, California – Under authority of section 1135(a) of the Water Resources Development Act of 1986 (33 U.S.C. 2309(a)), the Secretary shall carry out a project to construct a turbine by-pass at Pine Flat Dam, Kings River, California, in accordance with the project modification report and environmental assessment dated September 1996."

This project is considered to be the first increment in an overall plan to manage the coldwater fishery resource in the lake and would partially meet the planning objectives. However, since construction of this project is scheduled to be completed under Section 1135, this measure is assumed to be a future without-project condition and was not carried forward for further evaluation.

Measure 4. Construct a New Storage Facility on Mill Creek

This measure consists of constructing a 650,000 acre-foot storage facility at Mill Creek. This would allow a permanent minimum pool of 300,000 acre-feet in Pine Flat Lake, which would benefit fish, wildlife, and recreation users. The minimum pool would reduce reservoir fluctuations, improving spawning success for fish in Pine Flat Lake. Releases from Pine Flat Dam would improve downstream spatial habitat for trout, improve water temperatures, and increase spawning areas. The pool would also encourage use of recreational facilities and opportunities at the lake.

Reservoir construction would degrade or destroy about 3,700 acres of upland habitat and inundate 15 miles of Mill Creek and 1.7 miles of tributaries. Loss of these resources would require significant mitigation for wildlife. The warm water fishery in Mill Creek would also be lost, as would spawning gravel habitat. About 175 residences and one commercial operation would need to be relocated. In addition, there are six cultural resources sites and five ethnographic sites located in the proposed study area.

This measure would partially meet the planning objectives. However, the estimated first cost for construction of Mill Creek Dam is $468 million. Due to its high cost, adverse environmental effects, and lack of local support, this measure was not carried forward for further evaluation.

Measure 5. Construct a Water Transfer Pipeline

This measure consists of facilitating a means of exchanging water from an out-of-basin source such as the CVP and/or SWP for water stored in Pine Flat Lake. The exchange would provide water to augment instream flows in part of Kings River below Pine Flat Dam in late summer and fall. However, there would be no net water change resulting from the exchange.

During the irrigation season, exchanged water from either the CVP and/or SWP would be delivered to a member unit of the KRWA with available CVP and/or SWP contracts. The member unit's water remaining in Pine Flat Lake which is scheduled to be released, but is not because of the exchange, would be stored for later release to augment flows in the lower Kings River during the critical trout stress period from September through November.

The exchanged water would flow through the lower Kings River to the Fresno Weir and then would be conveyed through the FID existing system of canals to the FID western boundary. From this point, a new underground pipeline would be constructed to carry the exchanged water to the Mendota Pool area for return to another CVP and/or SWP contractor. Using the FID existing system would minimize the construction of new facilities to complete the connection to the Mendota Pool area.

This measure could substantially benefit instream habitat through increased flows and lower water temperature in part of the Kings River downstream of Pine Flat Dam. Since the measure would partially meet the planning objectives, it was carried forward for further evaluation. Four potential pipeline alignments were considered.

Measure 6. Restore Spawning Gravels

This measure consists of creating several thousand square feet of new spawning gravels in the lower Kings River. Boulders would be installed in areas that have sufficient flow with adequate temperature and would create hiding and nesting cover for trout and other fish species in the river.

In the spring of 2000, the KRCD constructed its first trout and coldwater fishery spawning and rearing channel. It is located 5 miles downstream of Pine Flat Dam and is about 2,000 feet long. The channel was named as the Thornburn Spawning Gravel Project in honor of the landowners who granted an easement for the project. Other spawning gravel and rearing channels are planned in the future as components of the Kings River Fisheries Management Program. The State and local participants are fully committed to implementing other actions in this program without Federal participation. As a result, this measure was not carried forward for further evaluation even though it partially meets the planning objectives.

Measure 7. Restore Avocado Side Channel Slough

This measure is to construct inflow and outflow channels at Avocado Lake. Water from the Kings River would be diverted into the lake, run through it, and then flow back into the river. Avocado Lake is located adjacent to the Kings River about 7 miles downstream of Pine Flat Dam. The lake was formed in the 1950's by stone quarry excavation, which was used for the construction of Pine Flat Dam. The quarry subsequently filled with seepage from the river, creating an 83-acre lake. The lake is operated by the Fresno County Department of Parks and Recreation as a day-use park. In the original plan, riparian and

SRA revegetation, creating spawning areas in the outflow channel, and improving water quality and weed (water milfoil) control in the lake were also proposed.

After additional study, a more suitable site to create spawning habitat and riparian vegetation was located, and thus the project was relocated. This new site is a small, natural side channel adjacent to the Kings River. The side channel is located just downstream of Avocado Lake and is known as the Avocado Side Channel Slough. It is 3,960 feet long, 10 feet wide, and flows back into the river. River water enters the channel during high irrigation and flood releases. Restoration of this side channel would involve channel excavation for suitable depths and flows, head gate installation for flow control, gravel placement for spawning areas, addition of woody debris and rocks for fish cover, and the planting of riparian and SRA vegetation for shade, cover, and wildlife. The channel would also provide refuge for fish from the high river flows and rearing areas for juvenile fish.

This measure was recommended for investigation separately under Section 1135 or Section 206 of the Water Resources Development Act of 1986. As a result, this measure was not carried forward for further evaluation even though it partially meets the planning objectives.

Measure 8. Construct Small Check Dams at Flume Cove in Pine Flat Lake

This measure consists of constructing several small check dams within the reservoir pool to create spawning areas for fish when the lake levels are high. As the lake level recedes, the water left behind in the check dams would promote the growth of buttonwillows and other vegetation, which would benefit wildlife by providing vegetated corridors to access the water. This measure would most effectively be implemented in conjunction with raising Pine Flat Dam.

However, raising Pine Flat Dam is not being considered further due to the uncertainty regarding the safety of the dam at an increased lake level. Without an increased gross pool, the potential restoration benefits of check dams would likely not be significant. Therefore, this measure was not carried forward for further evaluation even though it partially meets the planning objectives.

Measure 9. Restore Byrd Slough Riparian and SRA Habitat

This measure consists of restoring riparian, wetland and SRA habitat on a publicly owned site along the lower Kings River downstream from the dam near the Friant-Kern Canal siphon. The site encompasses 143.5 acres of land owned by the Fresno County Department of Parks and Recreation which is bisected by Byrd Slough, a relatively natural side channel of the Kings River. Historically, about one-third of the parcel was cleared, leveled, ditches and checks built, and used as irrigated pasture. The land has been leased for cattle grazing in the past and is in a degraded condition. The U.S. Bureau of Land Management (Bureau) owns about 120 acres along the north edge of the property and 700 acres to the east, and plans to restore riparian and SRA habitat values on their parcels. Restoration at the Bureau site may include riparian forest and shrub, SRA, emergent marsh, and threatened and endangered species habitats. Restoration of the Byrd Slough site could include riparian, wetlands slough, and SRA habitat, emergent marsh, and special-status species habitats.

The Byrd Slough Riparian and SRA Habitat site is bisected by Byrd Slough and the Kings River. The western portion of the restoration site is sandwiched between Byrd Slough and the Kings River.

During most of the year there is water in the slough, and it is apparent from the standing water and existing vegetation that groundwater is close to the surface. The east side is bordered by pastureland, Alta Main Canal and Piedra Road. Vegetation in this portion consists mainly of open annual grasslands with a few valley oaks, one elderberry shrub, riparian vegetation along the open water areas, and a stand of mature cottonwood trees. There is well-established riparian vegetation along Byrd Slough and a thin band of riparian habitat along the Alta Main Canal. Also, there are water conveyance ditches and control structures that were previously used for irrigation.

The western portion consists primarily of annual grasslands with a few valley oaks. No existing irrigation structures are apparent in this area. Adjacent to Byrd Slough are remnants of aquatic vegetation.

Since this measure could substantially increase aquatic, riparian ecosystem habitat for fish and wildlife along the lower Kings River and partially meets the planning objectives, it was carried forward for further evaluation.

Measure 10. Restore Lands on Westlake Farms

This measure consists of restoring 1,280 acres of land owned by Westlake Farms in the Tulare Lake basin. Historically, this land was subject to periodic flooding, but no longer displays any wetland characteristics and consists of leveled agricultural land. Restoration would consist of restoring wetland and upland vegetation by moving surface waters onto the site and would require the construction of water conveyance and management features.

This measure would partially meet the planning objectives. However, because of potential high costs for conveyance facilities and management, lack of surplus surface water, and distance from the other measures (about 70 miles), this measure was not carried forward for further evaluation.

Summary

Of these 10 restoration measures, three were carried forward for further evaluation in the feasibility phase of the study, and two were considered further under Section 1135 or Section 206 of the Water Resources Development Act of 1986. The remaining five were either deferred or deleted from further evaluation (see Table IV-1 and Plate 11).

Table IV–1. Summary of Measures

Measures Evaluated	Status	Comments
1. Raise Pine Flat Dam	Not carried forward	Uncertainty of safety
2. Construct a multilevel intake structure	**Carried forward**	**Further evaluation**
3. Construct a turbine bypass system	Not carried forward	Section 1135 study
4. Construct a new storage facility on Mill Creek	Not carried forward	High cost
5. Construct a water transfer pipeline	**Carried forward**	**Further evaluation**
6. Restore spawning gravels	Not carried forward	Local projects
7. Restore Avocado side channel slough	Not carried forward	Section 1135 or 206 study
8. Construct small check dams at Flume Cove in	Not carried forward	Uncertainty of gross pool

Pine Flat Lake		elevation and safety
9. Restore Byrd Slough Riparian and SRA Habitat	**Carried forward**	**Further evaluation**
10. Restore lands on Westlake Farms	Not carried forward	Lack of surplus surface water and too far from project area

SELECTED MEASURES

Three measures (2, 5, and 9) were carried forward as selected measures: 2. Construct a multilevel intake structure, 5. Construct a water transfer pipeline, and 9. Restore Byrd Slough riparian and SRA habitat. This section describes the evaluation to determine the most feasible selected measures to develop into alternative plans.

Selected Measure 2. Construct a Multilevel Intake Structure

Water Temperature Modeling. This selected measure involved the use of a calibrated CE-QUAL-W2 computer model developed for Pine Flat Reservoir by KRCD to evaluate water temperatures in the reservoir and downstream releases through a proposed multilevel intake structure design. The CE-QUAL-W2 computer model used 1988 for dry water year, 1992 for critically dry water year, and 1994 for normal water year. The temperatures were taken at a bridge 0.5 mile below Pine Flat Dam and Fresno Weir for these years (see Figures 1 and 2). This computer model analysis is described in Appendix C.

USFWS WUA (Weighted Usable Area) Analysis. The USFWS used an aquatic HEP analysis, PHABSIM AND SNTEMP, to determine the habitat units in weighted useable area (WUA) for coldwater fish. Rainbow trout was used as the indicator species for the coldwater fishery in this study due to the extensive studies, modeling and large amount of available information on this species. The weighted usable area, WUA, is defined as the amount of usable habitat in a river for juvenile, adult, and other life cycle stages of rainbow trout based on association between fish and average water velocities, depths, and substrate size, expressed as habitat suitability curves. Changes in the WUA as a function of water discharge and the closely related variable river channel width can be used to illustrate the importance of discharge to different life cycle stages of rainbow trout in maintaining diversity in channel form and flow. Several life stages of rainbow trout were used as an evaluation species in the 1998 aquatic HEP analysis.

The WUA are aquatic habitat units from an Instream Flow Incremental Methodology (IFIM) study and are similar to, but not comparable with, HU's or AAHU's in HEP, which are terrestrial habitat units (Brian Cordone, USFWS, personal communication, 2000). The primary differences are that in IFIM, a) there is no time function because the value changes are instantaneously effected by flow and derivative factors (temperature), and b) the suitability indices for depth, substrate, and flow, are site-specific. IFIM also takes advantage of hydraulic principles to simulate WUA over a range of discharges from field measurements at several points, but the principle is the same as HEP: take an area and weight it by an index. A modification of IFIM to further adjust WUA by a temperature-based preference factor is ideally suited to the proposed multi-level intake structure because of the available model predictions for reservoir outlet temperature, downstream temperature, and physical habitat (unadjusted WUA) from the 1991 Trihey IFIM study. (Steve Schoenberg, USFWS, memo, 2001)

The WUA and related models are well-known for use in aquatic interface/flood plain areas. The model used for the Pine Flat evaluation has been in use for over 25 years and is well documented as to appropriateness and satisfactory use in riverine environments. Further, this model was selected for use in the evaluation of alternatives because it effectively incorporates aspects such as water quality, changes in flow and related temperature, and habitat areas/types using Instream Flow Incremental Methodology. This model was developed around trout as an indicator species. Since other aquatic species benefit from trout type habitat and the trout model is well documented, it was agreed that use of the WUA model as a measurement for restoration outputs is appropriate.

Sustainability. Under the proposed multilevel intake structure measure, the coldwater fisheries would be sustained for about 13 miles downstream of Pine Flat Dam during normal flow periods and for at least 6 or 7 miles downstream of the dam during the worst-case critical dry year periods in the August through October time frames. In the without-project condition, there is no habitat value in either dry or critically dry years due to outlet temperatures above the survival threshold for coldwater fish for periods of weeks. A very minimal amount of habitat remains in normal years. With the multilevel intake structure, habitat value would be greatly improved at the onset of summer relative to the baseline. The multilevel intake structure does allow a portion of the river to remain viable for trout and other coldwater fish throughout the summer period. Sustainability is expected for all water year types with the multilevel intake structure alone, including critically dry years.

Other benefits of the multilevel intake structure would occur; for example, water temperature blending for species that do poorly in extremely cold conditions, improved sustainability of the native coldwater fishery in the lake and in the Kings River downstream of the dam, fishery, improved aquatic habitat for coldwater fishery, improved food source for the fishery, reduction in the habitat for nonnative fish and their survival, and improved floodplain and aquatic ecosystem in the Kings River watershed.

Ecosystem Benefit. Without the water temperature modification of the multi-level intake structure, the current tailwater fishery is subjected to extreme temperature changes, which could eliminate the native coldwater fishery in favor of a variety of more temperature tolerant nonnative species (see Appendix B). Temperature modification can have widespread benefits to a variety of riverine species including coldwater fish species, and have greater benefits to other fish species tolerant of slightly higher temperatures.

Port Configuration Analysis. This CE-QUAL-W2 model was then used to conduct a port configuration analysis to evaluate the structure and hydraulic design of the multilevel intake structure. The detailed analysis is included in the document entitled "Port Configuration Analysis, Multi-Level Intake Structure, Pine Flat Dam Fish and Wildlife Habitat Restoration Investigation," by KRCD, March 5, 1999. The work included determining the number and elevation of intake openings or withdrawal ports that would optimize the structure's release temperature effectiveness.

Seven different port configuration designs were evaluated (see Table IV-2). With the three straight 9-port configurations, the computer model projected a 6- to 10-degree C temperature change when releases were switched from port to port. Such a sudden change in water temperatures would result in reduced potential WUA benefits and could be detrimental to trout survival. With the 11 staggered 9-port configurations, the model showed no similar temperature change with port switches. All of the configurations appeared to effectively manage release temperatures, but the configuration which provided the maximum WUA was

determined to be elevation placement 857.5, 829.5, 801.5, 773.5, 745.5, 717.5, 652.5 lowest port. Two 12-port configurations were also evaluated. Although the model showed that these configurations provided more flexibility in terms of releases, they did not provide any additional WUA, and both had increased costs. Finally, a 21-port configuration was evaluated, but determined to be impractical in terms of existing available space, even higher costs, and no increase in WUA. The best 9-port staggered configuration for providing optimum temperatures for coldwater fishery survival rate in the lake and downstream of the dam is shown in Plate 12.

Incremental Analysis. An Incremental Analysis was performed with the assistance of the Corps' Institute for Water Resources (IWR) to identify the port configuration, which was most cost effective; that is, provided the maximum number of fishery benefits (expressed as WUA) at the least cost. The analysis used the costs for the various straight and staggered port configurations and elevations included in KRCD's 1999 analysis.

The costs per WUA for the various port configuration designs were then determined to identify the selected port configuration. As highlighted in Table IV-2, the staggered 9-port configuration, which provided the maximum WUA was also found to be most cost effective, providing 40 WUA at a cost of $0.98 million per WUA (see Appendix D).

Table IV-2. Incremental Analysis for Multilevel Intake Structure

Port Configuration Design (ports)	WUA	Cost ($million)	Cost/WUA ($million)	Average Annual Cost ($million)	Port Configuration (Elevation placement in feet)
0 (C0)[1]	0	0	0	0	0
9 (C1)	10	39.135	3.91	2.67	Straight 850, 750, 652.5
9 (C2)	20	39.135	1.96	2.67	Straight 870, 750, 652.5
9 (C3)	30	39.135	1.30	2.67	Straight 900, 760, 652.5
9 (C4)	40	39.135	0.98	2.67	Staggered 857.5, 829.5, 801.5, 773.5, 745.5, 717.5, 652.5 lowest port.
12 (C5)	40	52.18	1.30	3.54	Straight 910, 810, 730, 652.5
12 (C6)	40	52.18	1.30	3.54	Staggered
21 (C7)	40	91.31	2.28	6.15	Staggered

[1] The designation of C0 to C7 was used in the incremental analysis evaluation.

Selected Measure 5. Construct a Water Transfer Pipeline

Conveyance of Water through FID. The preliminary analysis first involved deciding on the most efficient route to convey the exchange water through the FID system of canals. Several meetings were held with FID to discuss their system and how the system could most effectively be used for conveyance. A total of seven alternative conveyance routes through FID were analyzed. From this analysis, it was determined that a route using FID's Dry Creek Canal system afforded the best means to

convey the water from their head gate on the Kings River through their system to an area near their western boundary from which a pipeline could be constructed to the Mendota Pool area.

Potential Pipeline Alignments - FID to Mendota Pool. An alignment then had to be selected from a point on the FID system to provide a connection to the Mendota Pool area. Four potential alignments were evaluated to determine the best alignment connecting FID's Dry Creek Canal system to the Mendota Pool area. Base map information was compiled along a 3-mile-wide corridor of land from Jensen Avenue on the north to American Avenue on the south.

Selected Measure 5.1

Alignment A - Malaga Avenue Alignment. Adjacent to this alignment both to the north and to the south are open fields used for agricultural production. The most common crops are grapes, almonds, alfalfa, and cotton. The Fresno County American Avenue Landfill is located south of Malaga Avenue at Lake Avenue. The County of Fresno will not allow pipelines to cross the landfill. Therefore, the pipeline would need to be diverted around the landfill. The County has also recently acquired additional land for future expansion of the landfill. There are areas of subdivided land zoned for private residential development. A large number of individual landowners may make it difficult to secure right-of-way easements.

Selected Measure 5.2

Alignment B - Central Avenue Alignment. There is an irrigation canal on this site at Central and Howard, which runs in an east-west direction. The land is presently in agricultural production.

Selected Measure 5.3

Alignment C. The pipeline for this alignment would be 14.5 miles in length; therefore, it is substantially more costly than the other alignments. This was the only alignment that had an outlet directly into the east boundary of the Mendota Wildlife Refuge Area, but DFG did not consider this a significant advantage.

Selected Measure 5.4

Alignment D. Two miles of this alignment are constrained by existing buried FID pipeline facilities. Due to the existing constraints along this alignment, it was never seriously considered. Therefore, field reconnaissance was not conducted.

Due to the restrictions posed by the County landfill and future residential development, Alignment A alone was eliminated from consideration. Alignment C was not selected because the overall cost was too high. A combination of Alignments A and B (selected measures 5.1 and 5.2) was carried forward for further evaluation as an alternative (see Plate 13).

USFWS WUA (Weighted Usable Area) Analysis. A similar WUA analysis to the multilevel intake structure was used for evaluating the water transfer pipeline.

Incremental Analysis. Both terrestrial and aquatic benefits were evaluated for the four pipeline alignments. The terrestrial benefits were determined using USFWS's HEP analysis. The results indicated that the terrestrial benefits for each alignment were only about 1 AAHU. Since the potential terrestrial benefits were small and did not vary among the alignments, the analysis focused on the aquatic benefits.

The Incremental Analysis was performed to identify the pipeline alignment, which was most cost effective; that is, provided the maximum number of fishery benefits (expressed as WUA) at the least cost. The construction costs for the four pipeline alignments were determined by the Corps. The WUA were derived by the USFWS using the same methodology as with the multilevel intake structure.

The evaluation indicated that all four alignments resulted in about 18 WUA (see Table IV-3) so the determining factors for selection were construction costs, constraints on implementation, and any potential unknown costs. Although alignment A had the lowest cost, it was not considered further when it was determined that it would go through an existing landfill and pose potential HTRW problems. In addition, several landowners along alignment A were unwilling to provide lands for right-of-way easements. Alignment B was not considered further due to potential constrained with crossing an existing irrigation canal. Both alignments C and D had higher construction costs with the increasing lengths of the pipelines, and alignment D was constrained by existing underground pipeline facilities.

Since none of the alignments alone were feasible, an alignment was developed to include part of alignment A and part of alignment B. The landfill and adjacent landowners were avoided, as well as the irrigation canal. A cost per WUA of $1.98 million was determined for the combination of A and B, which is highlighted as the selected alignment in Table IV-3.

Table IV-3. Incremental Analysis for Water Transfer Pipeline

Pipeline Alignment	WUA	Cost ($million)	Cost/WUA ($million)	Average Annual Cost ($million)	Pipe Line Alignment (length in miles)
0	0	0	0	0	0
A	18	31.86	1.77	2.18	9.5
B	18	34.21	1.90	2.33	10.2
A & B	18	35.553	1.98	2.42	10.6
C	18	48.63	2.70	2.30	14.5
D	18	38.57	2.14	2.63	11.5

Selected Measure 9. Restore Byrd Slough Riparian and SRA Habitat

Restoration Designs. Three designs were considered to evaluate various levels of intensity by which restoration could occur. (These three designs were selected based on the results of a detailed cost effectiveness and incremental cost analysis of eight possible restoration designs. This incremental analysis is discussed further in Appendix D. Each design would have a different habitat restoration value and cost.

Selected Measure 9.1

This selected measure would consist of repairing perimeter fences, installing revegetation signs and installing wildlife habitat enhancement structures at the proposed Byrd Slough riparian and SRA habitat site. This selected measure meets some of the ecosystem restoration objectives and would have some habitat value. However, since success of natural regeneration depends on environmental factors, this design would take significantly longer to achieve the ecosystem restoration objective of increasing riparian and SRA habitat than the other measures. The success rate for this selected measure might not be achievable without the assistance of additional planting and irrigation in the future. This selected measure was carried forward for Incremental Analysis purposes.

Selected Measure 9.2

This selected measure is the same as selected measure 9.1 and also includes moderate planting and irrigation to establish the vegetation at the proposed Byrd Slough riparian and SRA habitat site. The benefits of this selected measure include fencing of the site to prevent further cattle damage to the vegetation, moderate planting of vegetation to replace the vegetation lost due to cattle grazing and other human disturbance, and designing and constructing an irrigation system to establish the vegetation and promote quick habitat value benefit and overall aquatic floodplain ecosystem benefit. The irrigation offsets the cost of higher planting density without irrigation. This selected measure meets the ecosystem restoration objective, has the greatest habitat value, and was carried forward for further consideration.

Selected Measure 9.3

This selected measure is the same as selected measure 9.1 and also includes intensive planting restoration species at the proposed Byrd Slough riparian and SRA habitat site. Without the benefit of irrigation in the first 3 to 5 years, higher density of planting is required in the initial planting to provide some survival of the riparian and SRA vegetation. This selected measure meets some of the ecosystem restoration objectives and would have some intermediate habitat value. As a result, this selected measure was carried forward for further evaluation.

Incremental Analysis. An Incremental Analysis was performed with assistance from the Corps' IWR to identify which of the three restoration designs was most cost effective; that is, provided the maximum number of terrestrial benefits (expressed as AAHU) at the least cost. The costs for the three restoration designs were determined by the Corps. The terrestrial benefits were determined using USFWS's HEP analysis.

The incremental analysis involved evaluating four different methods of ecosystem restoration to the Byrd Slough site. A0 is for no fencing, no wildlife structures, no planting, and no irrigation. A1 is for fencing, revegetation signs, and wildlife structures. A2 is for fencing, signs, wildlife structures, moderate planting, and irrigation. A3 is for fencing, signs, wildlife structures, and high density planting without irrigation.

The resulting incremental analysis indicated that the highest cost was A3 with the high density planting to offset losses due to lack of irrigation. The least complex design of A1 was determined to be the most cost-effective design. However, this design would depend on natural environmental factors and could take more than 20 years to meet the project objectives of increasing riparian and SRA habitats, and

reestablishing native historic plant and wildlife communities along the lower Kings River. The "best buy" plan with the most habitat values gain was A2 with irrigation to establish the vegetation.

As a result, the best buy plan A2 was the selected design, providing about 84.56 AAHU's at a cost of $11,329 per AAHU. This design is highlighted in Table IV-4 and Appendix D.

Table IV-4. Incremental Analysis for Byrd Slough Habitat Restoration

Restoration Design	AAHU	Total Cost $	Cost/AAHU $	Average Annual Cost $	Restoration Features
A0	19.53	0	0	0	None
A1	42.39	112,050	2,643	7,484	Fence, signs and structures
A2	84.56	958,000	11,329	64,000	Fence, signs, structures, moderate plantings, and irrigation
A3	77.38	1,274,900	16,475	85,151	Fence, signs, structures, and high intensity planting

ALTERNATIVE PLANS

Based on the three selected measures carried forward for further evaluation, eight alternative plans were formulated. The eight plans represent individual measures and combinations of measures and show that restoration of fishery and wildlife habitat and the floodplain ecosystem can be accomplished by constructing a multilevel intake structure, building a water exchange pipeline to increase flows, restoring Byrd Slough riparian and SRA habitat, and combinations of the three alternatives. A no action alternative was also included as a basis of comparison. These alternatives are described below and are shown on Plate 14.

Alternative 1 - No Action

Under this alternative, the Corps would not participate in the ecosystem restoration project in the study area. This alternative is the same as the future without-project conditions discussed in Chapter II. The releases from the dam would not change, and the adverse effects of low storage, seasonal stratification, and high water temperatures on fisheries would continue, resulting in the continued decline of coldwater fishery both in the lake and in the river below the dam. Habitat for wildlife would continue to be limited along the lower Kings River. The no action alternative provides a baseline to evaluate the effects of all other alternatives.

However, as discussed under ongoing activities in Chapter I, KRCD, KRWA, and DFG are involved in a cooperative voluntary program to balance fishery needs with other beneficial uses of the Kings River. Under the Kings River Fisheries Management Program, these agencies have implemented, or intend to implement, several actions including the establishment of a 100,000 acre-foot temperature control pool within the reservoir, increasing minimum flows, fish stocking program, and fishery habitat

improvement, public education and involvement, public access improvements, and regulating fishing along the lower Kings River.

The establishment of these cooperative voluntary programs under the Kings River Fisheries Management Program would not be able to accomplish the overall goal of ecosystem restoration of the lower Kings River watershed unless one or more of the alternatives below is implemented.

Alternative 2 - Multilevel Intake Structure

The multilevel intake structure would be constructed on the upstream face of the dam (see Plates 11 and 15). The multilevel intake structure would consist of three separate steel (space frame) structures which extend from elevation 953.46 feet, mean sea level (msl), downward to elevation 616.5 feet, msl. The three separate steel structures would fit over the three existing power penstock intakes. Each of the three structures would have three port openings and gates. There would be a hoist and cable unit (including a motor) for each of the nine openings. The three port openings would be 25 feet high and 42 feet wide and would be staggered at seven different elevations that would permit selective withdrawal of water from a wide range of levels in the reservoir.

The 27-foot-high by 44-foot-wide steel gates would be constructed to close off each of the new port openings. One gate on all three of the structures would be at the same elevation, and two gates on each of the structures would be at different elevations. The gates would open in the downward direction and would sit in a structural channel when completely open. This design would take the gate loadings off the hoist cable. Cladding would be placed on the space frame to enclose each of the structures. Steel plates would be put on the bottom of each of the space frame structures to prevent water from leaking into each structure. A trash rack would be placed on the front face of each of the structures to prevent any large debris from entering the port openings and to protect the structure.

This alternative would allow water at various elevations and temperatures in the reservoir to be combined when released through the dam to the downstream channel. Mixing water from various elevations in the reservoir would preserve the cold water in the reservoir and promote downstream water temperatures suitable to sustain the coldwater fishery throughout the year, especially in the late summer and fall when the cold water can become depleted. As shown on Plate 16 for the critically dry year, without a temperature control pool, the water downstream of the dam would exceed critical temperatures for coldwater species survival. As shown on Plate 17 depicting the year 1992, with the multilevel intake structure and adjusted minimum reservoir temperature control pool of 100,000 acre-feet, the structure is capable of limiting release temperatures to a maximum of 18 °C (64.4 °F). In the wet year of 1993, because of the high volume of very cold snowmelt runoff entering the reservoir, there is minimum need to adjust the multilevel intake structure for the fishery downstream (see Plate 18). The temperature below the reservoir can be maintained below 17 °C (62 °F). In the normal to slightly below normal year of 1994, the multilevel intake structure is capable of maintaining the temperature at no more than 18 °C (64.4 °F) (see Plate 19). Additional details are included in Section 5 of Appendix C.

As stated in the selected measures, the multilevel intake structure would provide some fishery sustainability for all water year types, including critically dry years.

Alternative 3 - Water Transfer Pipeline

A combination of Alignments A and B was identified as the alignment that would best meet the planning criteria. The underground pipeline would consist of a 78-inch-diameter reinforced concrete pipe, which would extend 10.6 miles from the western portion of the FID's Dry Creek Canal to a section of the James Bypass located at the upper end of the Mendota Pool (see Plate 13). The top of the pipeline would be about 8.5 feet below the ground level, and the bottom would be about 15 feet below ground level.

The pipeline would begin at an existing check structure along Dry Creek about 310 feet east of the intersection of Howard and Central Avenues. The pipeline would travel west along Central Avenue and then turn south at Plumas Avenue and travel to Malaga Avenue where it would turn west. The pipeline would continue west along Malaga Avenue, thereby avoiding a subdivided residential area. A 55-foot siphon would be constructed under Ranch Canal, and the pipeline would terminate at the Fresno Slough flood channel (James Bypass) near the southern end of the Mendota Pool near El Dorado Avenue. The pipeline would have a 65-foot construction easement.

The water transfer facilitated by the pipeline would augment instream flows in part of the lower Kings River during the late summer and fall when flows are usually at their lowest level. Currently, flows in the lower Kings River during the fall range from 50 cfs to 100 cfs. Flows could be increased by 180 cfs via this exchange of water in part of the river. This alternative would benefit the coldwater fishery, provide an alternative means to meet water delivery needs in the San Joaquin Valley, and provide water to the Mendota Pool when it is most beneficial. The project is expected to enhance and restructure the timing of deliveries, and shorten delivery travel time and distance, thereby reducing conveyance losses due to evaporation and seepage. However, there would be no net water change due to the exchange.

The water transfer pipe alternative without the multilevel intake structure would provide periods of increased water flow downstream of the dam, but the water temperature would not necessarily be optimum for coldwater fish survival.

Alternative 4 – Byrd Slough Habitat Restoration

About 143.5 acres of Fresno County land downstream from the dam immediately south of the Friant-Kern Canal siphon would be acquired in fee title to reestablish riparian and SRA vegetation and wildlife habitat along the Kings River (see Plates 20 and 21). Figures 3 and 4 show existing riparian habitat at the site. The restoration work would involve repairing perimeter fences, installing revegetation signs at the fishing access parking area, fencing to exclude cattle from the restoration areas, planting restoration species (250 plants per acre), designing and constructing a system to irrigate the planted areas, and installing wildlife habitat enhancement structures. In order of priority, these structures could include brush piles, bluebird boxes, bat boxes, raptor perches, wood duck boxes, and/or songbird perches.

Figure 3. Byrd Slough Habitat Restoration Area south east of Byrd Slough.

Figure 4. Byrd Slough Habitat Restoration Area west of Byrd Slough and along Kings River.

Repairing perimeter fences would exclude cattle grazing from the site and would allow some natural revegetation of the restoration site. The revegetation signs would inform the public that an ecosystem restoration project is in progress and that riparian and SRA plants need to be protected. Planting and irrigating restoration species would help to maintain and preserve the aquatic wetland ecosystem along the Kings River.

The Byrd Slough area historically was part of the Kings River/ Byrd Slough flood plain and was primarily aquatic wetland and riparian in nature prior to construction of Pine Flat Dam. The proposed ecosystem habitat restoration would restore the lost riparian and SRA vegetation and seasonal and permanent wetlands that historically occurred in this area. The restoration of this site would provide a linkage of the Kings River to the historical flood plain. Restoration would create conductivity of the riparian and SRA system to the slough, groundwater and small ponds, and provide an improved ecosystem for fish and wildlife in the lower Kings River watershed.

The diversity of plant species in this community provides a variety of foods and microhabitats for fish and wildlife. The SRA habitat would help in reducing the Kings River water temperatures for coldwater fish, and the vegetation and overhanging tree limbs would provide refuge for juvenile fish from predators. The riparian vegetation would also provide refuge, food, and shelter for wildlife. The irrigation system would promote quicker regeneration of native species.

Alternative 5 - Combined Alternatives 2 and 3

This alternative would involve combining alternatives 2 (Multilevel Intake Structure) and 3 (Water Transfer Pipeline). The combination would benefit the survival rate for the coldwater fishery in the lower Kings River, where flows during later months of the year can stress the fishery due to decreased water supply and higher water temperatures. Since the turbine bypass is assumed to be in place, the combined alternative would allow better temperature control during below normal water years.

Under this alternative, the multilevel intake structure would allow greater flexibility in providing colder temperatures in the Kings River for longer durations and distances, thereby reducing thermal stress on the fishery during warmwater releases in below-normal water years. The multilevel intake and the pipeline would provide an added benefit to the turbine bypass effect of sustaining the fishery in dry water years. With the pipeline, water from the CVP and/or SWP would be made available to meet irrigation demands in the downstream portion of the Kings River Service Area during June, July, and August. Then, as a result of a water transfer, KRCD would release water from Pine Flat Dam later in the year to augment flows for fish in part of the lower Kings River in the critical late summer and fall months of September through November. Together, the combined alternative would provide the needed temperatures and flows to benefit a variety of fish, especially the coldwater fishery, downstream of the dam.

The combination of multilevel intake structure and water transfer pipeline would provide increased and improved habitat for the fishery in Pine Flat Reservoir and 13 miles of the Kings River downstream of Pine Flat Dam.

The combination of multilevel intake structure and water transfer pipeline would result in greater and more extended habitat values than the multilevel intake structure or water transfer pipeline individually, and would promote better spawning habitat downstream.

Alternative 6 - Combined Alternatives 2 and 4

This alternative would involve combining alternatives 2 (Multilevel Intake Structure) and 4 (Byrd Slough Habitat Restoration). The combination would benefit the ecosystem of the lower Kings River by restoring historic floodplain habitat values and benefit fish and wildlife by improving the sustainability of the fishery during later months of the year when the fishery can be stressed by higher water temperatures.

Under this alternative, the multilevel intake structure would allow greater flexibility in providing colder temperatures in the Kings River for about 13 miles below the dam, thereby reducing thermal stress on the fishery during warm water releases in below-normal water years. The multilevel intake structure would provide the needed temperatures and flows to benefit the survival of a variety of fish, especially the coldwater fishery, downstream of the dam. Riparian and SRA habitat restoration would increase vegetation along the existing riparian corridor, link the Kings River to the historic flood plain of Byrd Slough, and improve conductivity of the surface water of Byrd Slough and Kings River to the ground water.

The combination of multilevel intake structure and Byrd Slough habitat restoration alternatives would provide sustainability for a variety of fish and wildlife, and increased and improved riparian and

SRA habitat for the fish and wildlife in Pine Flat Reservoir and 13 miles of the Kings River downstream of Pine Flat Dam. The combination would also increase the ecosystem habitat values for the lower Kings River watershed.

Alternative 7 - Combined Alternatives 3 and 4

This alternative would involve combining alternatives 3 (Water Transfer Pipeline) and 4 (Byrd Slough Habitat Restoration). The combination would benefit the habitat for fisheries in the lower Kings River where flows during later months of the year can stress the fisheries due to decreased water supply and higher water temperatures. Since the turbine bypass is assumed to be in place, it would allow better temperature control during below normal water years.

The pipeline would provide a benefit to the turbine bypass effect of sustaining the fishery in dry water years. Water from the CVP and/or SWP would be made available to meet irrigation demands in the downstream portion of the Kings River Service Area during June, July, and August. KRCD would release water from Pine Flat Dam later in the year to augment flows for fish in part of the lower Kings River in the critical late summer and fall months of September through November. Riparian and SRA habitat restoration would increase vegetation along the historic floodplain corridor, improving wildlife habitat and adding shade for the aquatic environment.

The combination of water transfer pipeline and habitat restoration alternatives would provide increased and improved habitat for the fish and wildlife in Pine Flat Reservoir and 13 miles of the Kings River downstream of Pine Flat Dam. The combination would also increase habitat values at the restoration site.

Alternative 8 - Combined Alternatives 2, 3, and 4

This alternative would involve combining alternatives 2 (Multilevel Intake Structure), 3 (Water Transfer Pipeline), and 4 (Byrd Slough Habitat Restoration). The combination would benefit the survival of the coldwater fishery in the lower Kings River where flows during later months of the year can stress the fisheries due to decreased water supply and higher water temperatures. Since the turbine bypass is assumed to be in place, the combined alternative would allow better temperature control during all water years.

Under this alternative, the multilevel intake structure would allow greater flexibility in providing colder temperatures in the Kings River for longer durations and distances, thereby reducing thermal stress on the fishery during warm water releases in below-normal water years. The multilevel intake and the pipeline would provide an added benefit to the turbine bypass effect of sustaining the fishery in stressful dry water years. With the pipeline, water from the CVP and/or SWP would be made available to meet irrigation demands in the downstream portion of the Kings River Service Area during June, July, and August. Then, as a result of a water transfer, KRCD would release water from Pine Flat Dam later in the year to augment flows for fish in part of the lower Kings River in the critical late summer and fall months of September through November. Together, the combined alternative would provide the needed temperatures and flows to benefit a variety of fish, especially the coldwater fishery downstream of the dam. Byrd Slough habitat restoration would increase vegetation along the historic floodplain corridor, improve the SRA habitat, provide linkage of the Kings River to the flood plain at Byrd Slough, link the

surface water of Kings River and Byrd Slough to the groundwater to promote aquatic habitat values, enhance survivability of a variety of fish and wildlife species and improve the overall ecosystem of the lower Kings River watershed.

The combination of multilevel intake structure, water transfer pipeline, and Byrd Slough habitat restoration alternatives would provide increased and improved ecosystem habitat for the fish and wildlife in Pine Flat Reservoir and 13 miles of the Kings River downstream of Pine Flat Dam. The combination would also increase habitat values for the lower Kings River watershed.

EVALUATION AND COMPARISON OF ALTERNATIVES

Criteria

Alternative 1 - No Action

Completeness. This alternative would not meet the objective of increasing ecosystem habitat values for fish and wildlife.

Effectiveness. This alternative would not alleviate the identified problems.

Efficiency. This alternative would provide up to 19.53 AAHU ecosystem habitat values at the Byrd Slough site, but the existing habitat values could continue to decline.

Acceptability. This alternative is not acceptable because it does not provide any restoration benefits to fish and wildlife resources. Under this alternative, fish and wildlife would continue to decline in the study area. The native coldwater fishery could be lost or become extinct with continued unsuitable water temperature releases and low water flow.

Environmental Effects. Existing environmental resources would continue to be degraded or lost as a result of cattle grazing, and potential urban, residential, commercial, and/or industrial development.

Alternative 2 - Multilevel Intake Structure

Completeness. The multilevel intake structure would reduce water temperatures in Pine Flat Lake and instream temperatures during part of the year in the lower Kings River. The reduced water temperatures would reduce conditions that threaten fish and wildlife habitat. Fishery conditions would be improved in Pine Flat Lake, and fishery habitat would be improved in the lower Kings River. The multilevel intake structure would also increase the volume of coldwater fishery spatial habitat in the lake with appropriate levels of dissolved oxygen through selective withdrawals from various levels in the reservoir pool. Fishery sustainability is expected for all water year types with the multilevel intake structure alone, including critically dry years.

Effectiveness. The multilevel intake structure is effective in controlling water temperatures in Pine Flat Lake and the lower Kings River and would provide fishery sustainability for all water year types, including critically dry years. In order to evaluate the performance of the multilevel intake structure and

determine if it is capable of warming the spring and cooling the fall releases, years 1992 (critically dry), 1993 (wet), and 1994 (below average) were modeled.

For 1992, spring releases were warmed by 5 °C (41 °F). Late summer releases were cooled slightly. There was an additional 14 days of 18 °C (64.4 °F) or cooler releases as a result of the structure. The 1992 model as shown in Plate 17 included the 100,000 acre-foot temperature control pool as a pre-project condition. For 1993, the data were modeled to determine if warmer spring and summer releases could be obtained, and it was found that spring and summer flows through the structure were slightly warmer. For 1994, the release temperatures exceeded 18 °C (64.4 °F) by August 7 and reached a maximum 20 °C (68 °F) by August 20. Modeling of the multilevel intake structure showed an increase in the spring and early summer release temperatures of up to 4 °C (39 °F) while late summer and early fall release temperatures were maintained at no more than 18 °C (64.4 °F).

For the 1992 model year in Plate 16, there was so little water in storage that preserving a cooler hypolimnion for later release was not possible. But as a result of the 100,000 acre-foot temperature control pool as a pre-project condition as shown in the 1992 model on Plate 17, the temperature did not exceeded 18 °C (64.4 °F). During 1993, due to high volumes of very cold snowmelt runoff entering the reservoir, there was a shallow warm epilimnetic layer. Top port withdrawals were not practical due to the shallow epilimnetic layer. (See Plates 16, 17, 18, and 19 for release temperatures for the years 1992, 1993, and 1994.)

Efficiency. The first cost for this alternative is $35,000,000; the investment cost is $39,135,000; and the habitat value gained is 40 WUA. See Tables IV-2, IV-5, IV-6, IV-7, IV-9, IV-12, IV-15, and IV-16.

Acceptability. The multilevel intake structure meets all feasibility criteria. There is strong local support, and the non-Federal sponsor is willing to participate in this alternative provided that the sponsor is able to obtain financing for their share of the cost to construct the structure.

Environmental Effects. Wildlife including the bald eagle, prairie falcon, and spotted bat may experience temporary disturbance and/or displacement due to construction noise and activity for a period of about 24 months. However, any displaced species would be expected to return to the area once construction is completed.

Alternative 3 - Water Transfer Pipeline

Completeness. The water transfer pipeline would facilitate a water transfer or exchange which would allow water to remain in Pine Flat Reservoir during the summer and then be released downstream during the fall. This would benefit instream spatial habitat through increased flows and lower water temperatures in the lower Kings River. The water, which would remain in Pine Flat Reservoir, would also help preserve the cold water in the lake during the summer months.

Effectiveness. The water transfer pipeline is effective in transferring water without losses due to evaporation since it is an underground concrete structure. The pipeline would effectively transfer water for beneficial use without affecting the total quantity of water available. River flows for fish in part of the lower Kings River would be augmented and instream spatial habitat would be increased.

Efficiency. The first cost for this alternative is $31,900,000; the investment cost is $35,553,000; and the habitat values gained are 18 WUA (Weighted Usable Area) and 1 AAHU (Average Annual Habitat Unit). See Tables IV-3, IV-5, IV-6, IV-7, IV-10, IV-13, IV-15, and IV-16.

Acceptability. The water transfer pipeline is economically infeasible. The estimated construction costs are very high, and the pipeline would provide relatively few benefits. In addition, there is the potential for significant adverse effects on vernal pool/alkali scald habitat and special-status species along the pipeline. Due to these high costs and potential adverse effects, the Corps and non-Federal sponsor have agreed that this alternative should not be considered further at the time.

Environmental Effects. In addition to the agricultural areas, a 40-acre area of chenopod scrub and alkali scald (dry saline vernal pool), and scattered chenopod scrub vegetation are found along the pipeline. Since comprehensive surveys have not been conducted, it is assumed that construction could adversely affect the existing vernal pool/alkali scald habitat because alkali scald habitat does not regenerate once it is significantly disturbed. Consequently, it is also assumed that the wildlife species that occur in this environment could be significantly adversely affected. Federally and State-listed threatened and endangered species that inhabit vernal pool/alkali scald habitat include vernal pool tadpole shrimp, vernal pool fairy shrimp, San Joaquin woolly threads, palmate-bracted bird's-beak, Hoover's eriastrum, heartscale, Lost Hills crownscale, brittlescale, lesser saltbrush, and recurved larkspur.

Other Federally and State-listed threatened and endangered species which could be significantly adversely affected by construction of the pipeline include the blunt-nosed leopard lizard, San Joaquin (Nelson's) antelope ground squirrel, Fresno kangaroo rat and critical habitat, San Joaquin kit fox, and Hartweg's golden sunburst. Significant potential adverse effects could include damage or destruction of burrows, direct mortality from burrow collapses and subsequent suffocation, and direct mortality from construction vehicles or heavy equipment.

Implementation of this alternative will require comprehensive surveys for special-status species, as well as wetland delineation for vernal pools, in the area to determine the presence or absence of these species, their habitat, and vernal pools.

Other wildlife could experience temporary disturbance and/or displacement due to construction noise and activity, but would be expected to return to the area after construction is completed. In addition, construction of the pipeline could transport exotic fish species to the Mendota Pool. Although none have been recorded in Pine Flat Reservoir recently, the presence of exotic fish species such as white bass could have adverse effects on native fish species in the San Joaquin River and the San Joaquin-Sacramento Delta.

Alternative 4 - Byrd Slough Habitat Restoration

Completeness. Restoration of the Byrd Slough site would increase riparian and SRA habitats, reestablish native historic plant and wildlife communities along the lower Kings River, provide linkage of the Kings River to the historical flood plain, and provide conductivity of the surface water to the groundwater for increased survival of fish and wildlife. By repairing perimeter fences and installing revegetation signs, cattle would no longer graze on the site, and the public would be notified that the site

is being restored. Planting and designing and constructing an irrigation system at the Byrd Slough site would promote high habitat values and accelerate meeting the goal of ecosystem restoration.

Effectiveness. The restoration of the Byrd Slough site would be effective in increasing riparian and SRA habitats and reestablishing native historic plant and wildlife communities along the lower Kings River. Excluding cattle grazing from the site would allow regeneration of some native plant species. The revegetation signs would add additional protection to the site by giving notice to the public that a restoration project is in progress. Irrigation would be effective in reestablishing native historic plant and wildlife communities at a faster rate than through natural revegetation and would promote survival of the planted vegetation. Since the site is adjacent to other restoration sites, the value as a fish and wildlife corridor is increased. In addition, Byrd Slough bisects the site, thereby providing additional temperature control for the riparian and SRA habitat.

Efficiency. The first cost for this alternative is $800,000; the investment cost is $958,000; and the habitat value gained is 84.56 AAHU's (Average Annual Habitat Unit). See Tables IV-4, IV-5, IV-8, IV-11, IV-14, IV-15, and IV-16.

Acceptability. The Byrd Slough habitat restoration would meet all feasibility criteria. There is strong local support, and the non-Federal sponsor is willing to participate in this alternative provided that a suitable agreement can be negotiated with the County of Fresno for a fee title acquisition for the property.

Environmental Effects. Federally and State-listed threatened and endangered species which could be significantly adversely affected by the restoration include the California red-legged frog, California jewel flower, tree-anemone, and San Joaquin adobe sunburst. Significant potential adverse effects could include damage or direct mortality from construction vehicles or activities.

Implementation of this alternative will require comprehensive surveys for these special-status species to determine the presence or absence of the species and their habitat.

Other wildlife may experience temporary disturbance and/or displacement due to construction noise and activity, but would be expected to return to the area after restoration is completed.

Alternative 5 - Combined Alternatives 2 and 3

Completeness. The combined alternatives of the multilevel intake structure and water transfer pipeline would provide both temperature control and increase water flow downstream of the dam for fishery habitat. The multilevel intake structure would reduce the threat to fish and wildlife habitat by improving the fishery habitat in Pine Flat Lake and the lower Kings River. The structure would reduce water temperatures in the lower Kings River during part of the year through selective withdrawal of lake water at various levels. Spatial habitat in the lake could be increased through an increased level of dissolved oxygen in the lake. The water transfer pipeline would work in conjunction with the multilevel intake structure. The water held in Pine Flat Reservoir would be released late in the year to augment flows in part of the lower Kings River, thereby benefiting instream spatial habitat through increased flows and lower water temperatures.

Effectiveness. The multilevel intake structure would be effective in controlling water temperatures in Pine Flat Lake and the lower Kings River. Modeling showed an increase in the spring and early summer release temperatures of up to 4 °C (39 °F) while late summer and early fall release temperatures were maintained at no more than 18 °C (64.4 °F).

The water transfer pipeline would effectively transfer water for beneficial use without affecting the total quantity of water available. The water transfer would augment river flows, increase spatial habitat, and improve the quality of the habitat for fish in part of the lower Kings River.

The combination of multilevel intake structure and water transfer pipeline would result in greater and more extended habitat values than each alternative individually, and would promote better spawning habitat downstream.

Efficiency. The first cost for this alternative is $66,900,000; the investment cost is $74,688,000; and the habitat values gained are 58 WUA (Weighted Usable Area) and 1 AAHU (Average Annual Habitat Unit). See Tables IV-2, IV-3, IV-5, IV-6, IV-9, IV-10, IV-12, IV-13, IV-15, and IV-16.

Acceptability. Although the multilevel intake structure is acceptable, the water transfer pipeline is economically and environmentally infeasible. The estimated construction costs of the pipeline are very high, and the pipeline would provide relatively few benefits. In addition, there is the potential for significant adverse effects on vernal pool/alkali scald habitat and special-status species along the pipeline. Due to the high costs and potential adverse effects for the pipeline, the Corps and non-Federal sponsor have agreed that this alternative should not be considered further.

Environmental Effects. The environmental effects would be a combination of the effects of the multilevel intake structure and water transfer pipeline. At Pine Flat Dam, wildlife including the bald eagle, prairie falcon, and spotted bat may experience temporary disturbance and/or displacement due to construction noise and activity for a period of about 24 months. However, any displaced species would be expected to return to the area once constructed is completed.

In addition to the agricultural areas, a 40-acre area of chenopod scrub and alkali scald (dry saline vernal pool), and scattered chenopod scrub vegetation are found along the pipeline. Since comprehensive surveys have not been conducted, it is assumed that construction could adversely affect the existing vernal pool/alkali scald habitat because alkali scald habitat does not regenerate once it is significantly disturbed. Consequently, it is also assumed that the wildlife species that occur in this environment could be significantly adversely affected. Federally and State-listed threatened and endangered species that inhabit vernal pool/alkali scald habitat include vernal pool tadpole shrimp, vernal pool fairy shrimp, San Joaquin woolly threads, palmate-bracted bird's-beak, Hoover's eriastrum, heartscale, Lost Hills crownscale, brittlescale, lesser saltbrush, and recurved larkspur.

Other Federally and State-listed threatened and endangered species which could be significantly adversely affected by construction of the pipeline include the blunt-nosed leopard lizard, San Joaquin (Nelson's) antelope ground squirrel, Fresno kangaroo rat and critical habitat, San Joaquin kit fox, and Hartweg's golden sunburst. Significant potential adverse effects could include damage or destruction of burrows, direct mortality from burrow collapses and subsequent suffocation, and direct mortality from construction vehicles or heavy equipment.

Implementation of this alternative will require comprehensive surveys for special-status species in the pipeline and restoration areas, as well as wetlands delineation for vernal pools in the pipeline area. These surveys will be needed to determine the presence or absence of these species, their habitat, and vernal pools.

Other wildlife could experience temporary disturbance and/or displacement due to construction noise and activity, but would be expected to return to the area after construction is completed. In addition, construction of the pipeline could transport exotic fish species to the Mendota Pool. Although none have been recorded in Pine Flat Reservoir recently, the presence of exotic fish species such as white bass could have adverse effects on native fish species in the San Joaquin River and the San Joaquin-Sacramento Delta.

Alternative 6 - Combined Alternatives 2 and 4

Completeness. A combined alternative including the multilevel intake structure and Byrd Slough habitat restoration would provide a greater degree of ecosystem restoration to the fish and wildlife habitats. The multilevel intake structure would reduce the threat to fish and wildlife habitat by improving the fishery habitat in Pine Flat Lake and the lower Kings River. The structure would reduce water temperatures in the lower Kings River during critical times of the year through selective withdrawal of lake water from various levels. Spatial habitat in the lake could be increased through an increased level of dissolved oxygen in the lake. The multilevel intake structure would provide sustainability for all water year types, including critically dry years. Restoration of the Byrd Slough site would increase riparian and SRA habitat, and reestablish native historic plant and wildlife communities along the lower Kings River. The combination of the multilevel intake structure and Byrd Slough habitat restoration would provide linkage of the Kings River to the historical flood plain, provide conductivity and linkage of the surface water to the groundwater, and achieve the ecosystem goal of improving the fish and wildlife habitats of the lower Kings River watershed.

Effectiveness. This combined alternative would be effective in providing ecosystem restoration. The multilevel intake structure would be effective in controlling water temperatures in Pine Flat Lake and the lower Kings River as in Alternative 5.

Restoration of the Byrd Slough site would be effective in increasing riparian and SRA habitats and reestablishing native historic plant and wildlife communities along the lower Kings River. Repairing perimeter fences would exclude cattle grazing from the site; the revegetation signs would give notice to the public that a habitat restoration project is in progress; and planting and irrigating would establish native plant and wildlife communities at a faster rate than would natural revegetation.

Efficiency. The first cost for this alternative is $35,800,000; the investment cost is $40,093,000; and the habitat values gained are 40 WUA (Weighted Usable Area) and 84.56 AAHU's (Average Annual Habitat Unit). See Tables IV-2, IV-4, IV-5, IV-6, IV-7, IV-8, IV-9, IV-11, IV-12, IV-14, IV-15, and IV-16.

Acceptability. This combination alternative meets all feasibility criteria. There is strong local support, and the non-Federal sponsor is willing to participate in this alternative provided that the sponsor

is able to obtain financing for their share of the cost to construct the multilevel intake structure and that a suitable agreement can be negotiated with the County of Fresno for a fee title acquisition of the Byrd Slough site.

Environmental Effects. The environmental effects would be a combination of the effects of the multilevel intake structure and Byrd Slough habitat restoration. The temporary displacement of wildlife is same as in Alternative 5.

Federally and State-listed threatened and endangered species which could be significantly adversely affected by the restoration include the California red-legged frog, California jewelflower, tree-anemone, and San Joaquin adobe sunburst. Significant potential adverse effects could include damage or direct mortality from construction vehicles or activities.

Alternative 7 - Combined Alternatives 3 and 4

Completeness. A combined alternative of the water transfer pipeline and Byrd Slough habitat restoration would provide some degree of protection and restoration to the environment. The water transfer pipeline would work by holding the water in Pine Flat Reservoir in early summer for release late in the year to augment flows in part of the lower Kings River, thereby benefiting instream spatial habitat through increased flows and lower water temperatures. Restoration of the Byrd Slough site would increase riparian and SRA habitats and reestablish native historic plant and wildlife communities along the lower Kings River.

Effectiveness. The water transfer pipeline would effectively transfer water for beneficial use without affecting the total quantity of water available. The water transfer would augment river flows, increase spatial habitat, and improve the quality of the habitat for fish in part of the lower Kings River.

Restoration of the Byrd Slough site would be effective in increasing riparian and SRA habitats and reestablishing native historic plant and wildlife communities along the lower Kings River. Repairing perimeter fences would exclude cattle grazing from the site; the revegetation signs would give notice to the public that a habitat restoration project is in progress; and planting and irrigating would establish native plant and wildlife communities at a faster rate than would natural revegetation.

Efficiency. The first cost for this alternative is $32,700,000; the investment cost is $36,511,000; and the habitat values gained are 18 WUA (Weighted Usable Area) and 85.56 AAHU's (Average Annual Habitat Unit). See Tables IV-3, IV-4, IV-5, IV-6, IV-7, IV-8, IV-10, IV-11, IV-13, IV-14, IV-15, and IV-16.

Acceptability. Although the restoration of the Byrd Slough site is acceptable, the water transfer pipeline is economically infeasible. The estimated construction costs of the pipeline are very high, and the pipeline would provide relatively few benefits. In addition, there is the potential for significant adverse effects on vernal pool/alkali scald habitat and special-status species along the pipeline. Due to the high costs and potential adverse effects for the pipeline, the Corps and non-Federal sponsor have agreed that this alternative should not be considered further.

Environmental Effects. The environmental effects would be a combination of the effects of the water transfer pipeline and Byrd Slough habitat restoration.

For the water transfer pipeline, in addition to the agricultural areas, a 40-acre area of chenopod scrub and alkali scald (dry saline vernal pool), and scattered chenopod scrub vegetation are found along the pipeline. Since comprehensive surveys have not been conducted, it is assumed that construction could adversely affect the existing vernal pool/alkali scald habitat because alkali scald habitat does not regenerate once it is significantly disturbed. Consequently, it is also assumed that the wildlife species that occur in this environment could be significantly adversely affected. Federally and State-listed threatened and endangered species that inhabit vernal pool/alkali scald habitat include vernal pool tadpole shrimp, vernal pool fairy shrimp, San Joaquin woolly threads, palmate-bracted bird's-beak, Hoover's eriastrum, heartscale, Lost Hills crownscale, brittlescale, lesser saltbrush, and recurved larkspur.

Other Federally and State-listed threatened and endangered species which could be significantly adversely affected by construction of the pipeline include the blunt-nosed leopard lizard, San Joaquin (Nelson's) antelope ground squirrel, Fresno kangaroo rat and critical habitat, San Joaquin kit fox, and Hartweg's golden sunburst. Significant potential adverse effects could include damage or destruction of burrows, direct mortality from burrow collapses and subsequent suffocation, and direct mortality from construction vehicles or heavy equipment.

Federally and State-listed threatened and endangered species which could be significantly adversely affected by the restoration include the California red-legged frog, California jewelflower, tree-anemone, and San Joaquin adobe sunburst. Significant potential adverse effects could include damage or direct mortality from construction vehicles or activities.

Implementation of this alternative will require comprehensive surveys for special-status species in the pipeline and restoration areas, as well as a wetlands delineation for vernal pools in the pipeline area. These surveys will be needed to determine the presence or absence of these species, their habitat, and vernal pools.

Other wildlife could experience temporary disturbance and/or displacement due to construction noise and activity, but would be expected to return to the area after construction is completed. In addition, construction of the pipeline could transport exotic fish species to the Mendota Pool. Although none have been recorded in Pine Flat Reservoir recently, the presence of exotic fish species such as white bass could have adverse effects on native fish species in the San Joaquin River and the San Joaquin-Sacramento Delta.

Alternative 8 - Combined Alternatives 2, 3, and 4

Completeness. A combined alternative of the multilevel intake structure, water transfer pipeline, and Byrd Slough habitat restoration would provide the greatest degree of ecosystem restoration for fish and wildlife in the lower Kings River watershed. The multilevel intake structure would reduce the threat to fish and wildlife habitat by improving the fishery habitat in Pine Flat Lake and the lower Kings River. The structure would reduce water temperatures in the lower Kings River during part of the year through selective withdrawal of lake water from various levels. Spatial habitat in the lake could be increased through an increased level of dissolved oxygen in the lake.

The water transfer pipeline would work in conjunction with the multilevel intake structure. Through a water transfer, the water held in Pine Flat Reservoir would be released late in the year to augment flows in part of the lower Kings River, thereby benefiting instream spatial habitat through increased flows and lower water temperatures.

Restoration of the Byrd Slough site would increase riparian and SRA habitats and reestablish native historic plant and wildlife communities along the lower Kings River.

Effectiveness. A combined alternative would be the most effective alternative in providing environmental protection and restoration. The multilevel intake structure would be effective in controlling water temperatures in Pine Flat Lake and the lower Kings River. Modeling showed an increase in the spring and early summer release temperatures of up to 4 °C (39 °F) while late summer and early fall release temperatures were maintained at no more than 18 °C (64.4 °F).

The water transfer pipeline would effectively transfer water for beneficial use without affecting the total quantity of water available. The water transfer would augment river flows, increase spatial habitat, and improve the quality of the habitat for fish in part of the lower Kings River.

Restoration of the Byrd Slough site would be effective in increasing riparian and SRA habitats and reestablishing native historic plant and wildlife communities along the lower Kings River. Repairing perimeter fences would exclude cattle grazing from the site; the revegetation signs would give notice to the public that a habitat restoration project is in progress; and planting and irrigating would establish native plant and wildlife communities at a faster rate than would natural revegetation.

Efficiency. The first cost for this alternative is $67,700,000; the investment cost is $75,646,000; and the habitat values gained are 58 WUA (Weighted Usable Area) and 85.56 AAHU's (Average Annual Habitat Unit). See Tables IV-2 through IV-16.

Acceptability. Although the multilevel intake structure and restoration of the Byrd Slough site are acceptable, the water transfer pipeline is economically and environmentally infeasible. The estimated construction costs of the pipeline are very high, and the pipeline would provide relatively few benefits. In addition, there is the potential for significant adverse effects on vernal pool/alkali scald habitat and special-status species along the pipeline. Due to the high costs and potential adverse effects for the pipeline, the Corps and non-Federal sponsor have agreed that this alternative should not be considered further.

Environmental Effects. The environmental effects would be a combination of the effects of the other three alternatives. At Pine Flat Dam, wildlife including the bald eagle, prairie falcon, and spotted bat may experience temporary disturbance and/or displacement due to construction noise and activity for a period of about 24 months. However, any displaced species would be expected to return to the area once constructed is completed.

In addition to the agricultural areas, a 40-acre area of chenopod scrub and alkali scald (dry saline vernal pool), and scattered chenopod scrub vegetation are found along the pipeline. Since comprehensive surveys have not been conducted, it is assumed that construction could adversely affect the existing vernal

pool/alkali scald habitat because alkali scald habitat does not regenerate once it is significantly disturbed. Consequently, it is also assumed that the wildlife species that occur in this environment could be significantly adversely affected. Federally and State-listed threatened and endangered species that inhabit vernal pool/alkali scald habitat include vernal pool tadpole shrimp, vernal pool fairy shrimp, San Joaquin woolly threads, palmate-bracted bird's-beak, Hoover's eriastrum, heartscale, Lost Hills crownscale, brittlescale, lesser saltbrush, and recurved larkspur.

Other Federally and State-listed threatened and endangered species which could be significantly adversely affected by construction of the pipeline include the blunt-nosed leopard lizard, San Joaquin (Nelson's) antelope ground squirrel, Fresno kangaroo rat and critical habitat, San Joaquin kit fox, and Hartweg's golden sunburst. Significant potential adverse effects could include damage or destruction of burrows, direct mortality from burrow collapses and subsequent suffocation, and direct mortality from construction vehicles or heavy equipment.

Federally and State-listed threatened and endangered species which could be significantly adversely affected by the restoration include the California red-legged frog, California jewelflower, tree-anemone, and San Joaquin adobe sunburst. Significant potential adverse effects could include damage or direct mortality from construction vehicles or activities.

Implementation of this alternative will require comprehensive surveys for special-status species in the pipeline and restoration areas, as well as a wetland delineation for vernal pools in the pipeline area. These surveys will be needed to determine the presence or absence of these species, their habitat, and vernal pools.

Other wildlife could experience temporary disturbance and/or displacement due to construction noise and activity, but would be expected to return to the area after construction is completed. In addition, construction of the pipeline could transport exotic fish species to the Mendota Pool. Although none have been recorded in Pine Flat Reservoir recently, the presence of exotic fish species such as white bass could have adverse effects on native fish species in the San Joaquin River and the San Joaquin-Sacramento Delta.

Summary Table of the Alternatives

Table IV-5 is an evaluation and comparison of the alternatives based on planning criteria.

Table IV-5. Evaluation and Comparison of Alternatives Based on Planning Criteria

Alternative	Plan Formulation Criteria				Average Relative Ranking
	Completeness	Effectiveness	Efficiency	Acceptability	
Alternative 1 – No Action	Does not increase habitat values for fish and wildlife. Low	Does not alleviate identified problems. Low	No costs or benefits. Low	Little local support. Low	Low
Alternative 2 – Multilevel Intake Structure	Regulates water temperatures in Pine Flat Lake and lower Kings River. Increases spatial habitat in Pine Flat Lake and provides sustainability for fish. Medium	Effectively regulates water temperatures in Pine Flat Lake and lower Kings River during the spring, summer, and fall. Medium	High ecosystem benefit at significant cost. Medium	Meets all feasibility criteria. Strong local support. High	Medium to High
Alternative 3 – Water Transfer Pipeline	Augments river flows in part of the lower Kings River late in the season, resulting in lower water temperatures and increased spatial habitat. Low	Effective in augmenting flows in part of the lower Kings River by transferring water. Medium	Low ecosystem benefit at significant cost. Low	Economically and environmentally infeasible due to high construction costs and few benefits. Potential significant adverse environmental effects. Little local support. Low	Low

Table IV-5. Summary Comparison of Alternatives to Meeting Planning Criteria (Continued)

Alternative	Plan Formulation Criteria				Average Relative Ranking
	Completeness	Effectiveness	Efficiency	Acceptability	
Alternative 4 – Byrd Slough Habitat Restoration	Increases riparian and SRA habitats and reestablishes native historic plant and wildlife communities along the lower Kings River. Medium	Effective in increasing riparian and SRA habitat and reestablishing native historic plant and wildlife communities along the lower Kings River. Medium	High ecosystem benefit at low cost. High	Meets all feasibility criteria. Strong local support. High	Medium to High
Alternative 5 – Combined Alternatives 2 and 3	Same as Alternatives 2 plus 3. Medium	Effectively regulates water temperatures in Pine Flat Lake and lower Kings River during the spring, summer, and fall. Effective in augmenting flows in part of the lower Kings River by transferring water. Medium	High ecosystem benefit at significant cost. Low	Economically and environmentally infeasible due to pipeline. Potential significant adverse environmental effects. Little local support. Low	Low to Medium
Alternative 6 – Combined Alternatives 2 and 4	Same as Alternatives 2 plus 4. High	Effectively regulates water temperatures in Pine Flat Lake and lower Kings River during the spring, summer, and fall. Effective in increasing riparian and SRA habitat and reestablishing native historic plant and wildlife communities along the lower Kings River. High	High ecosystem benefit at significant cost. Medium	Meets all feasibility criteria. Strong local support. High	Mostly High

Table IV-5. Summary Comparison of Alternatives to Meeting Planning Criteria (Continued)

Alternative	Plan Formulation Criteria				Average Relative Ranking
	Completeness	Effectiveness	Efficiency	Acceptability	
Alternative 7 – Combined Alternatives 3 and 4	Same as Alternatives 3 plus 4. Medium	Effective in augmenting flows in part of the lower Kings River by transferring water. Effective in increasing riparian and SRA habitat and reestablishing native historic plant and wildlife communities along the lower Kings River. Medium	Medium ecosystem benefit at significant cost. Low	Economically and environmentally infeasible due to pipeline. Potential significant adverse environmental effects. Little local support. Low	Low to Medium
Alternative 8 – Combined Alternatives 2, 3, and 4	Same as Alternatives 2 plus 3 plus 4. High	Effectively regulates water temperatures in Pine Flat Lake and lower Kings River during the spring, summer, and fall. Effective in augmenting flows in part of the lower Kings River by transferring water. Effective in increasing riparian and SRA habitat and reestablishing native historic plant and wildlife communities along the lower Kings River. High	Highest ecosystem benefit at significant cost. Low	Economically and environmentally infeasible due to pipeline. Potential significant adverse environmental effects. Little local support. Low	Medium

Habitat Values and Costs

The habitat values for the alternatives are separated into aquatic and terrestrial habitats. The aquatic habitat analysis for the multilevel intake structure and water transfer pipeline is calculated in Weighted Usable Area (WUA) per 13 miles of river from June 1 to mid-October, respectively. Table IV-6 shows the total WUA for the multilevel intake structure and water transfer pipeline for 1994 (normal year), 1992 (critically dry year), and 1988 (dry year). Table IV-7 shows the daily WUA for the multilevel intake structure and water transfer pipeline for 1994 (normal year), 1992 (critically dry year), and 1988 (dry year). The total WUA gained for each alternative is the difference between the baseline condition and the alternative.

Plates 16 and 17 show the release temperatures without and with a 100,000 acre-foot temperature control pool for 1992. Plates 18 and 19 show the release model temperatures of 1993 and 1994. Plates 22 through 30 show the habitat units for all these model years comparing the baseline condition to the alternatives. The total WUA for each alternative is the summation of the area between the baseline condition and the alternative.

Specific information on these selected years and modeling scenarios is included in Appendix C and Appendix A of the EIS/EIR.

Table IV-6. Total WUA[1] for Multilevel Intake Structure and Water Transfer Pipeline

WUA Total	Baseline	MLI[2]	WTP[3]
Normal 1994	128	162	148
Δ		34	20
Critical Dry 1992	82	130	103
Δ		48	21
Dry 1988	95	134	107
Δ		39	12
Total	305	426	358
Avg	102	142	119
Δ Avg		40	18

[1] Weighted Usable Area
[2] Multilevel intake structure
[3] Water transfer pipeline

Table IV-7. Daily WUA[1] for Multilevel Intake Structure and Water Transfer Pipeline

WUA Daily	Baseline	MLI[2]	WTP[3]
Normal 1994	0.91	1.15	1.05
	Δ	0.24	0.14
Critical Dry 1992	0.58	0.92	0.73
	Δ	0.34	0.15
Dry 1988	0.67	0.95	0.76
	Δ	0.28	0.09
Total	2.16	3.02	2.54
Avg	0.72	1.01	0.85
Δ Avg		0.29	0.13

[1] Weighted Usable Area
[2] Multilevel intake structure
[3] Water transfer pipeline

The terrestrial habitat analysis for the Water Transfer Pipeline and Byrd Slough Habitat Restoration is calculated using HEP analysis in habitat unit (HU) and average annual habitat unit (AAHU) (see Table IV-8). See USFWS Coordination Act Report (CAR).

Table IV-8. Output in AAHU's for the Byrd Slough Habitat Restoration

Restoration Design	Restoration Features	Output (AAHU's)
A0	None	19.53
A1	Fencing and wildlife structures	42.39
A2	Fencing, wildlife structures, moderate planting, and irrigation	84.56
A3	Fencing, wildlife structures, and high density planting	77.38

Tables IV-9 through IV-11 show the first costs for the multilevel intake structure, water transfer pipeline, and Byrd Slough habitat restoration. The cost data are updated from the original 1998 MCACES estimates to the October 2000 price levels.

Table IV-9. Multilevel Intake Structure First Cost[1] (x $1,000)

Type	Description	Federal	Non-Federal	Total First Cost
6	Fish & Wildlife Multilevel Intake Structure	$29,014	0	$29,014
30	Planning Engineering and Design	$3,565	0	$3,565
31	Construction Management	$2,421	0	$2,421
Non Federal Contribution		-$12,250	$12,250	0
Total First Cost		$22,750	$12,250	$35,000

[1]50-year project life, 6 3/8 percent interest rate, October 2000 price levels

Table IV-10. Water Transfer Pipeline First Cost[1] (x $1,000)

Type	Description	Federal	Non-Federal	Total First Cost
01	Lands and Damages	$69	$509	$578
02	Relocations	0	$136	$136
06	Fish & Wildlife Water Transfer Pipeline	$25,627	0	$25,627
18	Cultural Resources	$208	0	$208
30	Planning Engineering and Design	$3,180	$20	$3,200
31	Construction Management	$2,137	$14	$2,151
Non-Federal Contribution		-$10,486	$10,486	0
Total First Cost		$20,735	$11165	$31,900

[1]50-year project life, 6 3/8 percent interest rate, October 2000 price levels

Table IV-11. Byrd Slough Habitat Restoration First Cost[1] (x $1,000)

Type	Description	Federal	Non-Federal	Total First Cost
01	Lands and Damages	$14	$333	$347
06	Fish & Wildlife Byrd Slough Habitat Site	$369	0	$369
18	Cultural Resources	$4	0	$4
30	Planning Engineering and Design	$51	0	$51
31	Construction Management	$29	0	$29
Federal Reimbursement		$53	-$53	0
Total First Cost		$520	$280	$800

[1]50-year project life, 6 3/8 percent interest rate, October 2000 price levels

Tables IV-12 through IV-14 show the investment and annual costs for the multilevel intake structure, water transfer pipeline, and Byrd Slough habitat restoration.

Table IV-12. Multilevel Intake Structure Investment and Annual Costs[1] (x $1,000)

Investment Cost	Total
First Cost	$35,000
Interest During Construction	$4,135
Total Investment Cost	$39,135
Annual Cost	
Interest and Amortization	$2,615
OMRR&R	$55
Total Annual Cost	$2,670

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels.

Table IV-13. Water Transfer Pipeline Investment and Annual Costs[1] (x $1,000)

Investment Cost	Total
First Cost	$31,900
Interest During Construction	$3,861
Total Investment Cost	$35,761
Annual Costs	
Interest and Amortization	$2,389
OMRR&R	$49
Total Annual Cost	$2,438

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels.

Table IV-14. Byrd Slough Habitat Restoration Investment and Annual Costs[1] (x $1,000)

Investment Cost	Total
First Cost	$800
Interest During Construction	$162
Total Investment Cost	$962
Annual Cost	
Interest and Amortization	$63
OMRR&R	$1
Total Annual Cost	$64

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels.

Tables IV-15 and IV-16 compare the costs and habitat values of the eight alternatives.

Table IV-15. Comparison of First Costs, Investment Costs, Annual Cost, and Habitat Values[1] (x $1,000)

Alternative	First Cost	Investment Cost	Annual Cost	Habitat Values
1. No Action	0	0	0	19.53 AAHU
2. Multilevel Intake Structure	$35,000	$39,135	$2,670	40 WUA[2]
3. Water Transfer Pipeline	$31,900	$35,553	$2,424	18 WUA + 1 AAHU
4. Habitat Restoration	$800	$958	$64	84.56 AAHU[3]
5. Combination of 2 and 3	$66,900	$74,688	$5,094	58 WUA + 1 AAHU
6. Combination of 2 and 4	**$35,800**	**$40,093**	**$2,734**	**40 WUA + 84.56 AAHU**
7. Combination of 3 and 4	$32,700	$36,511	$2,488	18 WUA + 85.56 AAHU
8. Combination of 2, 3, and 4	$67,700	$75,646	$5,158	58 WUA + 85.56 AAHU

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels.
[2] Weighted usable area.
[3] Average annual habitat unit.

Table IV-16. Comparison of First Costs, Investment Costs, Annual Cost, and Habitat Values[1] From Least Cost to Most Cost (x $1,000)

Alternative	First Cost	Investment Cost	Annual Cost	Habitat Values
1. No Action	0	0	0	19.53 AAHU
4. Habitat Restoration	$800	$958	$64	84.56 AAHU[3]
3. Water Transfer Pipeline	$31,900	$35,553	$2,424	18 WUA + 1 AAHU
7. Combination of 3 and 4	$32,700	$36,511	$2,488	18 WUA + 85,56 AAHU
2. Multilevel Intake Structure	$35,000	$39,135	$2,670	40 WUA[2]
6. Combination of 2 and 4	**$35,800**	**$40,093**	**$2,734**	**40 WUA + 84.56 AAHU**
5. Combination of 2 and 3	$66,900	$74,688	$5,094	58 WUA + 1 AAHU
8. Combination of 2, 3, and 4	$67,700	$75,646	$5,158	58 WUA + 85.56 AAHU

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels.
[2] Weighted usable area.
[3] Average annual habitat unit.

Fishery

Comparison of the total habitat units (acres per the 13 miles) for adult trout in a normal year (1994) to both the dry year (1988) and critically dry year (1992) indicates that the multilevel intake structure and water transfer pipeline alternatives both increase the habitat units during the critical months of July through October in the critically dry water year. (See Figures 6, 7, and 8 in the USFWS' draft CAR.) In the normal and dry years, the multilevel intake structure and water transfer pipeline provide increased cooler water temperatures for the fishery. The greatest benefit to the fishery is during the critically dry water year when the allotment of water is usually the lowest and also the water temperature is the highest. In the critically dry water year, the cooler water temperature and the increased water flows would provide the most benefit to the fishery. In the critically dry water year without the proposed alternatives, there would be very

little habitat values in the critically dry months from July through October, and there would be losses to the fishery. However, some sustainability is expected for all water year types with the multilevel intake structure alone, including critically dry years. The total habitat values for the fishery are the sum of the area under the graphs shown on Plates 22 through 30.

Habitat Restoration

Comparison of the habitat restoration of alternative 8 and alternative 1 shows that the habitat values would increase from nearly zero to 58 WUA + 84.56 AAHU's (see Table IV-15). This habitat value would increase the diversity of the plants and wildlife species and would enhance the sustainability of the fishery and the overall ecosystem of the study area.

Combination of Alternatives

Alternative 8 (combination of alternatives 2, 3, and 4) would provide the most habitat values to both fish and wildlife habitat. This combination alternative would enhance the fishery by increasing the vegetative canopy overhanging the river, providing shelter for the fish, and providing cooler water temperatures. This combination alternative would increase wildlife and fish diversity, and provide shelter, food, and suitable habitat. However, alternative 3 would provide few benefits when compared to the very high construction cost and has potential significant adverse environmental effects. As a result, this alternative fails the acceptability criterion, and the Corps and the non-Federal sponsor have agreed that this alternative should not be considered further. Of the remaining alternatives, Alternative 6 would provide the most habitat values at the least cost and is strongly supported by local interests.

Other Environmental Benefits

Other environmental benefits would include (1) increasing the habitat and foraging area for fish and wildlife; (2) increasing the diversity of fish, wildlife, and plants; (3) providing shelter for fish and wildlife; (4) reducing the chances of plant and species loss due to lack of habitat; (4) improving water quality; (5) providing linkage of the Kings River to the historical flood plain; (6) providing conductivity of the surface water to the groundwater of the lower Kings River ecosystem and (7) enhancing the health of the ecosystem in the study area.

FINAL ALTERNATIVES

The final alternatives are Alternative 1 - No Action, Alternative 2 - Multilevel Intake Structure, Alternative 4 - Byrd Slough Habitat Restoration, and Alternative 6 - Combination of Alternatives 2 and 4. Alternatives 2, 4, and 6 meet the planning criteria and all or part of the planning objectives. They are economically feasible, provide a variety of ecosystem benefits, provide sustainability to coldwater fishery even in critically dry years, and have strong support by local interests and the non-Federal sponsor.

CHAPTER V

TECHNICAL AND ENVIRONMENTAL STUDIES

Various technical and environmental studies were used to develop and evaluate the ecosystem restoration alternatives in the study area, as well as provide the basis for development of a plan. Results of these studies are discussed in Appendix C and summarized below.

Environmental studies involved determining existing natural, socioeconomic, and cultural resources; evaluating the effects of the alternatives on these resources; and developing any necessary mitigation measures. Results of the environmental and cultural studies are discussed in the EIS/EIR.

BASIS OF DESIGN

Hydraulic Design

The Hydraulic Design Report, July 1998, discussed the data, assumptions, and methodologies used to evaluate the hydraulic characteristics of the multilevel intake structure and the water transfer pipeline (Section II of Appendix C). The restoration site has no hydraulic design considerations.

Since the multilevel intake would be a structure attached to the upstream face of the dam, hydraulic analyses included hydrostatic pressure and wave-induced dynamic pressure. The MAC3D program was used to mathematically model the multilevel intake system. The computer model is useful for looking at velocities, temperatures, and turbulence, but it cannot duplicate the dynamic response to structural features such as trash racks, structural members, valves, gates, free surface vortices, and transient flow features associated with changing gate settings. (A future physical model will be required to evaluate these structural features.) The MAC3D computer simulation showed the lowest pressures at the junction of the entrance to the penstock with the circular penstock; however, the pressures did not appear to be so low as to cause cavitations. The model was also used to check the temperature results of the two-dimensional CE-QUAL-W2 computer model used by KRCD to evaluate intake port location versus temperature output from the reservoir to the downstream river.

Preliminary hydraulic calculations for the pipeline were based on surveyed stationing and elevations. The elevation differences would convey a flow requirement of 150 cfs using a 78-inch-diameter pipe. Steel pipe extensions would prevent negative pressure in the pipeline and would either allow excess air to be released or would allow air to enter the pipeline to prevent cavitations. The 78-inch-diameter pipe size would work for either upstream or downstream control. The pipeline is assumed to flow full, and velocities were kept less than 5.0 feet per second.

Control structures and operational requirements need to be identified. The effects of existing agricultural systems and structures on the hydraulic grade line need to be identified. Design criteria should be reviewed for refinement of operations and timing of various flows and identification of structural requirements and deficiencies. The trench depth requirement for a 78-inch-diameter water transfer pipe needs to be determined, and a survey of the pipeline alignment needs to be conducted.

Surveying and Topography

No surveying or topographic information was required for the multilevel intake structure because the structure would be attached to the upstream face of the existing dam (Section III of Appendix C).

A ground survey was performed in January 1998 for the water transfer pipeline to determine the alignment and to verify general ground slopes. The topography in the area of the alignment was found to be relatively flat and uniform; therefore, extensive topographic work was not required. An aerial photography flight was conducted on January 27, 1998, to effectively identify the proposed alignment features and locations of the pipeline. The aerial images have been digitized, cropped, and rectified to a scale of 1 inch equals 100 feet using control survey points.

No surveying was required for the restoration site. Topographic information was obtained from available resource agency documents and from aerial photographs taken in 1996. Additional information was provided by KRCD and was collected during site visits conducted in February and May 1997.

Geotechnical

Pine Flat Dam is within 55 miles of the Kern Canyon and Sierra Nevada Faults, 65 miles from the Owens Valley Fault, and 90 miles from the San Andreas Fault. The dam is located in seismic zone 3, in which the potential hazard (damage capability) is considered to be major. The Corps performed an earthquake analysis of Pine Flat Dam in 1987 and concluded that the dam is capable of withstanding, under a gross pool condition, a 0.32 g, maximum ground acceleration without earthquake-induced cracking of the dam structure.

Geotechnical issues related to the engineering feasibility of the pipeline are now under study. Soil information was obtained from the USDA Soil Conservation Service's Soil Survey of the Eastern Fresno Area, California, October 1971.

Design

The multilevel intake structure for Pine Flat Dam has a similar space frame structure as the temperature control device at Shasta Dam. The structural design report analyzed the structural support systems and design issues, including materials, gravity load support system, stream and cross-canyon load support systems, loading conditions, hoist platform steel, steel frame connections, dam connections, steel cladding panels and bridge plank, gates, trash racks,

and corrosion protection (Sections IV, V, and VII of Appendix C). The Water Temperature Model Study for the Multi-Level Intake Structure analyzed the water temperatures in the reservoir and downstream releases through a multilevel intake structure design. The study modeled a multitude of structural configurations in order to determine a configuration that proved to be beneficial under a broad range of water year types. The Multi-Level Intake Structure Port Configuration Analysis, March 1999, summarized the results of the analysis, selecting the intake port configuration.

The Water Transfer Pipeline Preliminary Engineering Feasibility Report, June 1998, analyzed how the FID system could most effectively be used for water conveyance (Sections IV, V, and VII of Appendix C). Seven canals were analyzed using the criteria of land use, utility information, existing private facilities, land ownership, public roads and facilities, cost estimates, and other constraints. An alignment was selected and analyzed using the criteria of property ownership, utility information, pipe materials, hydraulics, pipeline layout, and soils information.

The design, habitat values, and costs for the restoration site are discussed in the EIS/EIR.

Mechanical/Electrical

The Mechanical and Electrical Design Report, July 1998, discussed the mechanical and electrical features of the multilevel intake structure (Sections IV, V, and VII of Appendix C). Mechanical design involved the design of the gate hoists and the gates. The electrical features included the general requirements for equipment and materials, electrical power, motor control centers, gate-position indicating system, and electrical interlock and safety features.

The design requirements for the gate hoists are a major mechanical consideration. Since underwater hydraulic cylinders have been found to be unreliable, all major components would be located above water. A motor control center would be located on each of the three bays and would provide the necessary controls for operation of the gate hoists. All hoist motors for the temperature control device normally would be controlled from a remote location.

No mechanical/electrical considerations were identified in the Water Transfer Pipeline Preliminary Engineering Feasibility Report.

Real Estate

Real estate issues were evaluated for the three selected measures (Section VI of Appendix C and Appendix E). No land is required for the multilevel intake structure since it would be attached to the upstream face of the dam. A staging area of 2.07 acres would be located near the left abutment of the dam on Federal property.

Real estate requirements associated with the pipeline include a permanent pipeline easement and a temporary work area easement. Construction of the pipeline requires a 35-foot-wide permanent easement from an existing check structure along Dry Creek about 310 feet east of the intersection of Howard and Central Avenues to the Fresno Slough flood channel near the upper end of the Mendota Pool near El Dorado Avenue. The pipeline would run mainly across

the frontage of private property, but also through the middle of certain private holdings in some areas. Once past Highway 145, the pipeline would be constructed in open fields. There are 48 parcels in private ownership, 1 parcel in public ownership, and 4 road crossings along the proposed pipeline for a total of 49 parcels (31 private landowners and 1 public landowner). The permanent pipeline easement would allow access to the pipeline for required inspections. The temporary work area easement would be for 1 year. The temporary work area easement would allow construction of the pipeline.

The 143.5-acre Byrd Slough habitat restoration site is currently owned by the Fresno County Parks Department. KRCD will obtain fee title from the County to this site during the PED process.

Hazardous, Toxic, and Radiological Waste

The HTRW Preliminary Assessment Report, October 1997, evaluated past land use, potential sources of contamination, and potential pesticide use in the water transfer pipeline and Byrd Slough restoration areas (Section V of Appendix C). The preliminary assessment of past site use and potential sources of contamination included review of available environmental documents related to the site, regulatory agency file review and data requests, regulatory database search, aerial photograph review, site inspection, limited soil sampling, and interviews with site personnel.

The pipeline area consists of open grassy fields with some orchards along Central Avenue, Plumas Avenue, and Malaga Avenue. A field investigation was performed on each of the proposed alignments, and no HTRW were encountered. Evidence of fill ports (to underground storage tanks, clarifiers, or sumps) was not encountered within or adjacent to the area. Ponds, pits, and sumps or other solid waste or liquid waste disposal areas were not observed on any portions along the three alignments.

The Byrd Slough habitat restoration site did not appear to have any HTRW. No ponds, pits, and sumps or other solid waste or liquid waste disposal areas were observed during the field investigation of the site.

Cost Estimate

The detailed cost estimate consists of first costs and annual costs for the Federal and non-Federal sponsor (Section IX of Appendix C). The first costs include work performed for fish and wildlife facilities, planning, engineering and design, construction management, and the habitat restoration site, lands and damages. Annual costs include investment, interest during construction and OMRR&R costs. The MCACES cost estimate has been updated to October 2000 price level.

PORT CONFIGURATION ANALYSIS

The Multi-level Intake Structure Port Configuration Analysis, March 5, 1999 (available upon request), used the CE-QUAL-W2 model to analyze and determine the number and elevation of intake openings or withdrawal ports that would optimize the structure's release temperature effectiveness. The analysis showed the selected port configuration to be a top port centerline elevation of 857.5 feet with the lower five ports evenly spaced at 28 feet center to center.

EIS/EIR

Environmental Resources

Several environmental studies were conducted during plan formulation and preparation of the EIS/EIR. These studies provided information, evaluated potential effects of alternative plans, and proposed mitigation measures to offset any significant adverse effects.

The USFWS prepared the Coordination Act Report, which described the trout population (indicator species for coldwater fishery) and distribution, stocking practices, habitat quality, and entrainment through Pine Flat Dam. Habitat Evaluation Procedures (HEP) were used to quantify the anticipated future beneficial effects to wildlife and fish resources which would occur with the construction of potential habitat restoration improvements. HEP is a methodology developed by the USFWS and other Federal and State resources agencies. This methodology can be used to document the quality and quantity of available habitat for selected wildlife and fish species, as well as the effects of proposed actions on the quality and quantity of this habitat. Using habitat units as a measure of successful terrestrial restoration, the results from this analysis were used to compare restoration habitat values and costs.

The USFWS conducted a fisheries analysis to evaluate the habitat value of the multilevel intake structure on three stages of the trout life cycle as the indicator species for the coldwater fishery in the Kings River watershed. They also conducted the same type of analysis to evaluate the habitat value of the water transfer pipeline on these three stages. Each of these analyses applied results from the instream flow study on the Kings River and modified them with temperature and flow criteria.

The Biological Data Report, which describes the special-status wildlife, fisheries, and plants in the study area is included in the EIS/EIR. The species included in the report were provided in August 4, 1997, May 24, 1999, June 30, 2000, and January 31, 2001, letters from the USFWS. The Biological Data Report also evaluated the potential effects of the alternatives on the special-status species.

The initial study of environmental conditions for the Byrd Slough habitat restoration site is included in the EIS/EIR. Information regarding the site setting and existing conditions was

gathered from available resource agency documents and from aerial photographs taken in 1996. Additional information was provided by KRCD and was collected during site visits conducted in February and May 1997.

Cultural Resources

Cultural resources studies included a review of past inventories and records for the area, as well as ground surveys by Sacramento District archeologists. A cultural resources inventory of Pine Flat Dam and Lake was completed by archeologists from the University of California, Berkeley, prior to construction of the dam in 1954. In 1984, archeologists with the University of California, Los Angeles, reexamined known sites and surveyed all additional Pine Flat Lake parklands. While 33 prehistoric sites were recorded, none are located near Pine Flat Dam.

In March 1998, Sacramento District archeologists examined the water transfer pipeline alignment, which extends along existing county roads. No evidence of structures, buildings, or historic or prehistoric archeological remains was evident. The potential for buried cultural resources in this area is minimal since there are no natural features that would have encouraged occupation prior to modern times.

A records search by the Southern San Joaquin Valley Information Center was completed in 1993 for the habitat restoration area. No prehistoric or historic archeological sites were located within the area although three sites are located one-third mile to the east. A ground survey was conducted in March 1998 by Sacramento District archeologists. There were no indications of any other prehistoric or historic archeological remains.

CHAPTER VI

RECOMMENDED PLAN AND IMPLEMENTATION

IDENTIFICATION OF NATIONAL ECOSYSTEM RESTORATION PLAN

Based on the evaluation, Alternative 2 - Multilevel Intake Structure, Alternative 4 - Byrd Slough Habitat Restoration, and Alternative 6 - Combination of Alternatives 2 and 4 meet the planning criteria and all or part of the planning objectives. They are all economically and environmentally feasible, provide a variety of environmental benefits, and have strong non-Federal support. However, only Alternative 6 would meet all of the objectives, reasonably maximize ecosystem restoration benefits, and is thus identified as the National Ecosystem Restoration (NER) Plan." The NER Plan is also the Recommended Plan.

PLAN COMPONENTS

The Recommended Plan (Alternative 6) consists of the components of alternatives 2 (Multilevel Intake Structure) and 4 (Byrd Slough Habitat Restoration).

Multilevel Intake Structure

A multilevel intake structure would be constructed on the upstream face of Pine Flat Dam (see Plate 15). This multilevel intake structure would consist of three separate steel (space frame) structures which extend from elevation 953.46 feet, mean sea level (msl), downward to elevation 616.5 feet, msl. The three separate steel structures would fit over the three existing power penstock intakes. Each of the three structures would have three port openings and gates. There would be a hoist and cable unit (including a motor) for each of the nine openings. The three port openings would be 25 feet high and 42 feet wide and would be staggered at seven different elevations that would permit selective withdrawal of water from a wide range of levels in the reservoir.

Steel gates measuring 27 feet high by 44 feet wide would be constructed to close off each of the new port openings. One gate on all three of the structures would be at the same elevation, and two gates on each of the structures would be at different elevations. The gates would open in the downward direction and would sit in a structural channel when completely open. This design would take the gate loadings off the hoist cable. Cladding would be placed on the space frame to enclose each of the structures. Steel plates would be put on the bottom of each of the space frame structures to prevent water from leaking into each structure. A trash rack would be placed on the front face of each of the structures to prevent any large debris from entering the port openings and to protect the structure.

Byrd Slough Habitat Restoration

About 143.5 acres of Fresno County land downstream of the dam and immediately south of the Friant-Kern Canal siphon would be acquired in fee title to reestablish riparian and SRA habitat for fish and wildlife along the Kings River (see Plates 20 and 21). The restoration work would involve repairing perimeter fences to exclude cattle from the restoration area, installing revegetation signs at the fishing access parking area, planting restoration species (250 plants per acre), designing and, an irrigation system to the planted areas, and installing wildlife habitat enhancement structures. In order of priority, these structures could include brush piles, bluebird boxes, bat boxes, raptor perches, wood duck boxes, and/or songbird perches.

After implementation of the Recommended Plan, the Corps would be responsible for a 3- to 5-year establishment period (including monitoring) to ensure the survival of the plantings at the restoration site. At the end of the establishment period, the project would be turned over to KRCD, who would maintain the restoration site for the life of the project.

PLAN ACCOMPLISHMENTS

The Recommended Plan would result in aquatic ecosystem benefits without committing additional water supplies, which is critical because of the high demand for Kings River water. This project also supports the Kings River Fisheries Management Program because it helps to meet the objective to reduce the maximum instream temperatures in the lower Kings River and allows greater flexibility to balance the multiple beneficial uses served by the dam, reservoir and river.

At the Pine Flat Dam, the Recommended Plan would allow water at various elevations and temperatures in the reservoir to be combined when released through the dam to the downstream channel. Mixing water from various elevations in the reservoir would preserve the cold water in the reservoir and promote downstream water temperatures suitable to sustain the coldwater fishery throughout the year, especially in the late summer and fall when the cold water can become depleted. Based on the HEP analysis, there would be a gain of 40 WUA in habitat value for King River fisheries.

At the Byrd Slough habitat restoration site, repairing perimeter fences would exclude cattle grazing from the site and would promote natural revegetation. The revegetation signs would inform the public that an ecosystem restoration project is in progress and that riparian and SRA plants need to be protected Planting and irrigating the restoration species (250 plants per acre) would help to restore and preserve the aquatic wetland ecosystem along the Kings River.

The riparian and SRA mixed vegetation would support the most diverse fish and wildlife communities in the area. The diversity of plant species in this community

provides a variety of foods and microhabitats for fish and wildlife. Also, a SRA canopy environment would help reduce the Kings River water temperature for trout and other coldwater fish, and provide food, shelter and refuge for juvenile fish from predatory fish. The riparian and SRA habitat also provides food, water, shelter, and hiding area for a variety of wildlife. The irrigation system would be designed and constructed to promote quicker regeneration of native species. Based on the HEP analysis, there would be a gain of 84.56 AAHU's in terrestrial habitat value.

The combination of the multilevel intake structure and Byrd Slough habitat restoration would promote sustainability of the coldwater fishery in the reservoir and the lower Kings River, provide a linkage of the Kings River to the historical flood plain at Byrd Slough, provide conductivity of the surface water and groundwater, and provide increased habitat values to the overall ecosystem in the lower Kings River watershed.

ENVIRONMENTAL EFFECTS AND MITIGATION

The Recommended Plan would have both beneficial and adverse effects on environmental resources. Direct beneficial effects include increasing, improving, and conserving the amount and quality of habitat values for vegetation and wildlife, fisheries, and special status species in the lower Kings River area. In addition, the work at the restoration site would add to the esthetic value of the surrounding area, enhance the recreational experience, restore the aquatic wetland ecosystem and conserve the area for wildlife. Potential adverse environmental effects of the plan would include increase in noise levels, disturbance to vegetation and wildlife including special-status species, and increase in air quality emissions.

However, since the overall goal of this project is to restore fish and wildlife habitat, any potential adverse effects would be avoided or reduced to less than significant. The increases in noise levels would only be temporary during construction and would not exceed any noise standards. Temporary disturbance to existing vegetation would be reduced by implementing best management practices during construction, and any displaced wildlife would be expected to return to the area after construction. Adverse effects on any special-status species or their habitat at the restoration site would be avoided. The temporary increase in air quality emissions would not be significant because construction would be scheduled to avoid violating any Federal or State air quality standards. Land use at the restoration site would change from open space with grazing to open space. This would be a permanent change that is supported by the local interests and is consistent with local land use plans and policies.

Since the Recommended Plan would not be expected to have any significant adverse effects, no additional mitigation (beyond best management practices and avoidance) or compensation measures would be required. Additional details of the effects and mitigation are included in the EIS/EIR.

REAL ESTATE

Since the multilevel intake structure would be attached to the upstream face of Pine Flat Dam, no land acquisition is required. Acquisition of 143.5 acres of real property in fee title is required as part of the Byrd Slough Habitat Restoration for the Recommended Plan. A detailed discussion of the real estate requirements and issues is included in Appendix E.

DESIGN AND CONSTRUCTION

Following approval of this report, work would be initiated on negotiation of a Project Management Plan (PMP) and the Planning, Engineering, and Design (PED) agreement prior to initiation of the PED phase. Following completion of the PED agreement and receipt of construction funds, plans and specifications would take about 24 months to complete. Construction would require 36 months.

During the construction period, measures would be followed to maintain public dialogue, minimize disturbance to environmental and cultural resources, ensure proper debris disposal methods, and restore the site. As appropriate, necessary safety measures would be taken to protect individuals present or living in the vicinity of the construction area.

OPERATION AND MAINTENANCE

The non-Federal sponsor would be responsible for performing 100% of the annual operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) to maintain the improvements. Annual OMRR&R costs for the Recommended Plan are estimated at $56,000. A brief discussion and breakdown of the estimated items for annual OMRR&R and associated costs are included in Appendix C, Section V.

COSTS AND HABITAT VALUES OF THE RECOMMENDED PLAN

Costs

Estimated costs for the Recommended Plan are shown in Table VI-1. The estimated first cost (October 2000 price levels) is $35,800,000. The estimated investment cost (October 2000 price levels) is $40,093,000. Annual costs, including interest, amortization, and OMRR&R, would be $2,734,000.

Table VI-1. Investment and Annual Costs for Recommended Plan[1] (x $1,000)

	Multilevel Intake Structure	Byrd Slough Habitat Restoration	Total
Investment Cost			
First Cost	$35,000	$800	$35,800
Interest During Construction	$4,135	$162	$4,297
Total Investment Cost	$39,135	$962	$40,097
Annual Cost			
Interest and Amortization	$2,615	$63	$2,678
OMRR&R (100% Non-Federal Cost)	$55	$1	$56
Total Annual Cost	$2,670	$64	$2,734

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels.

Table VI-2 is an apportionment of the first cost between Federal and non-Federal interests. The division of responsibility between Federal and non-Federal interests, along with the sponsor's financial capability, is presented later in this chapter. As shown in the table, the non-Federal sponsor would be responsible for $12,529,000 of the first cost; and the Federal share of the project first cost is $23,271,000.

Table VI-2. Cost Apportionment for Recommended Plan[1] (x $1,000)

Type	Description	Federal	Non-Federal	Total
01	Lands and Damages	$14	$333	$347
06	Fish & Wildlife	$29,383	0	$29,383
18	Cultural Resources	$4	0	$4
30	Planning, Engineering, and Design	$3,616	0	$3,616
31	Construction Management	$2,450	0	$2,450
Non-Federal Contribution		-$12,196	$12,196	0
Total First Cost		$23,271	$12,529	$35,800
Total Cash		$23,271	$12,196	$35,467
Total LERRD		0	$333	$333
Total Share		$23271	$12, 529	$35,800

[1] 50-year project life, 6 3/8 percent interest rate, October 2000 price levels

Habitat Values

The primary benefits of the Recommended Plan would be to provide optimum water temperatures for coldwater fish survival, improve fishery habitat in Pine Flat Lake

and below the dam in the lower Kings River, restore historic floodplain aquatic wetland, increase riparian and SRA habitats along the lower Kings River, and increase the fish and wildlife habitat value of the overall ecosystem of the lake and the lower Kings River. The habitat values for the Recommended Plan are estimated to be 40 WUA and 84.56 AAHU.

INCREMENTAL COST ANALYSIS

A detailed cost effectiveness and incremental cost analysis of alternative restoration designs was conducted on each alternative (see Appendix D). This analysis of cost effectiveness helped to eliminate plans that were not cost effective. The analysis identified the changes in costs as levels of restoration inputs were increased.

IMPLEMENTATION REQUIREMENTS

Following are the steps necessary to implement the Recommended Plan. These steps are based on existing policy for plan implementation and cost-sharing requirements.

Report Approval

The draft report will be circulated for public and agency review and comment. The report will be revised based on comments received, and the final report will be prepared. The final report will be submitted to the Corps South Pacific Division and Washington D.C. Headquarters.

Division of Plan Responsibilities

Federal Responsibilities. Following completion of the final feasibility report and EIS/EIR and the authorization of the project by Congress, the Federal Government will prepare detailed plans and designs, including plans and specifications. After completion of the plans and specifications, the Federal Government will construct the project after funds are appropriated and non-Federal interests provide the lands, easements, rights-of-way, relocations, disposal areas (LERRD's), and assurances for the non-Federal cooperation requirements.

Non-Federal Responsibilities. Current Federal law requires non-Federal participation in the financing of projects. In accordance with the Water Resources Development Act of 1986 and other requirements, the non-Federal sponsor will:

- Provide all LERRD's necessary to construct and maintain the restoration measures.

- Provide additional cash contribution, if necessary, to bring the non-Federal share to 35 percent of the total project costs.

- Provide, or pay to the Federal Government the cost of providing, all physical features that may be required at any excavated material disposal areas required for the construction and OMRR&R of the project.

- Hold and save the United States free from damages caused by the construction and maintenance of the project, except damages due to the fault or negligence of the United States or its contractors.

- Operate, maintain, repair, rehabilitate, and replace all completed work, without cost to the United States, in accordance with regulations prescribed by the Secretary of the Army.

- Comply with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646; 84 Stat. 1984), as amended.

- Perform at the initiation of construction, and thereafter, any environmental investigations necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. 9601) on all lands necessary for project construction and OMRR&R.

- Assume complete financial responsibility for the cleanup of any hazardous materials on project lands and regulated under CERCLA and be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner so that liability will not arise under CERCLA.

- Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, Department of Defense Directive 5500.11, and Army Regulation 600-7.

- Comply with Section 103 of the Water Resources Development Act of 1986 (Public Law 662), as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

- Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

Federal and non-Federal obligations and requirements will be defined in a PMP and a Project Cooperation Agreement (PCA) will be signed prior to initiation of construction. The non-Federal funds will not need to be provided until after Congress authorizes the project and appropriates construction funds and a PCA is signed. Payment of the funds will be made at intervals during construction.

Views of Non-Federal Sponsor

Local interests have been supportive of the fish and wildlife restoration study and project. Throughout development of this study, there has been significant coordination with the KRCD, KRWA, and other interested State and Federal agencies. Copies of the non-Federal sponsor's letter of request for the study and project support are provided in Appendix F.

Financial Capability of the Sponsor

The non-Federal sponsors, KRCD and KRWA (equal cost-sharing partners) support the Recommended Plan (Alternative 6). They will provide letters of support and intent to the Corps prior to submission of the final feasibility report. A financial capability plan will be attached in Appendix G.

Project Management Plan and Plan, Engineering, and Design Agreement

Prior to initiation of plans and specifications, the Federal Government and non-Federal project sponsor will execute a PMP and PED agreement. This agreement will define responsibilities of the non-Federal project sponsor for plans and specifications, project construction, and project operation. The draft PMP and PED agreement are included as Appendix H.

Project Schedule

The following is a potential schedule for the project:

- Public and agency review of the draft report and EIS/EIR — Jun 2001
- Finalize report and EIS/EIR, process documents, initiate plans and specifications, and obtain Corps approval — Sep 2001
- Corps and sponsor sign the PED Agreement — Jan 2002
- Implement project — Jan 2004
- Improved fishery and wildlife habitat implemented — Jan 2007

CHAPTER VII

CONCLUSIONS AND RECOMMENDATION

CONCLUSIONS

Major conclusions of the study are:

- Pine Flat Dam, located on the Kings River in Fresno County, California, provides local and regional flood protection and contains storage capacity for about 1 million acre-feet of water. Due to the design and operation of the dam, a portion of the reservoir pool can experience a significant increase in water temperature at certain times of the year.

- The inability to regulate water temperature in the lake threatens the survival of the lake fishery along with the coldwater fishery downstream from the dam in the Kings River. These adverse effects become even more pronounced in years of low-water storage or periods of long, hot, dry weather.

- In May 1999, a Kings River Fisheries Management Program Framework Agreement was signed by KRCD, KRWA, and DFG. This agreement established a number of fishery goals and objectives for the lower Kings River and Pine Flat Lake. An important component of this agreement is to modify Pine Flat Dam or construct other features to increase minimum flows and/or lower release temperatures from the dam.

- A plan to improve the fishery habitat within Pine Flat Lake and downstream of the dam on the lower Kings River is physically, economically, and environmentally feasible.

- Of the eight plans considered, the Recommended Plan, which includes installing a multilevel intake structure at Pine Flat Dam and restoring 143.5 acres of historic floodplain riparian and SRA habitat at the Byrd Slough site, was found to be the most cost effective and is supported by the KRCD and other local interests.

- Based on plan formulation and analysis, the Recommended Plan would improve fishery survival conditions in Pine Flat Lake and in the Kings River downstream of the dam, improve fish and wildlife habitat, increase riparian and SRA habitats, reestablish native historic plant and wildlife communities along the lower Kings River, improve the linkage of the Kings River to the historical flood plain and improve the ground and surface water regimen at Byrd Slough and the lower Kings River below the dam, and provide increased ecosystem habitat values to the lower Kings River watershed.

- The primary features of the Recommended Plan include (1) installing a multilevel intake structure at Pine Flat Dam to regulate release temperatures and (2) restoring 143.5 acres of riparian and SRA habitat at the Byrd Slough site. The estimated first cost for the Recommended Plan is $35,800,000 ($23,190,000 Federal and $12,610,000 non-Federal).

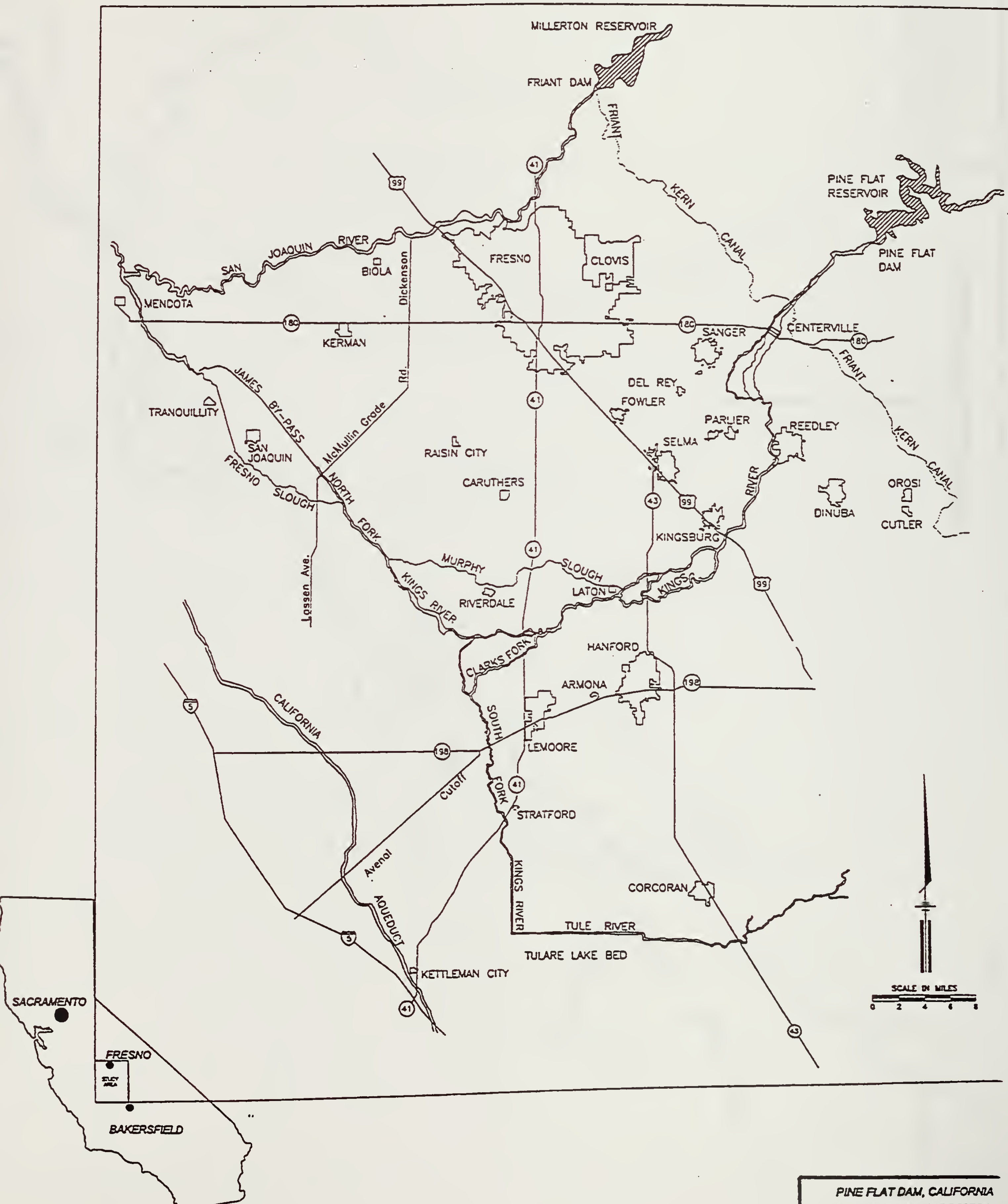
RECOMMENDATION

After giving careful consideration to the environmental, social, and economic effects and engineering feasibility of the alternative plans, I recommend that the Recommended Plan for improving fishery and wildlife habitat at Pine Flat Lake and below Pine Flat Dam on the lower Kings River, with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable, be authorized for implementation as a Federal project, subject to cost sharing, financing, and other requirements of the Water Resources Development Act of 1986. I further recommend that this report be approved as the basis for preparation of plans and specifications for construction of this project.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding.

Michael Walsh
Colonel,
Corps of Engineers

PLATES



PINE FLAT DAM, CALIFORNIA
FISH & WILDLIFE HABITAT RESTORA

REGIONAL MAP

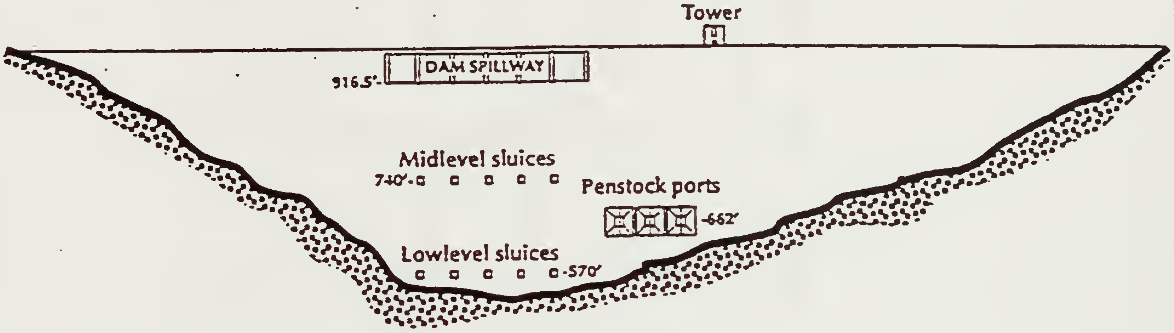
Plate 1

WINTON PARK
ACOE BRIDGE
PINE FLA
SPRINGS RD.
HUGHES CREEK
MILL CREEK
ELWOOD RD.
TRIMMER
RIVER
Piedra
RD. KINGS
TRIMMER SPRINGS
RIVER
FRESNO WEIR
KINGS
AVOCADO LAKE
FRIANT-KERN CANAL
RD
SPRINGS
TRIMMER
AVENUE
BELMONT
PIEDRA RD.
RIVER
PIEDRA
RD.
HWY. 180
Centerville
KINGS
Minkler
SCALE IN MILES
0
1
2
PINE FLAT DAM, CALIFORNIA
FISH & WILDLIFE HABITAT RESTORATION
VICINITY MAP

Plate 2

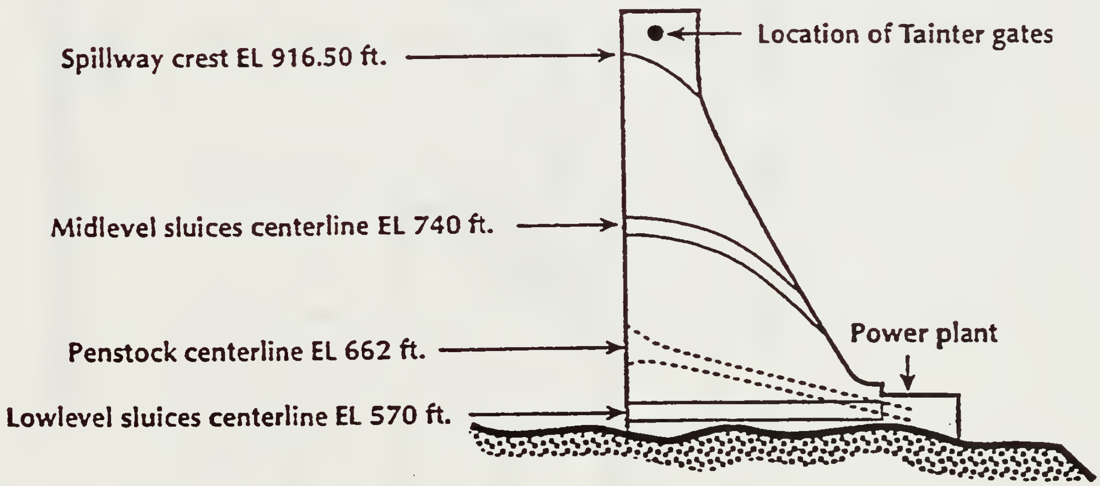
PINE FLAT DAM

UPSTREAM FACE



PINE FLAT DAM

PROFILE VIEW OF DAM

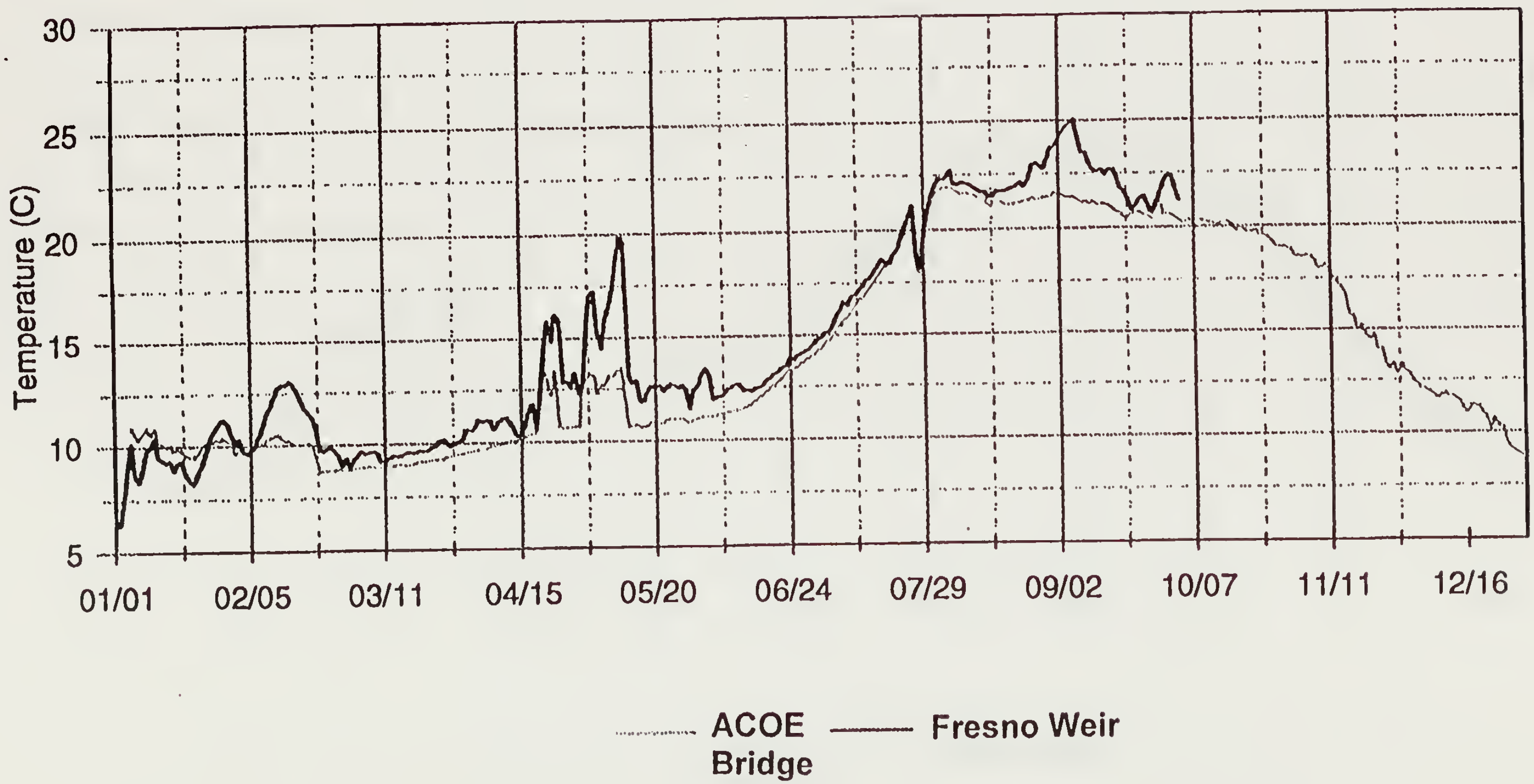


PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION

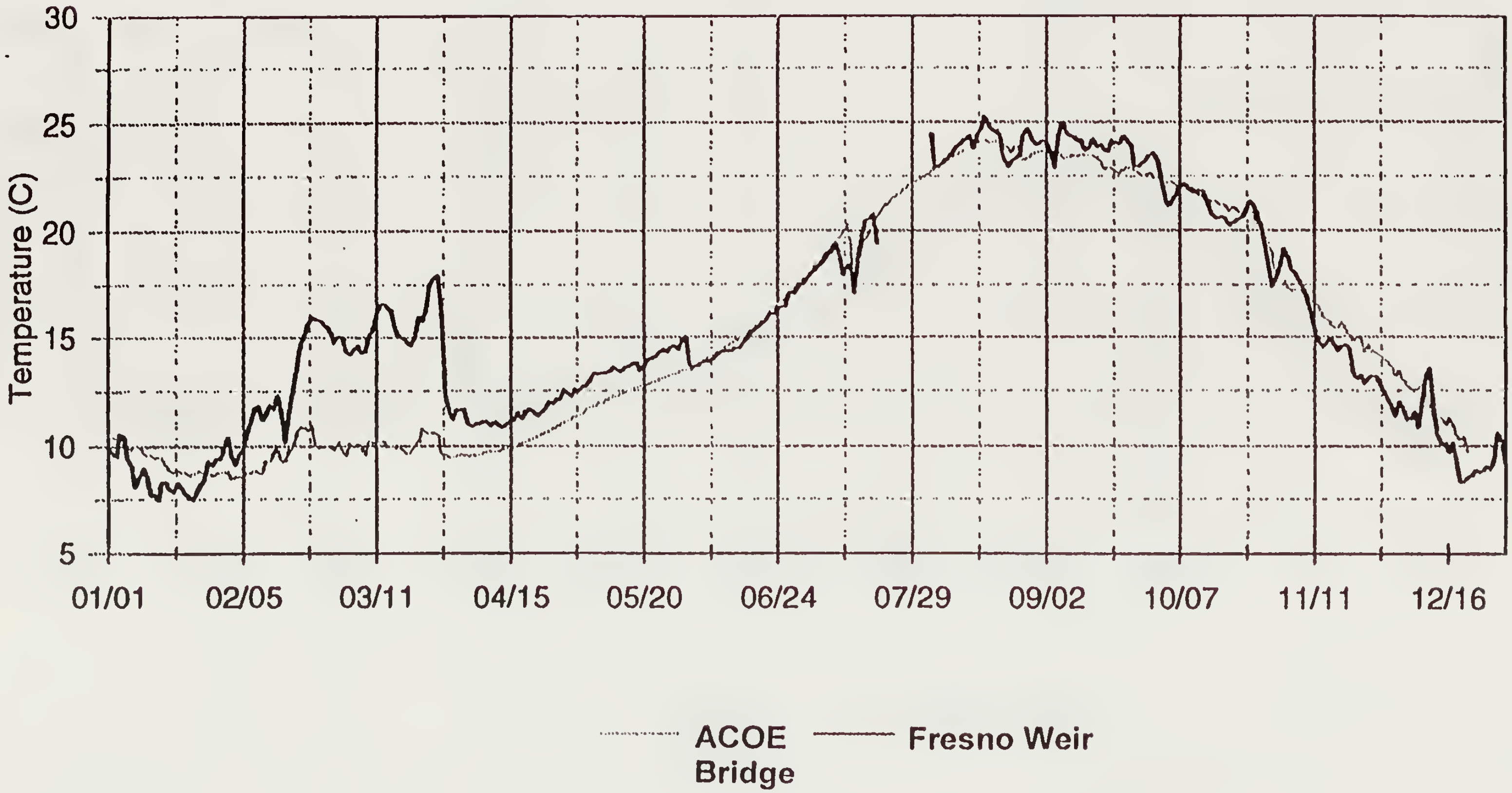
UPSTREAM FACE AND CROSS-SECTIONAL DIAGRAMS OF PINE FLAT DAM

SACRAMENTO DISTRICT CORPS OF ENGINEERS

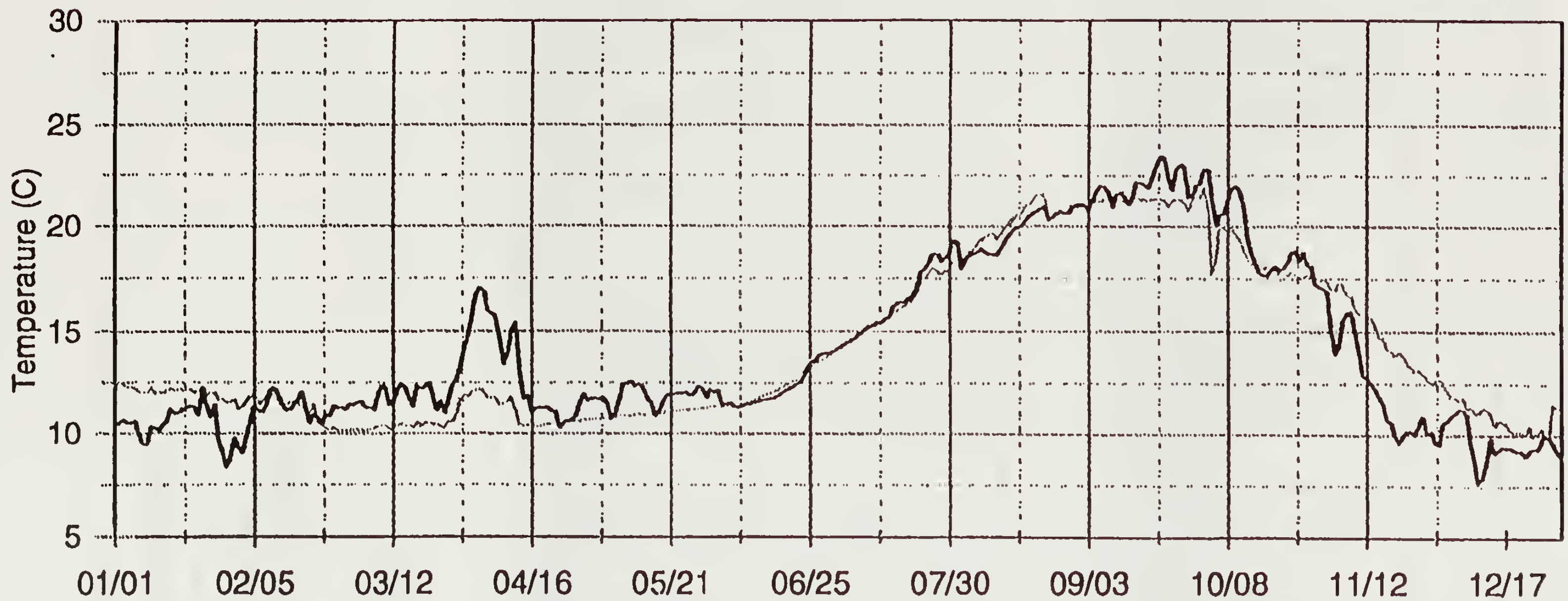
Daily Average Water Temperatures
1988

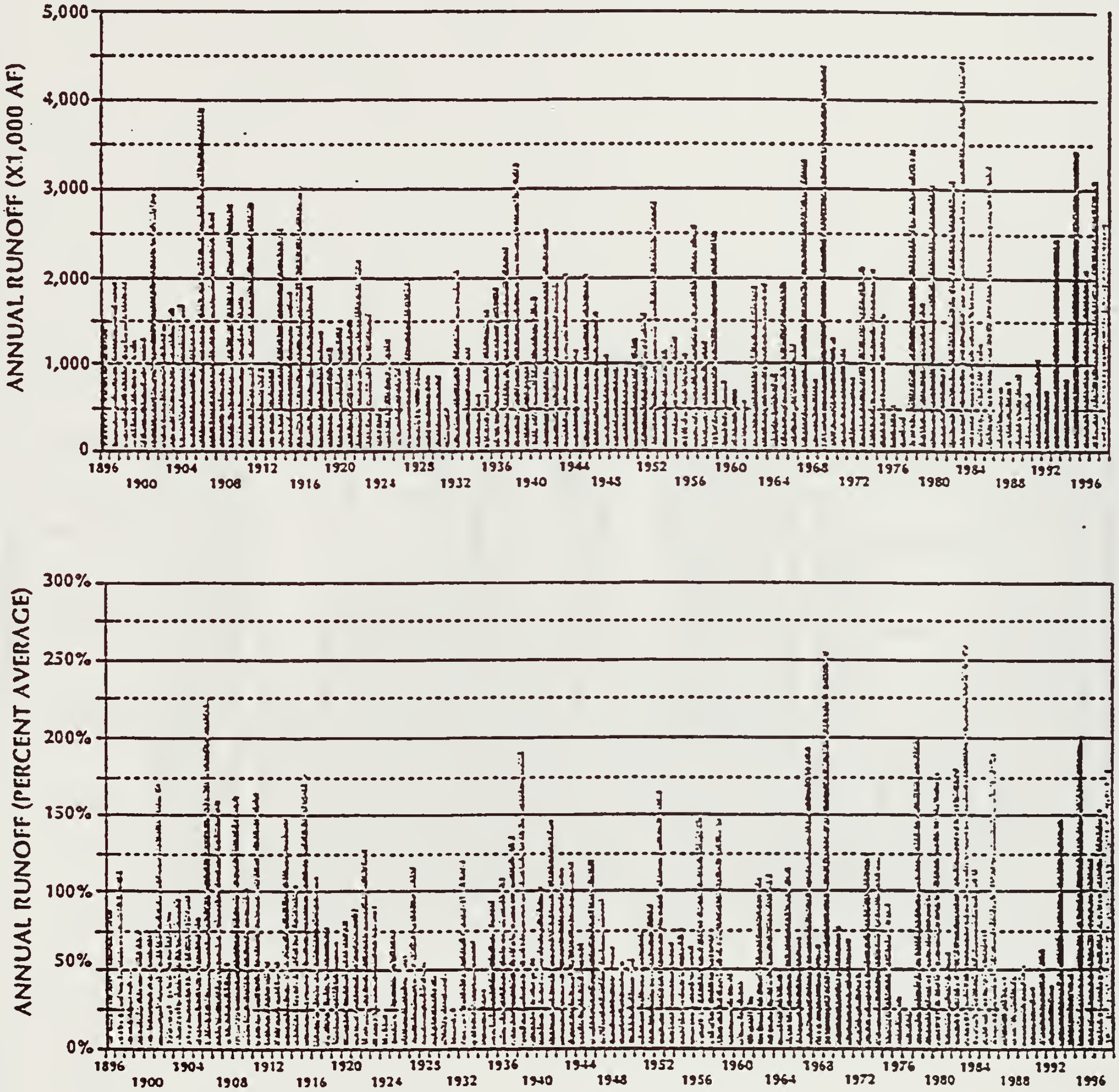


Daily Average Water Temperatures
1992



Daily Average Water Temperatures
1994

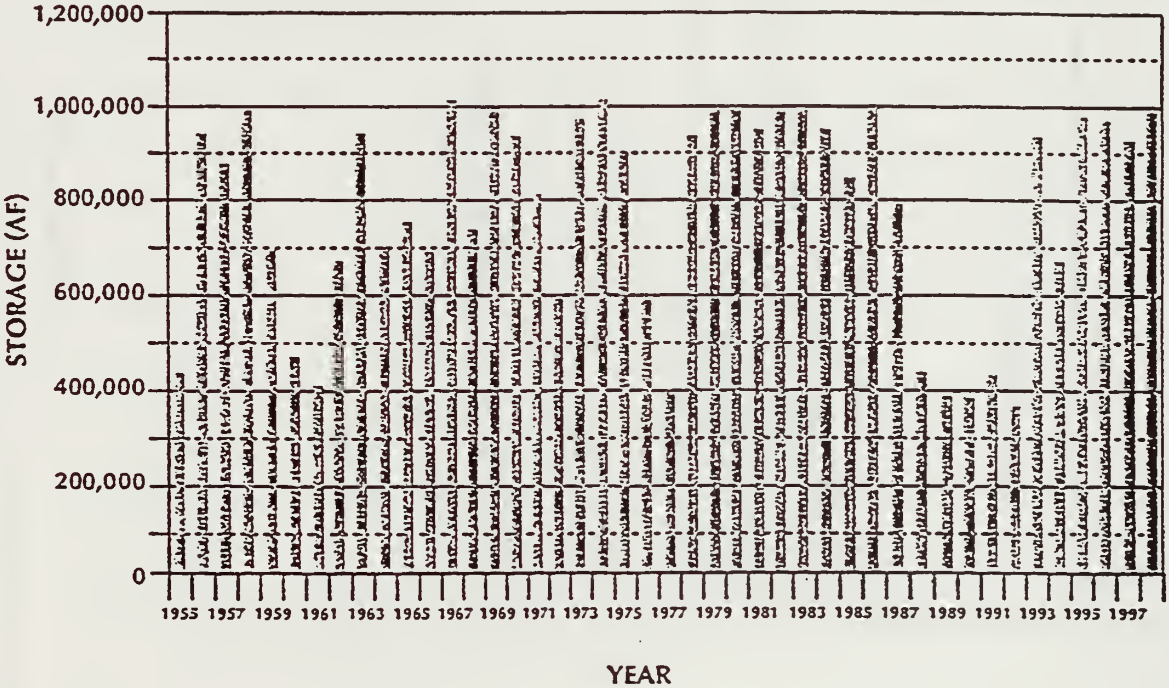




PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION

KINGS RIVER ANNUAL RUNOFF FROM U.S.G.S RECORDS

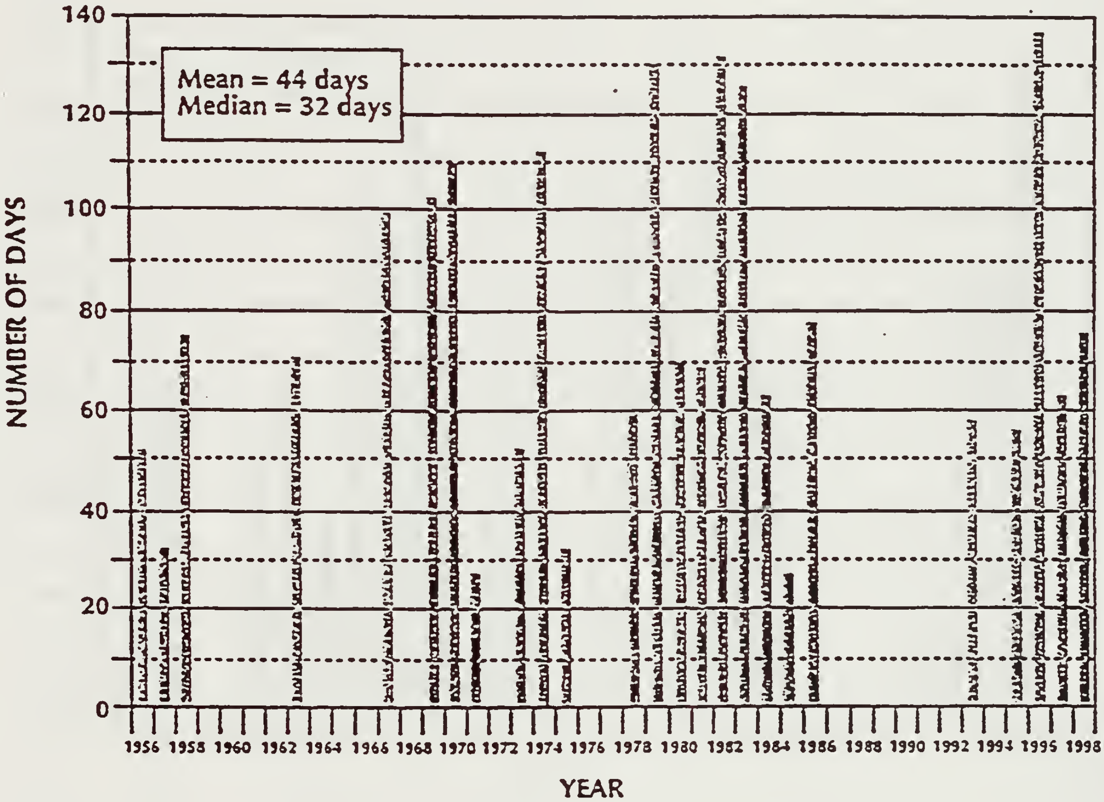
SACRAMENTO DISTRICT CORPS OF ENGINEERS



PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION

PINE FLAT RESERVOIR MAXIMUM STORAGE

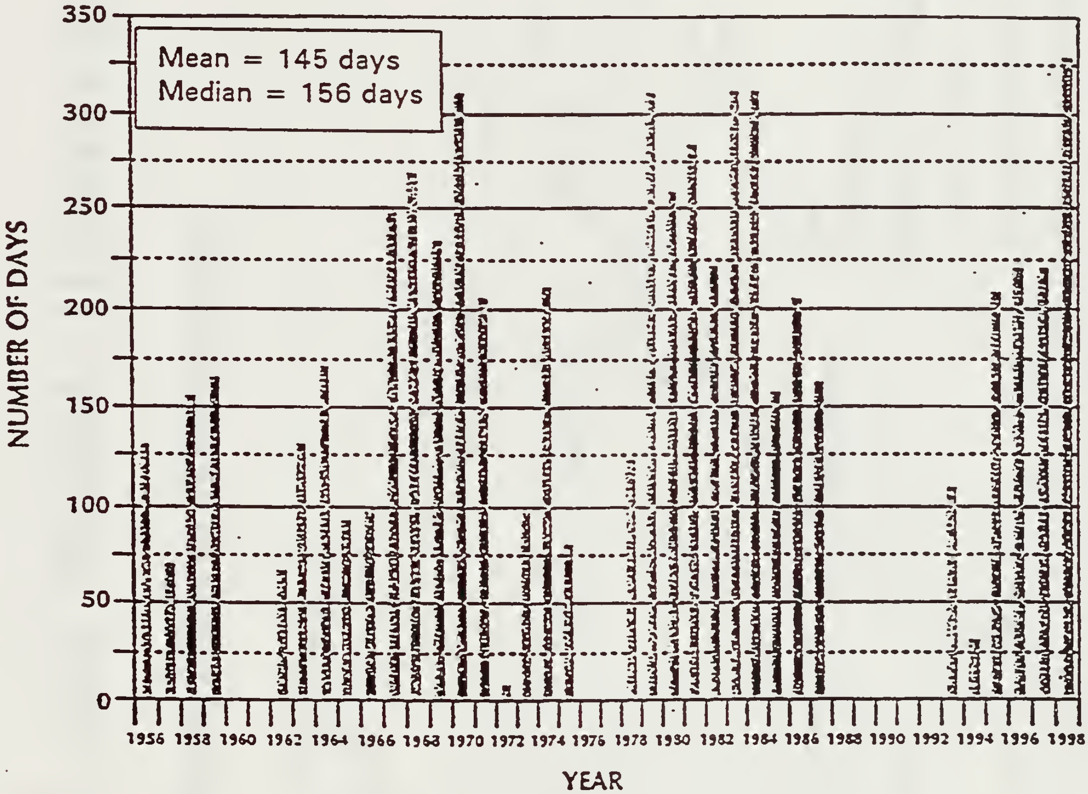
SACRAMENTO DISTRICT CORPS OF ENGINEERS



PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION

PINE FLAT RESERVOIR
DAYS OF STORAGE
GREATER THAN 800,000 AF
ELEVATION=915.5 FEET

SACRAMENTO DISTRICT CORPS OF ENGINEERS



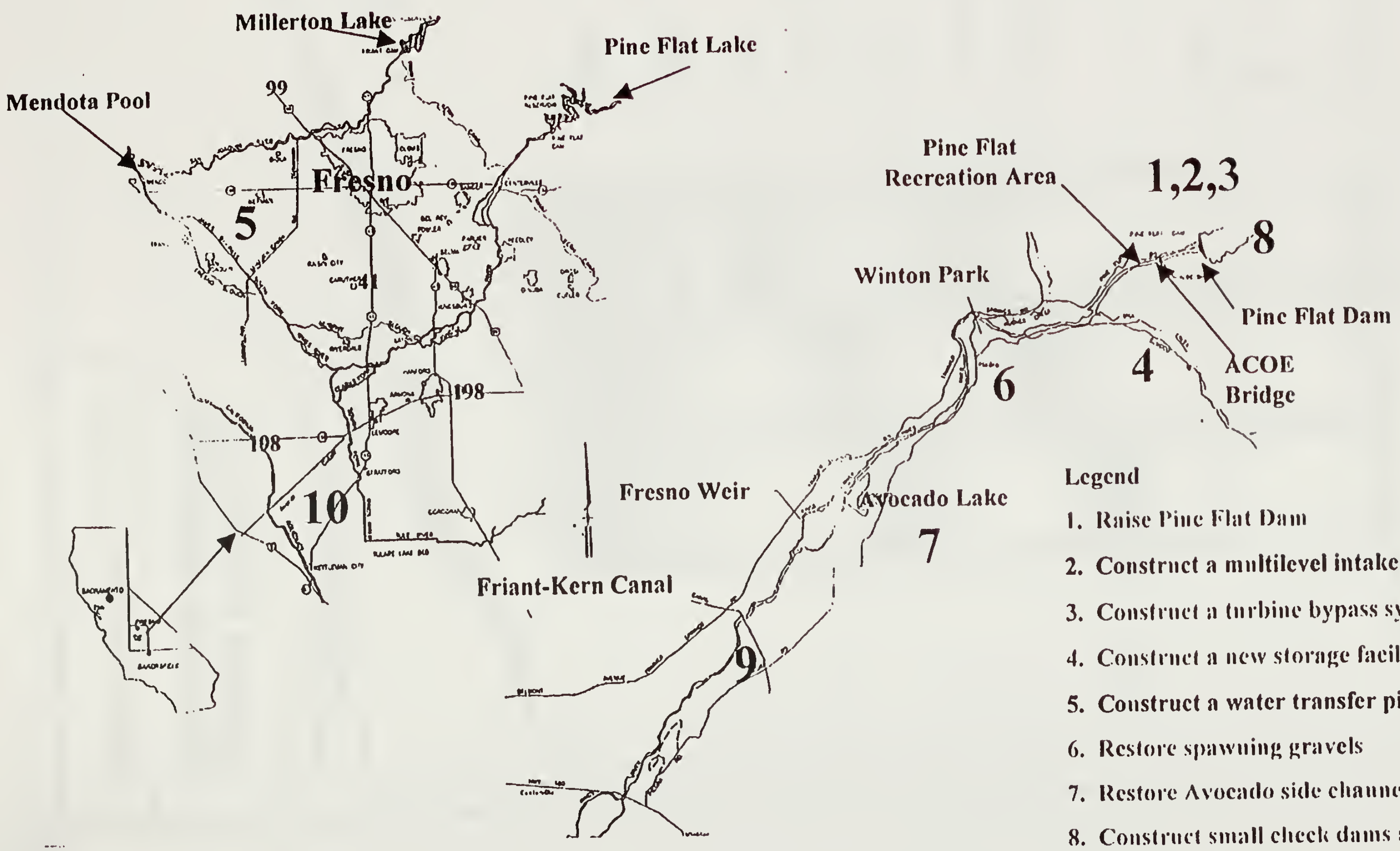
PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION

PINE FLAT RESERVOIR
DAYS OF STORAGE
GREATER THAN 600,000 AF
ELEVATION=874 FEET

SACRAMENTO DISTRICT CORPS OF ENGINEERS

Pine Flat Dam Fish and Wildlife Habitat Restoration

Restoration Measures



Legend

1. Raise Pine Flat Dam
2. Construct a multilevel intake structure
3. Construct a turbine bypass system
4. Construct a new storage facility on Mill Creek
5. Construct a water transfer pipeline
6. Restore spawning gravels
7. Restore Avocado side channel slough
8. Construct small check dams at Flume Cove in Pine Flat Lake
9. Byrd Slough Habitat Restoration
10. Restore lands on Westlake Farms

Plate 11

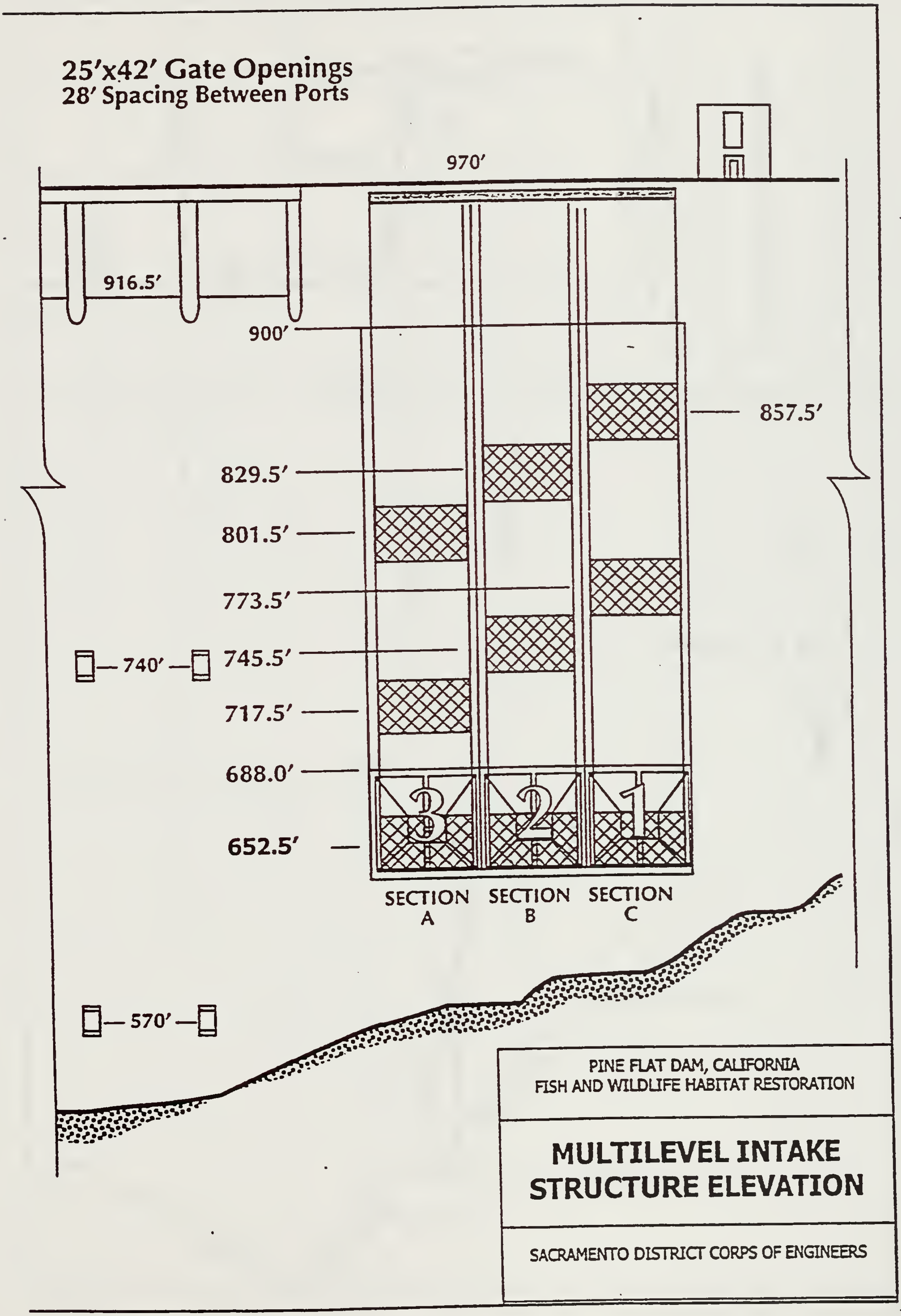

25′x42′ Gate Openings
28′ Spacing Between Ports
970′
916.5′
900′
857.5′
829.5′
801.5′
773.5′
745.5′
740′
717.5′
688.0′
652.5′
3
2
1
SECTION A
SECTION B
SECTION C
570′
PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION
MULTILEVEL INTAKE STRUCTURE ELEVATION
SACRAMENTO DISTRICT CORPS OF ENGINEERS

Plate 12

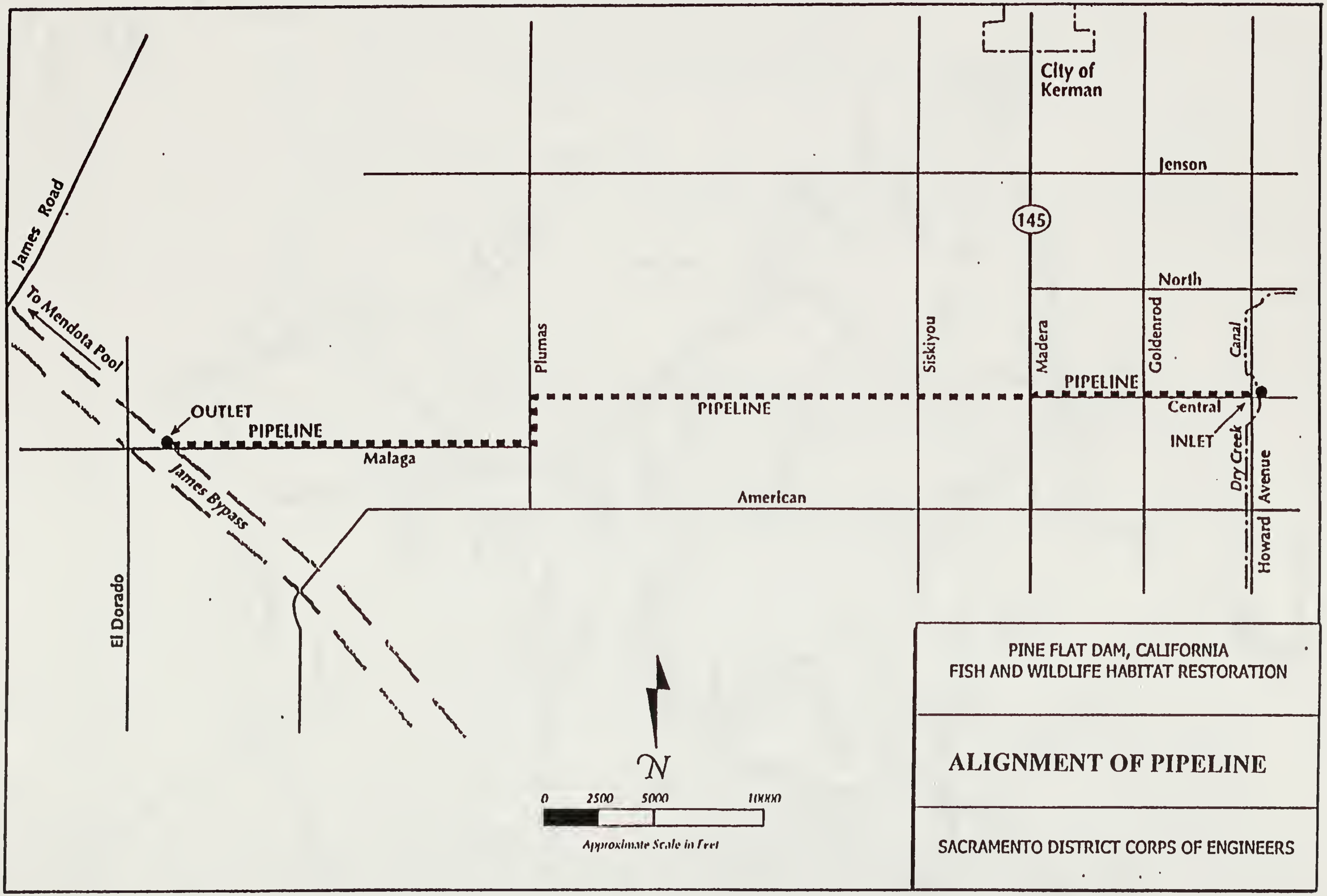
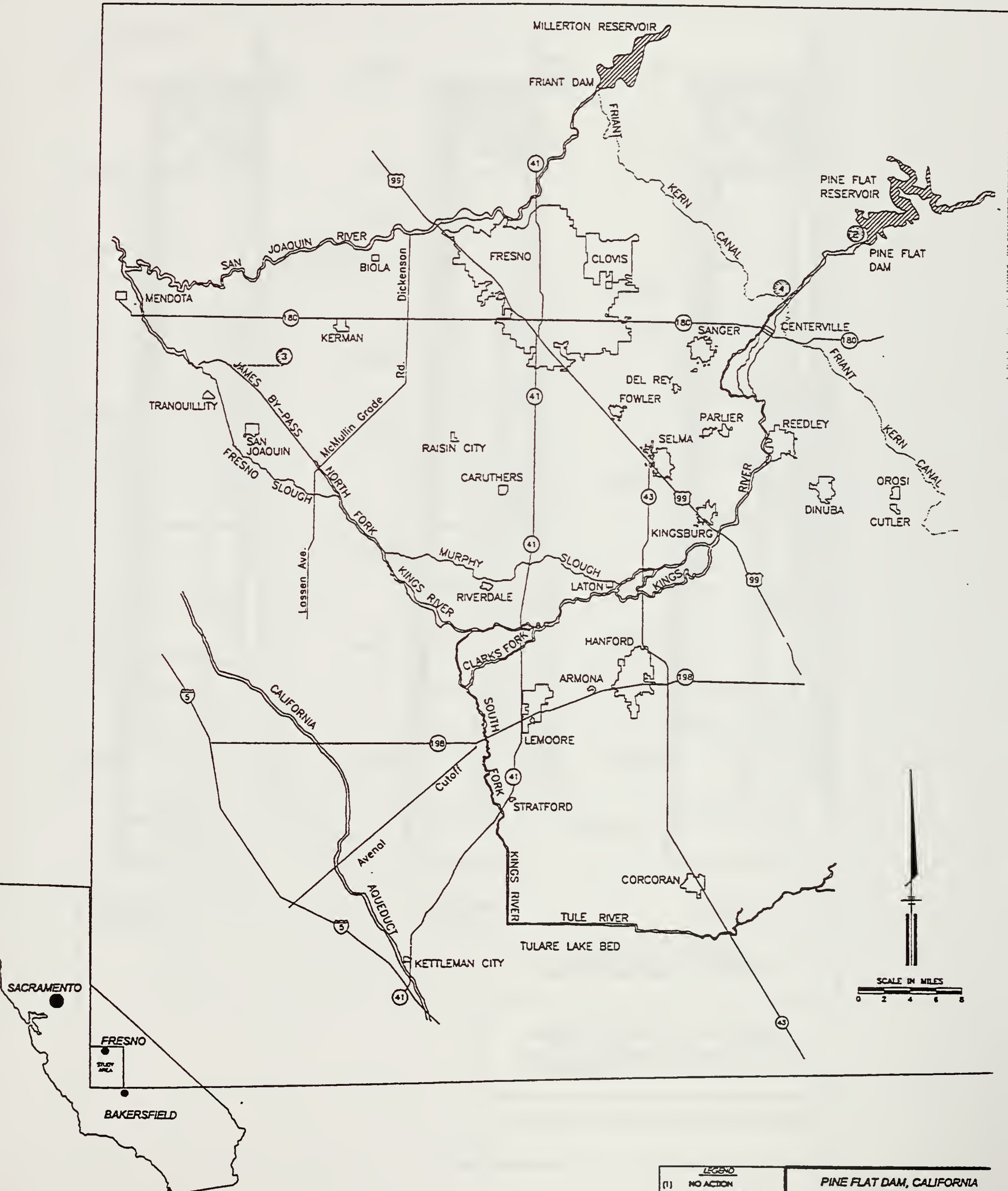

PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION
ALIGNMENT OF PIPELINE
SACRAMENTO DISTRICT CORPS OF ENGINEERS
City of
Kerman
Jenson
145
North
Goldenrod
Canal
Madera
Siskiyou
Plumas
PIPELINE
PIPELINE
Central
INLET
Dry Creek
Howard Avenue
American
OUTLET
PIPELINE
Malaga
James Bypass
James Road
To Mendota Pool
El Dorado
N
0
2500
5000
10000
Approximate Scale in Feet

Plate 13



LEGEND

(1) NO ACTION
(2) MULTILEVEL STRUCTURE
(3) WATER TRANFER PIPELINE
(4) FRIANT-KERN CANAL HABITAT RESTORATION
(5,6,7,8) COMBINATIONS

PINE FLAT DAM, CALIFORNIA
FISH & WILDLIFE HABITAT RESTORAT

ALTERNATIVES

Project File:
Dwg. No.

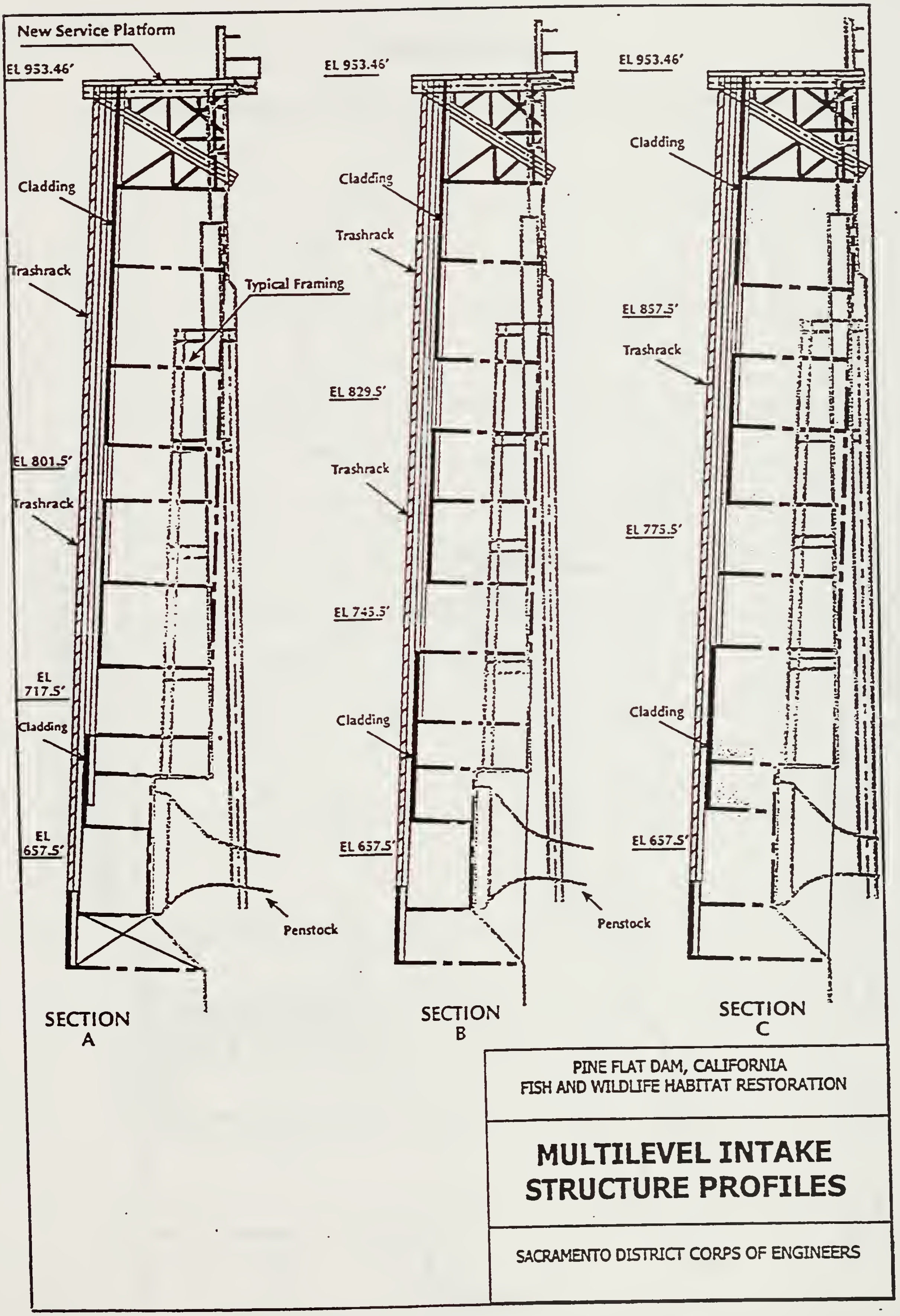

New Service Platform
EL 953.46'
Cladding
Trashrack
Typical Framing
EL 801.5'
Trashrack
EL 717.5'
Cladding
EL 657.5'
Penstock
SECTION A
EL 953.46'
Cladding
Trashrack
EL 829.5'
Trashrack
EL 745.5'
Cladding
EL 657.5'
Penstock
SECTION B
EL 953.46'
Cladding
EL 857.5'
Trashrack
EL 775.5'
Cladding
EL 657.5'
SECTION C
PINE FLAT DAM, CALIFORNIA
FISH AND WILDLIFE HABITAT RESTORATION
MULTILEVEL INTAKE STRUCTURE PROFILES
SACRAMENTO DISTRICT CORPS OF ENGINEERS

Plate 15

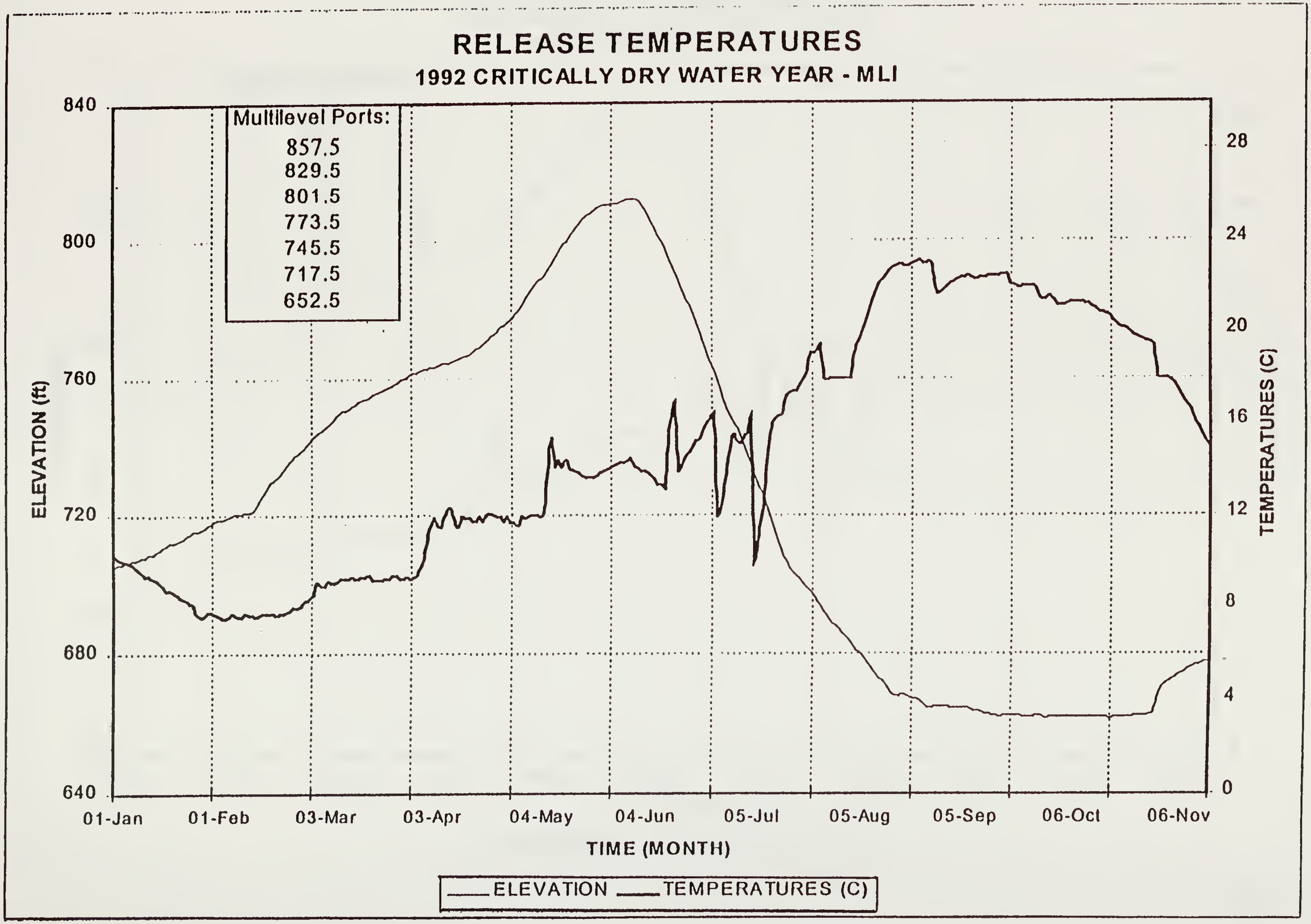

RELEASE TEMPERATURES
1992 CRITICALLY DRY WATER YEAR - MLI
Multilevel Ports:
857.5
829.5
801.5
773.5
745.5
717.5
652.5
840
800
760
720
680
640
ELEVATION (ft)
28
24
20
16
12
8
4
0
TEMPERATURES (C)
01-Jan
01-Feb
03-Mar
03-Apr
04-May
04-Jun
05-Jul
05-Aug
05-Sep
06-Oct
06-Nov
TIME (MONTH)
ELEVATION
TEMPERATURES (C)

Plate 16

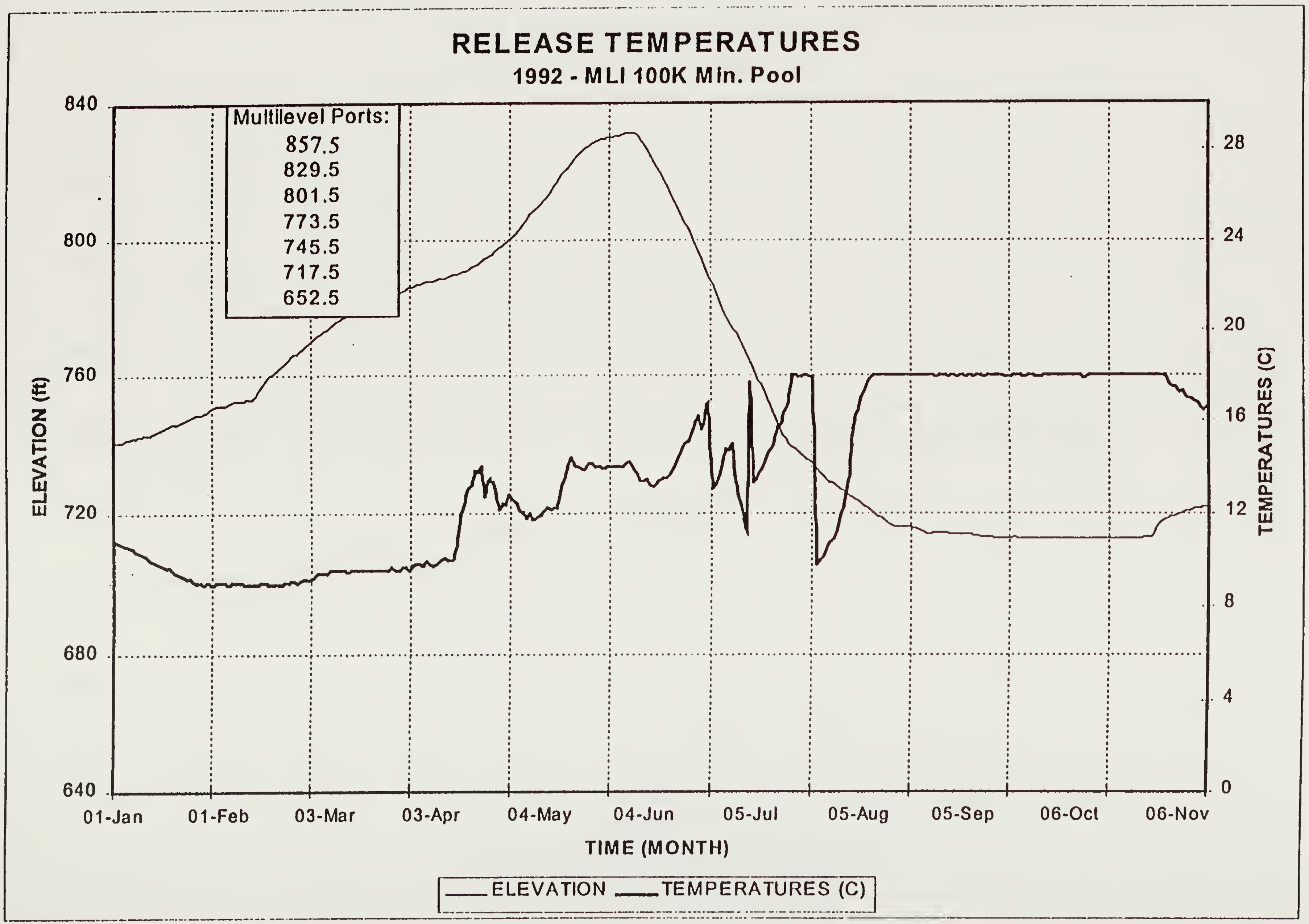

RELEASE TEMPERATURES
1992 - MLI 100K Min. Pool
Multilevel Ports:
857.5
829.5
801.5
773.5
745.5
717.5
652.5
ELEVATION (ft)
840
800
760
720
680
640
TEMPERATURES (C)
28
24
20
16
12
8
4
0
01-Jan
01-Feb
03-Mar
03-Apr
04-May
04-Jun
05-Jul
05-Aug
05-Sep
06-Oct
06-Nov
TIME (MONTH)
ELEVATION
TEMPERATURES (C)

Plate 17

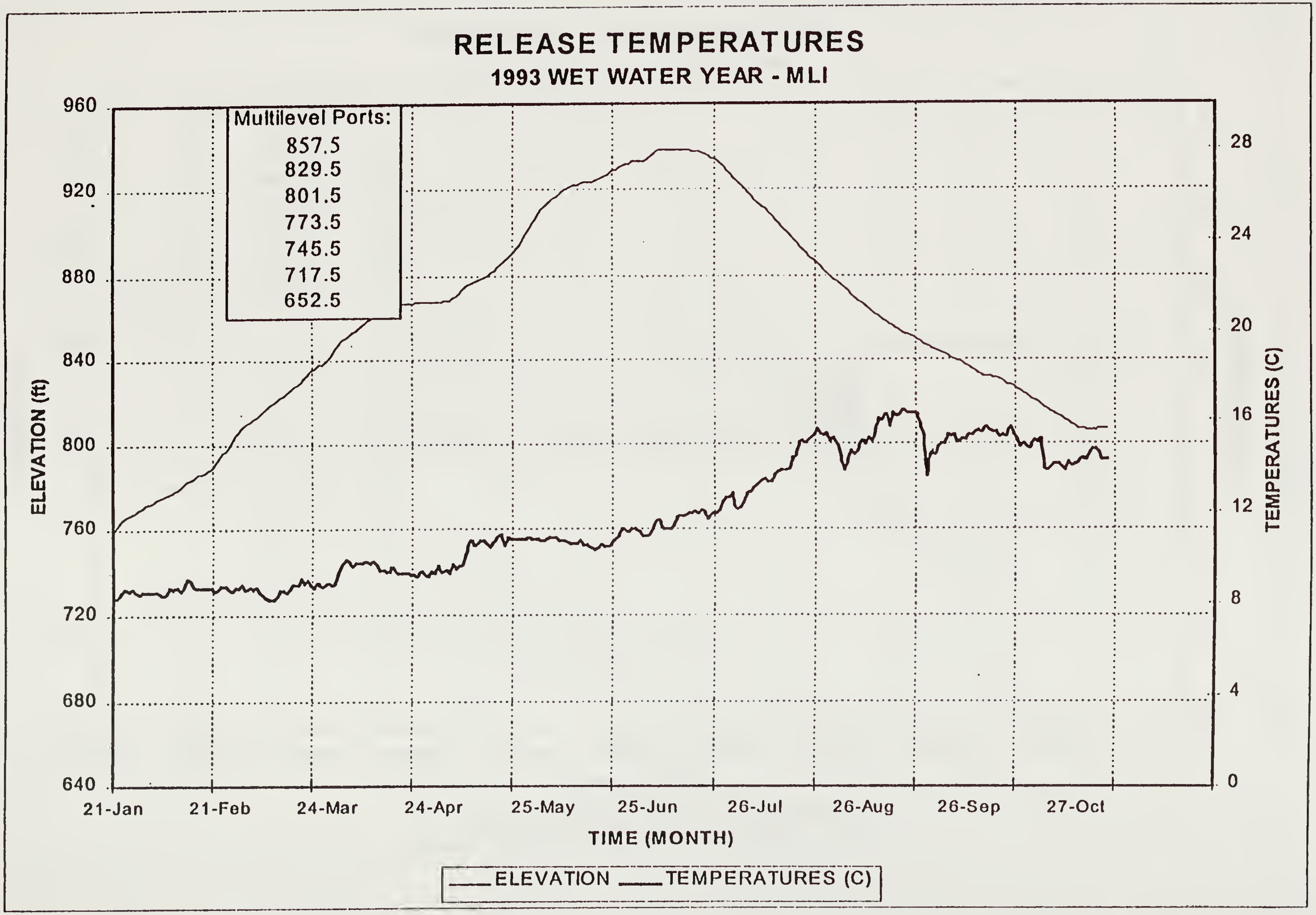

RELEASE TEMPERATURES
1993 WET WATER YEAR - MLI
Multilevel Ports:
857.5
829.5
801.5
773.5
745.5
717.5
652.5
ELEVATION (ft)
960
920
880
840
800
760
720
680
640
TEMPERATURES (C)
28
24
20
16
12
8
4
0
21-Jan
21-Feb
24-Mar
24-Apr
25-May
25-Jun
26-Jul
26-Aug
26-Sep
27-Oct
TIME (MONTH)
ELEVATION
TEMPERATURES (C)

Plate 18

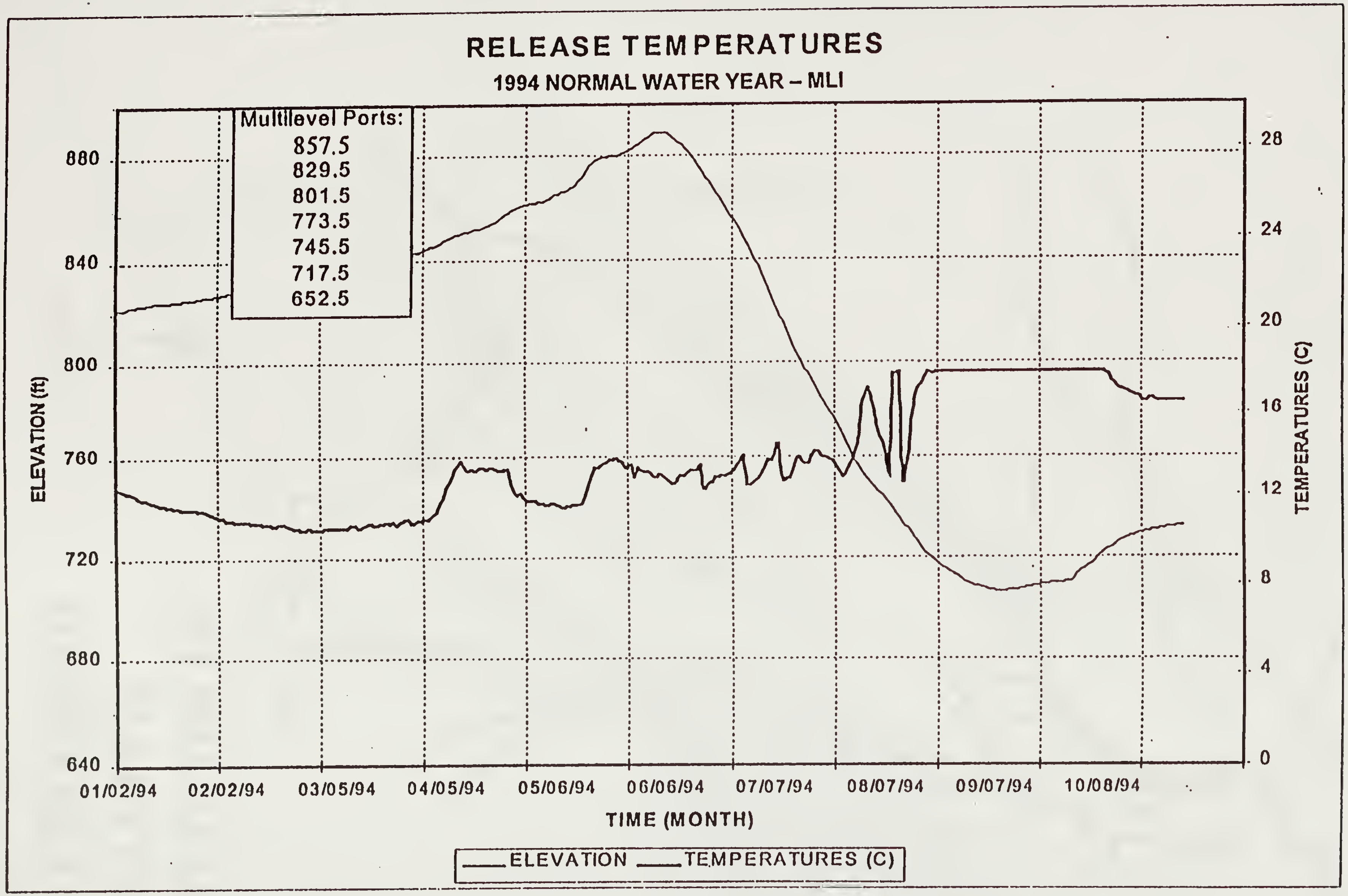
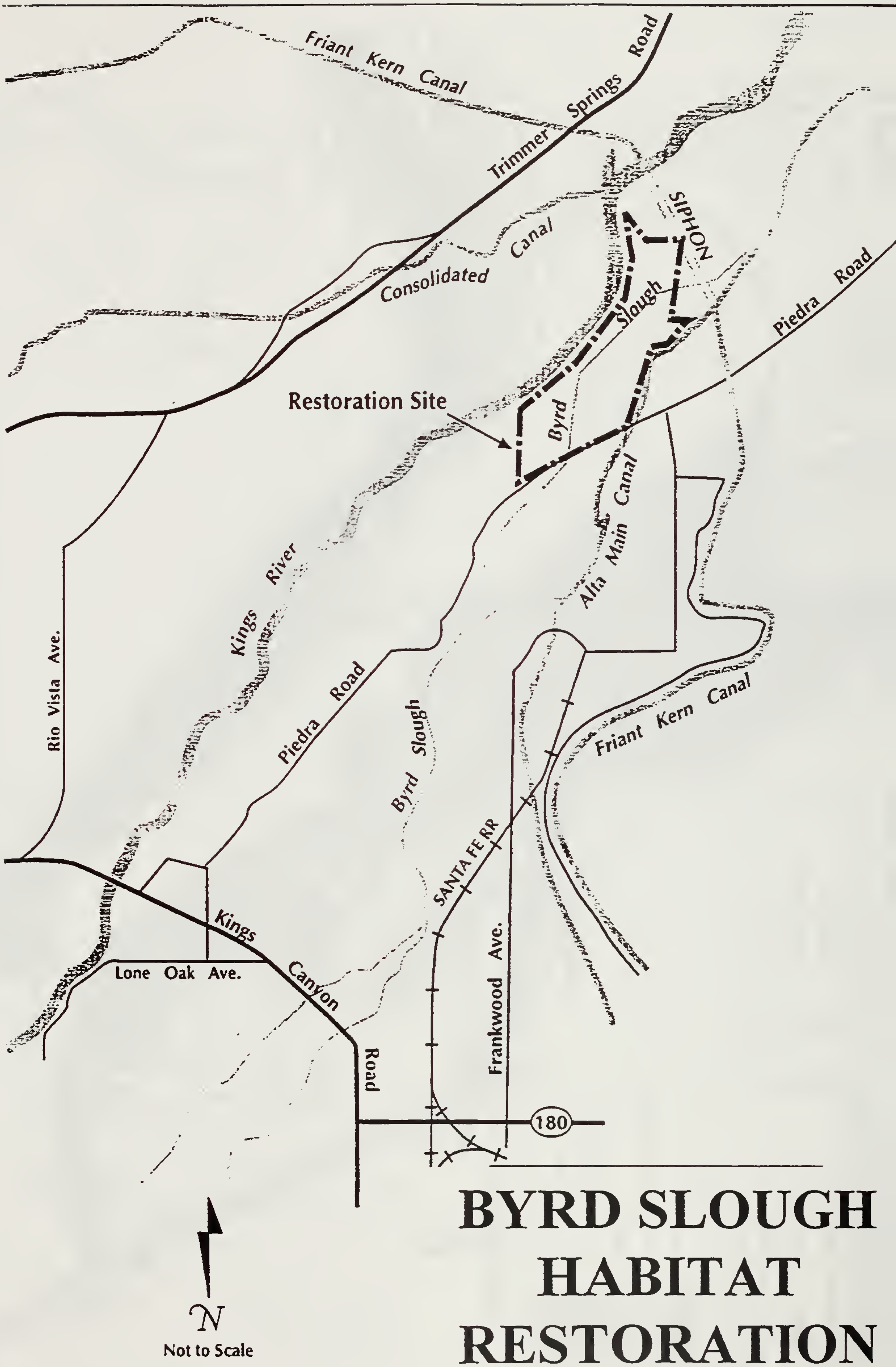
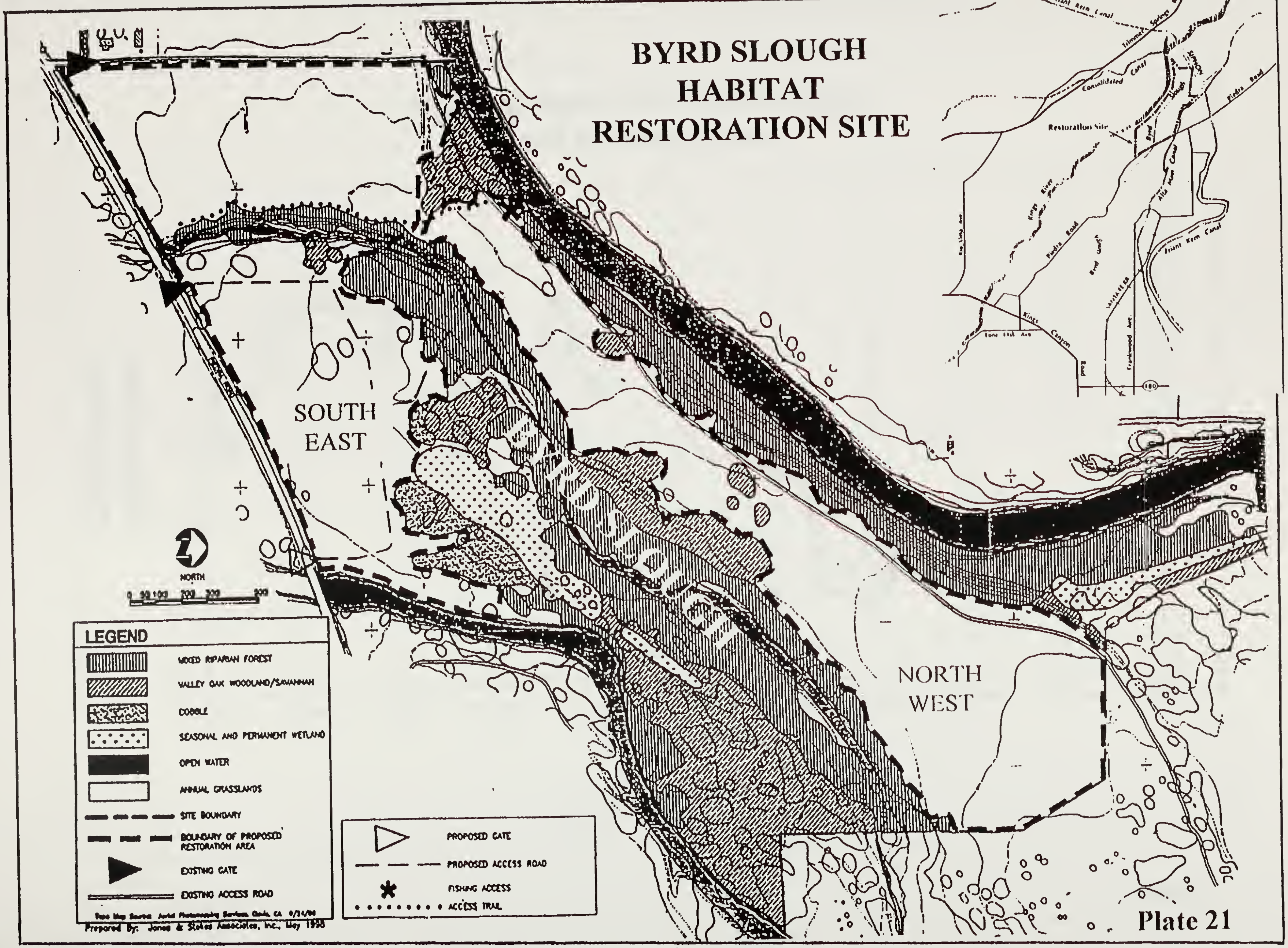

RELEASE TEMPERATURES
1994 NORMAL WATER YEAR – MLI
Multilevel Ports:
857.5
829.5
801.5
773.5
745.5
717.5
652.5
ELEVATION (ft)
880
840
800
760
720
680
640
TEMPERATURES (C)
28
24
20
16
12
8
4
0
01/02/94
02/02/94
03/05/94
04/05/94
05/06/94
06/06/94
07/07/94
08/07/94
09/07/94
10/08/94
TIME (MONTH)
ELEVATION
TEMPERATURES (C)

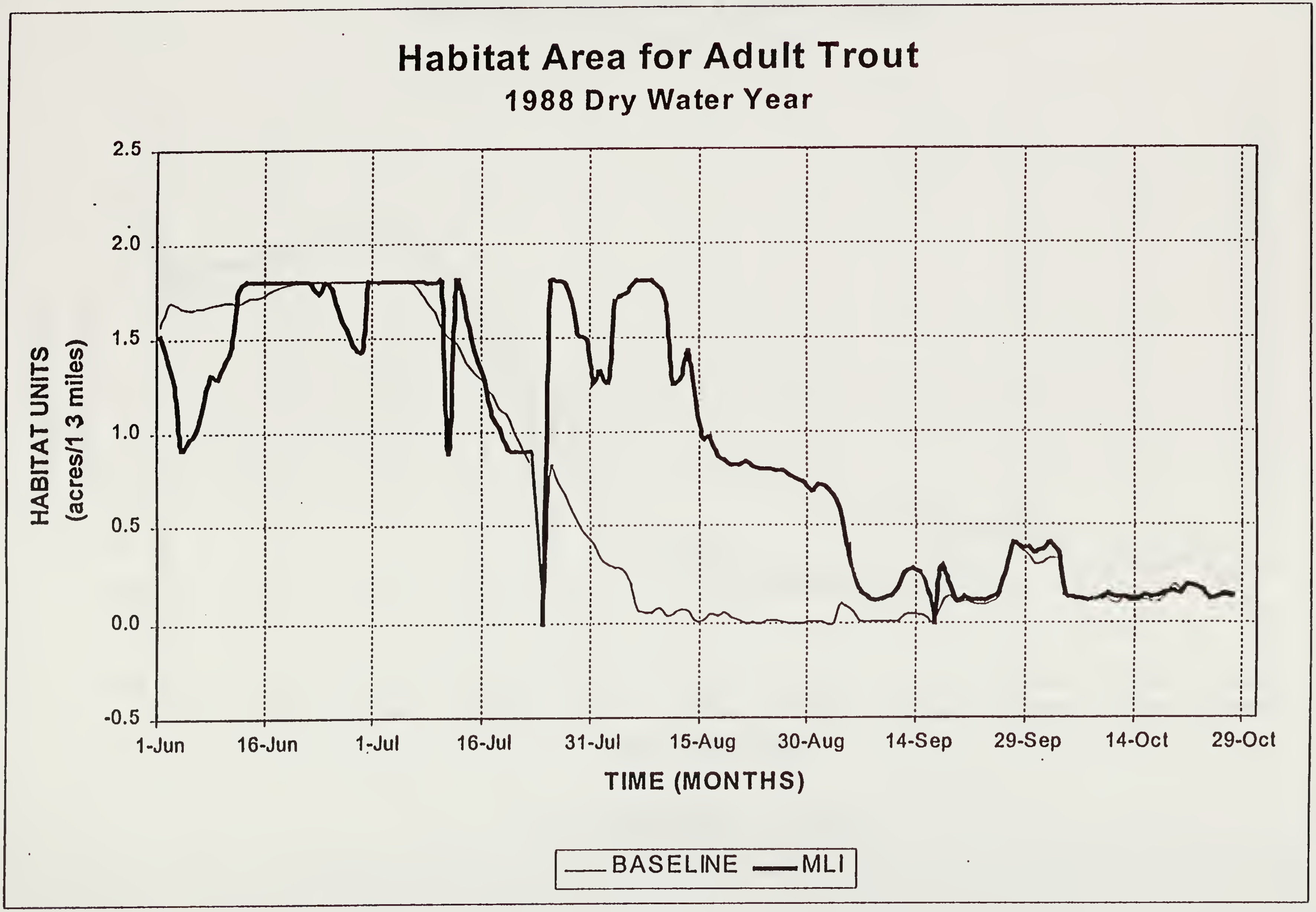
Plate 19



BYRD SLOUGH HABITAT RESTORATION SITE

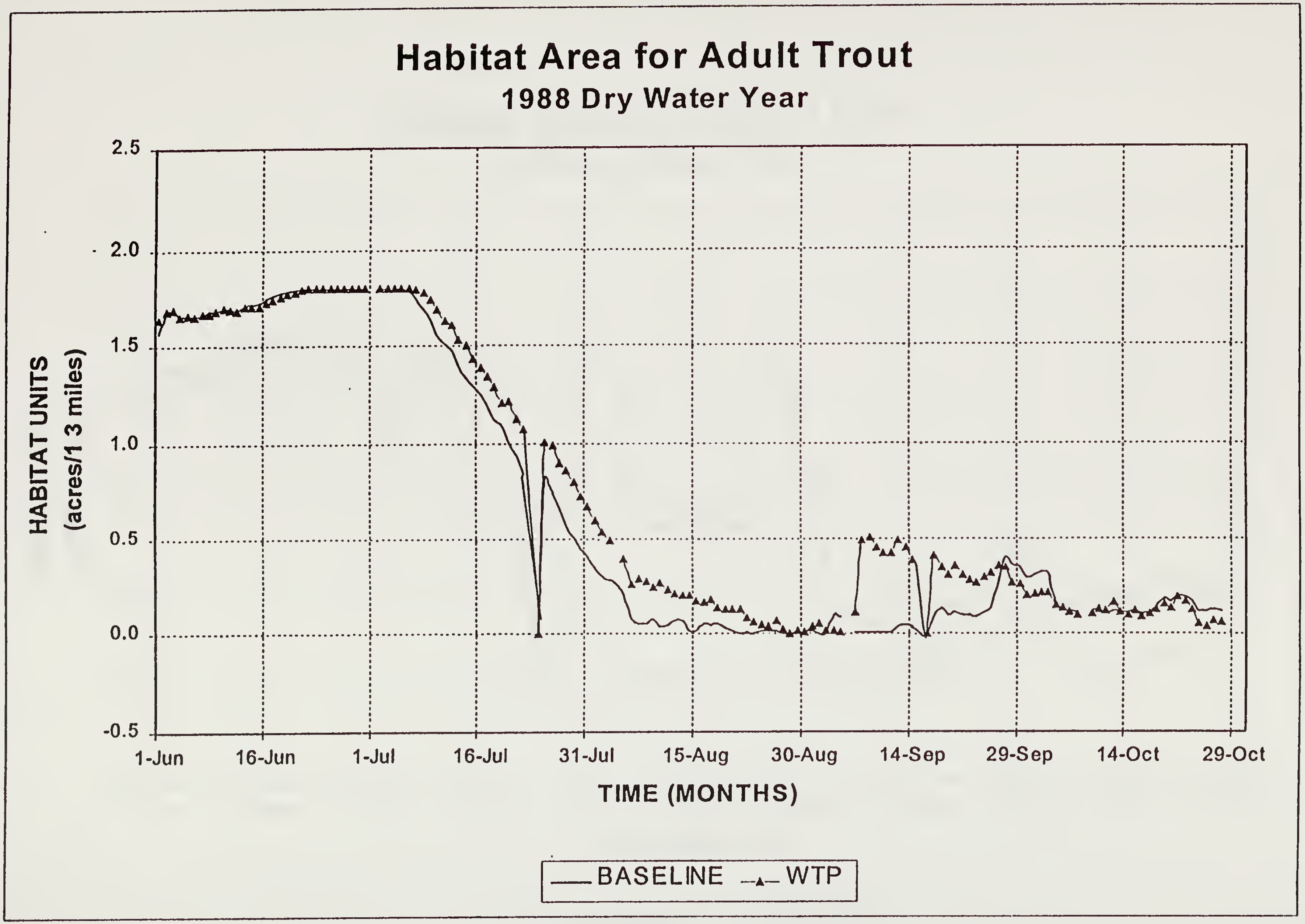
Plate 20


BYRD SLOUGH
HABITAT
RESTORATION SITE
SOUTH
EAST
NORTH
WEST
BYRD SLOUGH
NORTH
0 50 100 200 300 500
LEGEND
MIXED RIPARIAN FOREST
VALLEY OAK WOODLAND/SAVANNAH
COBBLE
SEASONAL AND PERMANENT WETLAND
OPEN WATER
ANNUAL GRASSLANDS
SITE BOUNDARY
BOUNDARY OF PROPOSED RESTORATION AREA
EXISTING GATE
EXISTING ACCESS ROAD
PROPOSED GATE
PROPOSED ACCESS ROAD
FISHING ACCESS
ACCESS TRAIL
Prepared By: Jones & Stokes Associates, Inc., May 1998
Restoration Site
Consolidated Canal
Kings River
Piedra Road
Kings Canyon Road
Friant Kern Canal
Alta Main Canal
Byrd Slough
Frankwood Ave.
180
Plate 21



Habitat Area for Adult Trout
1988 Dry Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
MLI

Plate 22



Habitat Area for Adult Trout
1988 Dry Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
WTP

Plate 23

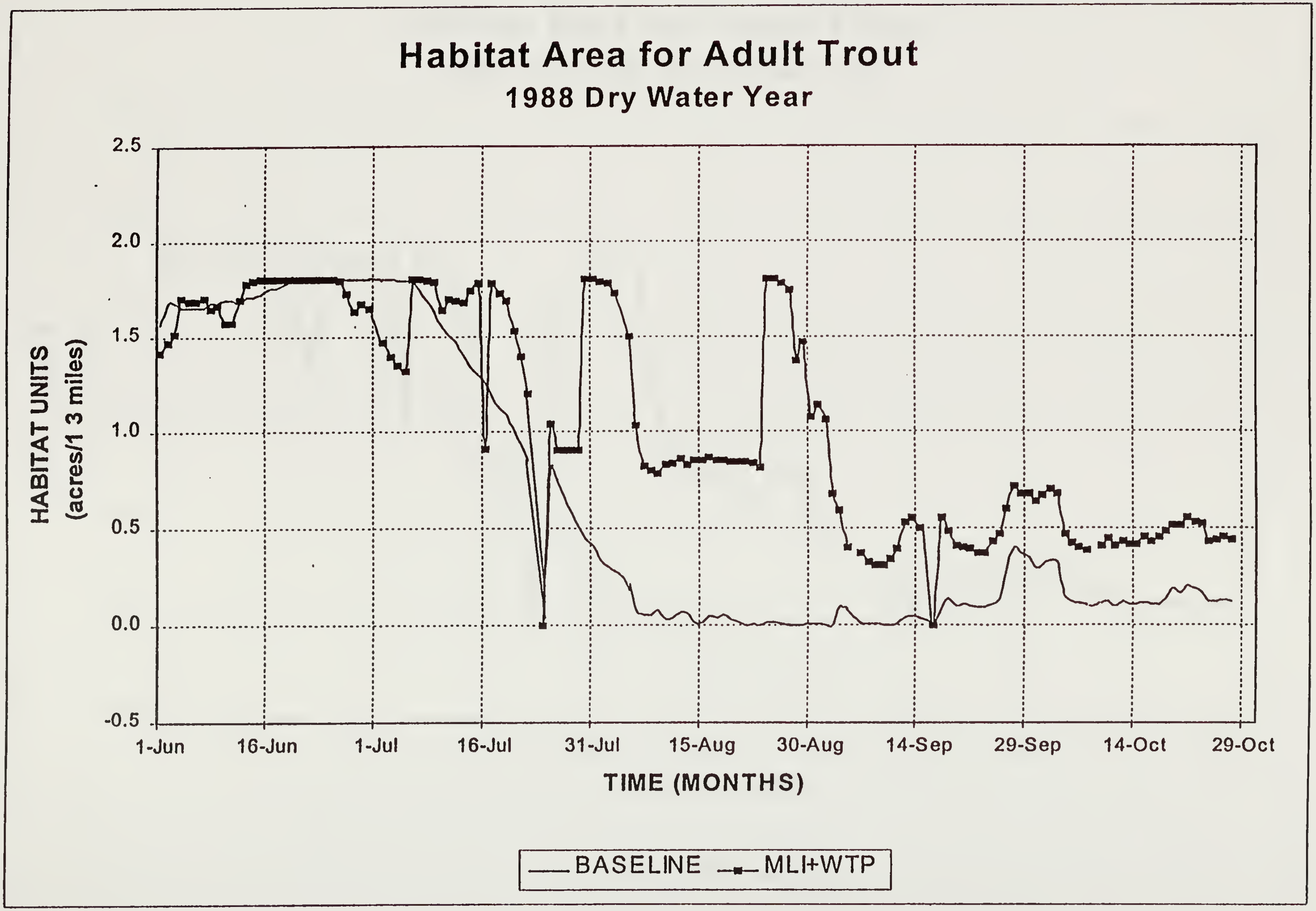
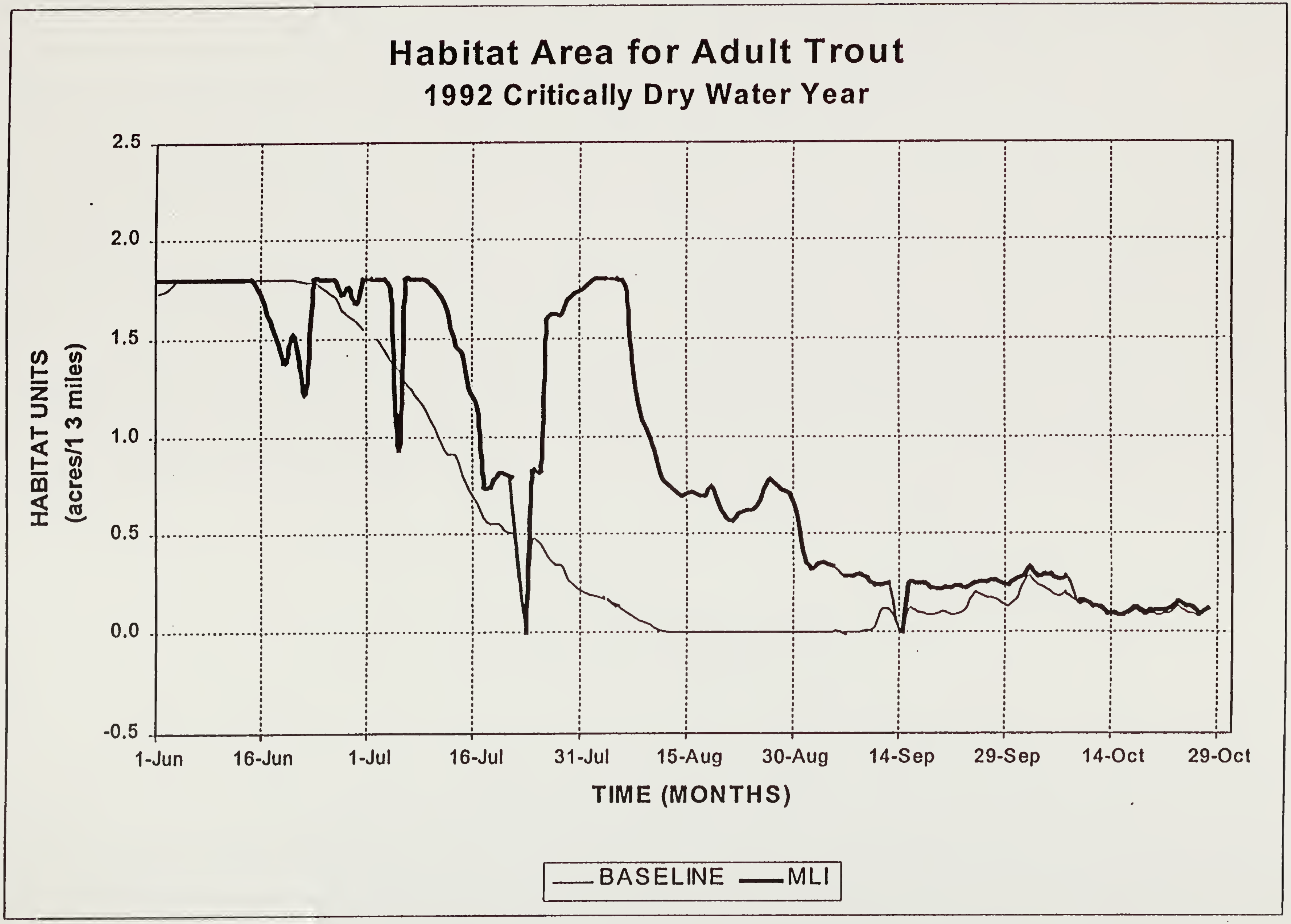
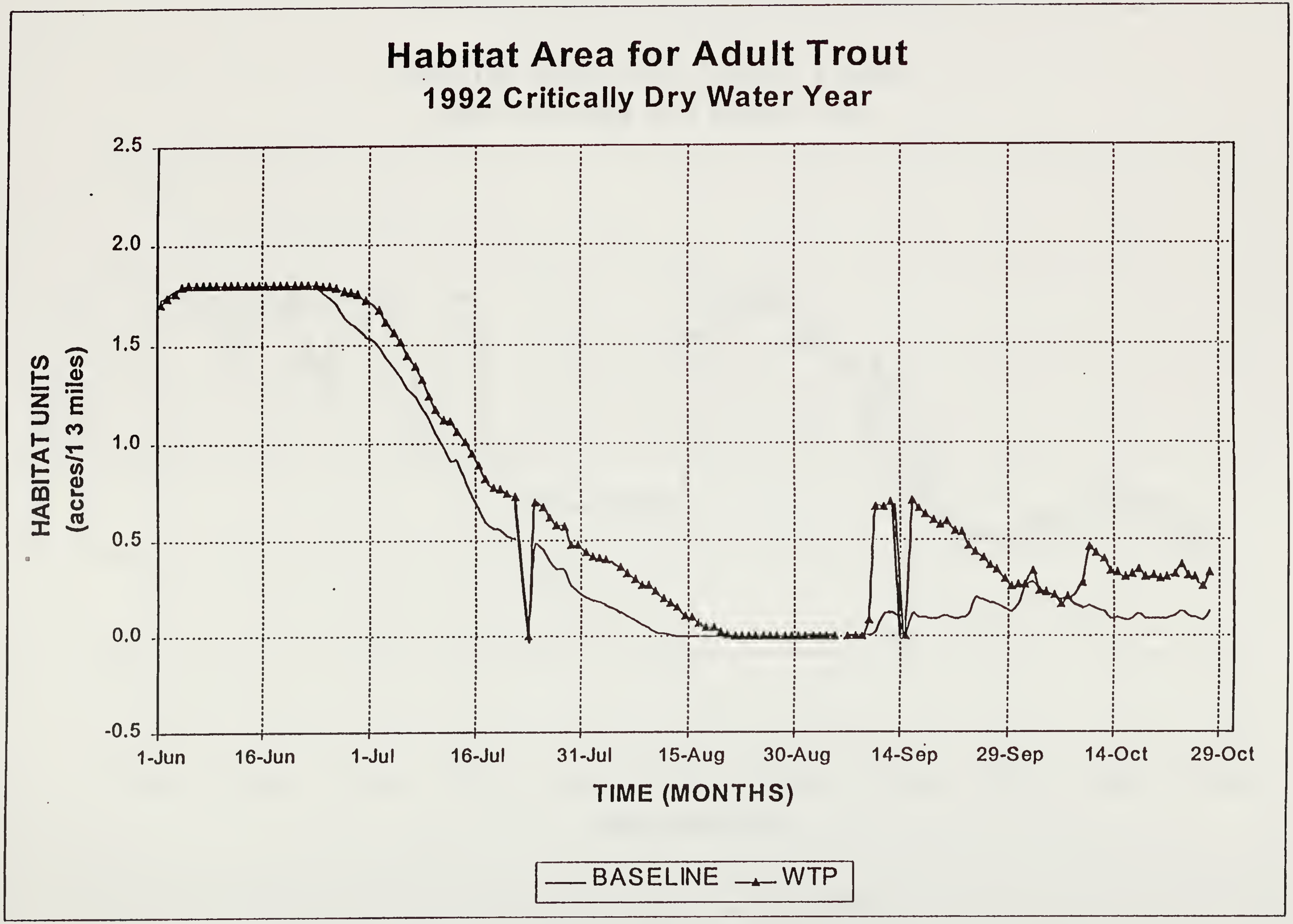

Habitat Area for Adult Trout
1988 Dry Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
MLI+WTP

Plate 24



Habitat Area for Adult Trout
1992 Critically Dry Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
MLI

Plate 25



Habitat Area for Adult Trout
1992 Critically Dry Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
WTP

Plate 26

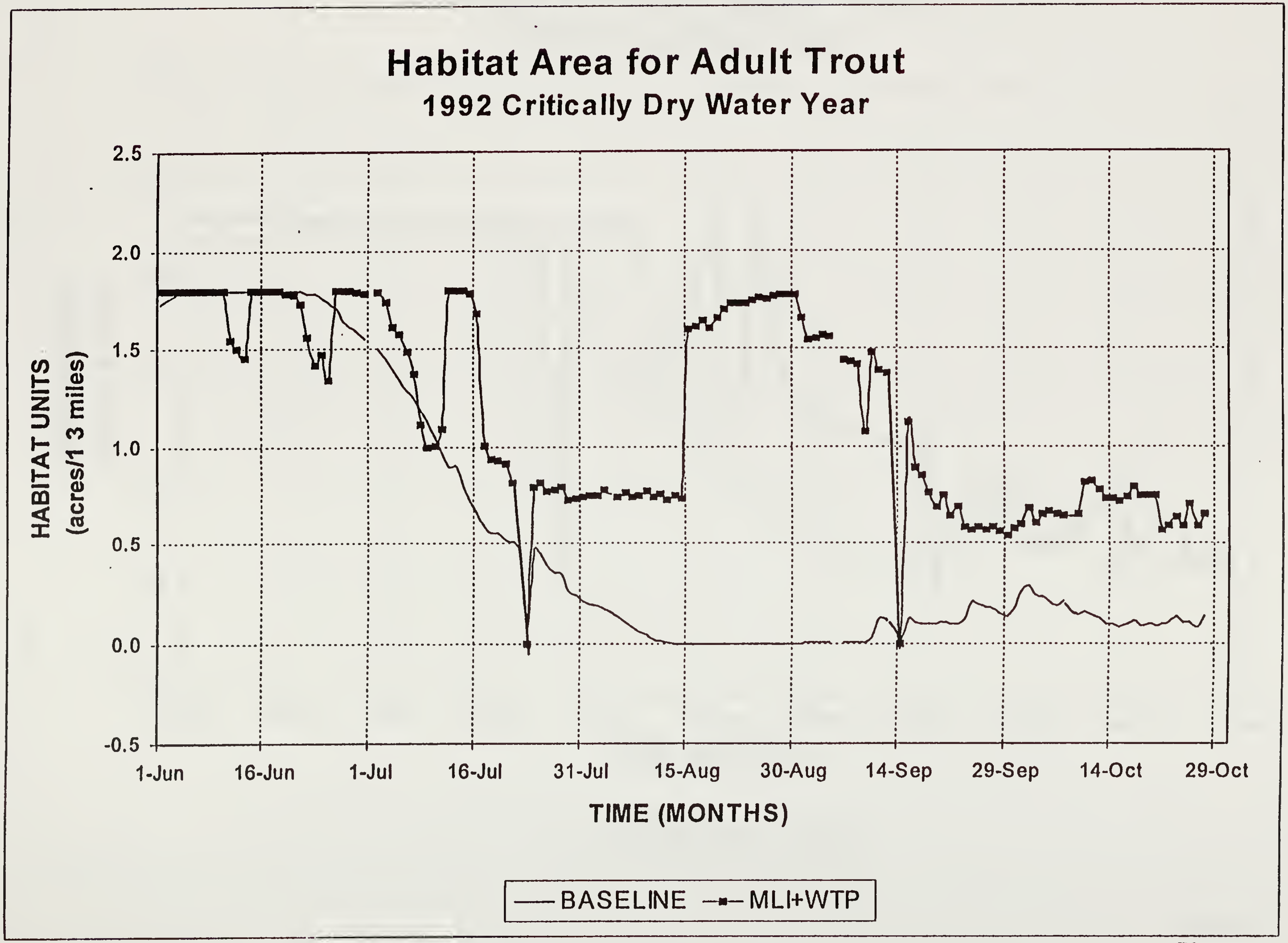

Habitat Area for Adult Trout
1992 Critically Dry Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
MLI+WTP

Plate 27

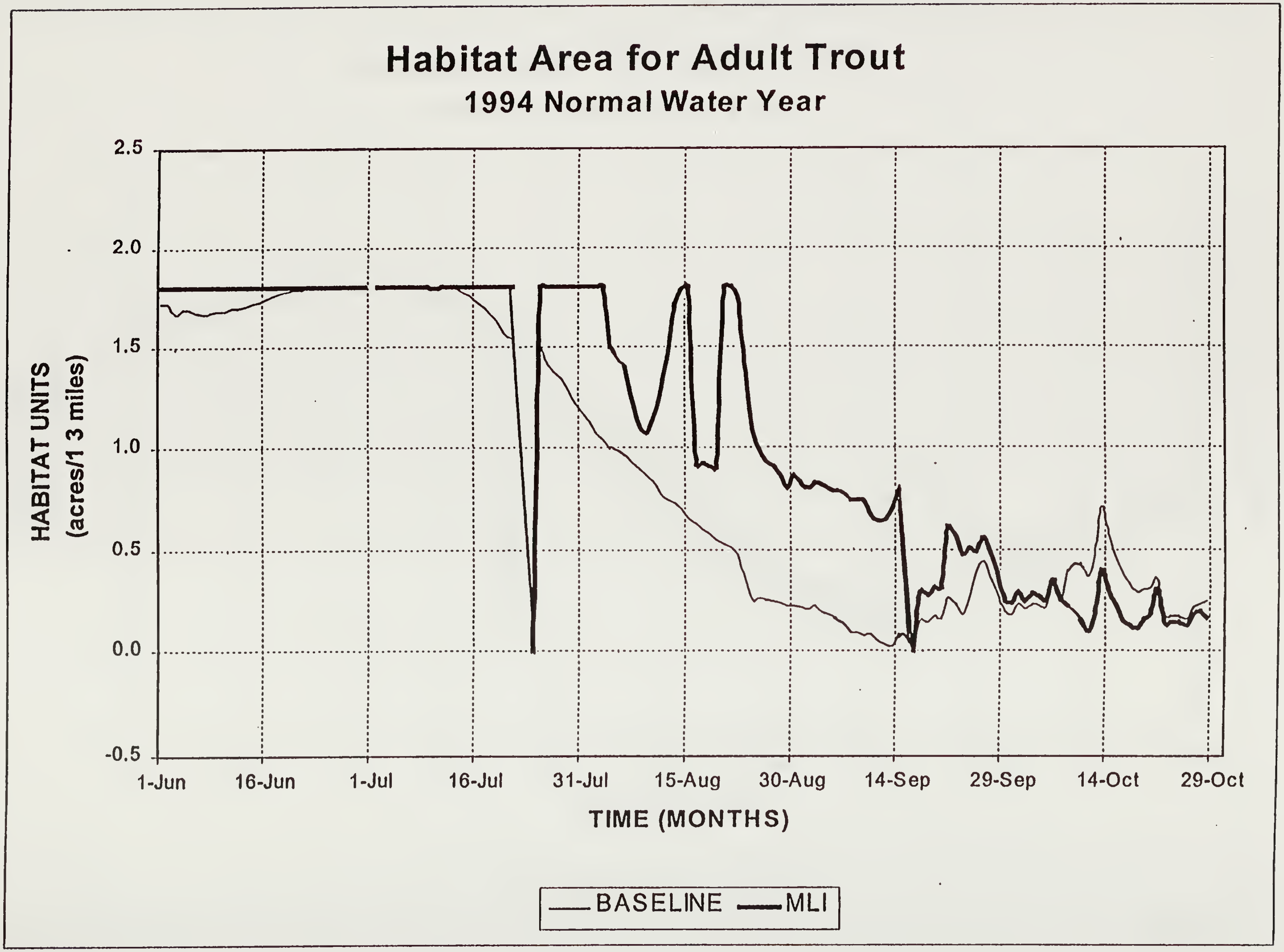
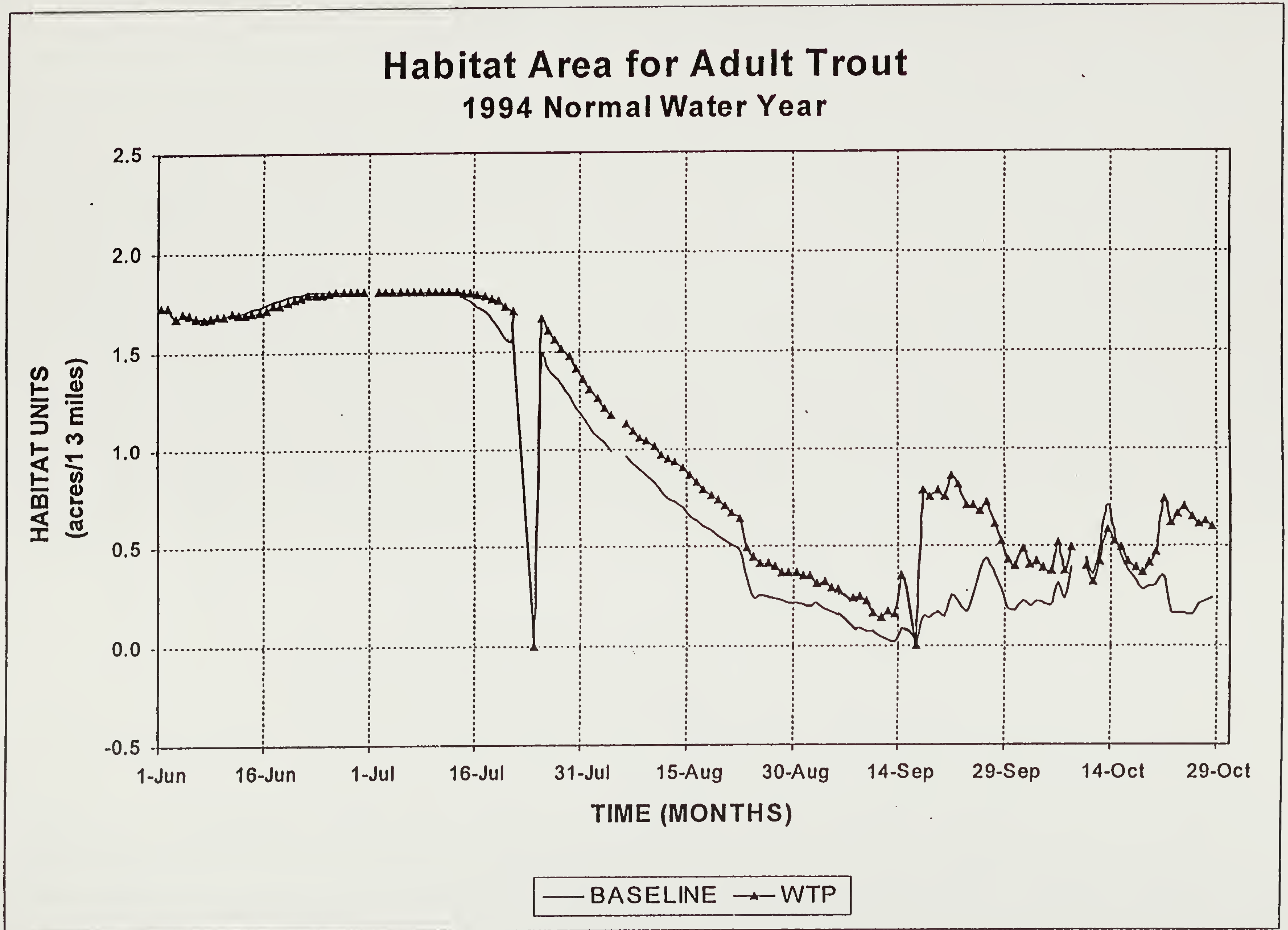

Habitat Area for Adult Trout
1994 Normal Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
MLI

Plate 28



Habitat Area for Adult Trout
1994 Normal Water Year
HABITAT UNITS
(acres/1 3 miles)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
1-Jun
16-Jun
1-Jul
16-Jul
31-Jul
15-Aug
30-Aug
14-Sep
29-Sep
14-Oct
29-Oct
TIME (MONTHS)
BASELINE
WTP

Plate 29

Appendix A

Kings River Fisheries Management Program Framework Agreement

COPY

KINGS RIVER FISHERIES MANAGEMENT PROGRAM
FRAMEWORK AGREEMENT

KRWA

THIS FRAMEWORK AGREEMENT is made and effective as of May 28, 1999 by and between the Kings River Water Association (the "Association"), the Kings River Conservation District (the "District") and the State of California, acting by and through the California Department of Fish and Game (the "Department"), and is made with reference to the following facts:

A. Fish and Game Code Section 711.7 provides that the fish and wildlife resources of the State are held for the people in trust by and through the Department. Fish and Game Code 1802 provides that it is the policy of the State to encourage the preservation, conservation and maintenance of those trust resources, and other sections of that Code empower the Department to manage the natural and introduced fish and wildlife populations of the State. Accordingly, the Department, as trustee, has the responsibility and authority (subject at all times to existing laws) to determine and implement those measures it believes will best conserve the public trust resources under its jurisdiction. Further, the Fish and Game Commission is empowered, to the extent specified in existing laws, to make regulations for the protection of fish and wildlife, which are enacted and enforced by and through the Department. Section 1017 of the Fish and Game Code specifically empowers the Department to consult with other parties in order to further the purposes of that Code, including the preservation, conservation and maintenance of the public trust resources managed by the Department.

B. The Association was formed in 1927 and now consists of 28 public and private agencies holding the vested rights to the waters of the Kings River. By virtue of agreements between its members, the Association is obligated and empowered to preserve and protect the vested rights and interests in the waters of the Kings River held by its members. In accordance with agreements between its members and pursuant to those members' vested water rights, the Association is empowered to, among other things: (i) allocate the natural flow of the Kings River and the storage space within Pine Flat Reservoir, as available, among its members, (ii) make, measure, and report on water deliveries to its members, (iii) negotiate certain agreements and memoranda of understanding on behalf of its members pertaining to Kings River operations, and (iv) ensure compliance of all Kings River water operations, except flood control operations, with the internal agreements of its members.

C. The District is a public agency created in 1951 by virtue of the Kings River Conservation District Act. The District was formed to act as the local agency responsible for the operation and maintenance of the Corps of Engineers flood control project downstream from Pine Flat Dam so as to allow for the safe passage of flood waters in the Kings River channel. Further, the District was licensed in 1979 by the Federal Energy Regulatory Commission to construct and Operate the Pine Flat

Hydroelectric Project. an electrical power generating project owned by the District located at Pine Flat Dam. Such project has no attendant water storage or consumptive use rights, and as such, operates conjunctively with water storage behind an d releases from Pine Flat Dam for other purposes. The district has responsibility to operate the project in a manner consistent with the Federal license. including specific conditions relating to fish and other aquatic resources imposed by said license.

D. On September 11, 1964. the Association and the Department entered into that certain Agreement (the "1964 Agreement") providing for, among other things. minimum releases from Pine Flat Dam, minimum flows in the Kings River below Pine Flat Dam at specified locations and other matters relating to fish and wildlife resources associated with the Kings River below Pine Flat Dam. By its express terms, the 1964 Agreement was intended to make permanent provision for the operation of Pine Flat Dam and the associated facilities in the interest of the existing fish and wildlife resources in and adjacent to the Kings River. Nevertheless, it is the policy of the Association and the District that efforts to address environmental issues should be ongoing, consistent with the need for reliability and certainty of Kings River water supplies and flood control operations. As a result, the Association and the District have continued an open dialogue with the Department concerning management of Kings River resources and have. in cooperation with the Department. undertaken numerous projects intended to improve the fish and wildlife resources associated with the Kings River below Pine Flat Dam since 1964.

E. Most recently, the Association. the District and the Department have actively and in good faith pursued the development of a comprehensive program (referred to as the Kings River Fisheries Management Program) to further enhance the broad range of fish and wildlife resources associated with the Kings River and Pine Flat Reservoir (the "Program"). The principles underlying the development of the Program were initially set forth in a Statement of Intent executed by the Association. the District and the Department on August 1. 1994. and have been substantially refined through intensive study and analysis since that time. The parties now anticipate that the Program will ultimately involve (i) changes in the operation of Pine Flat Dam and related facilities. (ii) the establishment of a temperature control pool in Pine Flat Reservoir, (iii) enhanced releases for fisheries purposes from Pine Flat Dam. (iv) the installation of new facilities for fish and wildlife purposes at Pine Flat Dam and in the Kings River. (v) a rigorous program of law enforcement. fish stocking and monitoring, and (vi) other physical and non-flow related elements intended to protect or enhance fish populations or improve aquatic habitat quality within Pine Flat Reservoir and the Kings River below Pine Flat Dam. The parties jointly acknowledge that the Program is an enhancement program which will. among other benefits. extend trout habitat suitability throughout the year in most years and for longer periods in every year than existed historically. The Program is intended to create a partnership between the parties officially recognized and designated to act on behalf of the public relative to the aquatic resources of the Kings River. and to provide each of the parties flexibility while ensuring meaningful enhancement of the fish and wildlife resources of the Kings River.

F. The parties recognize that the entire Program cannot be finalized or fully implemented until. among other things. (i) substantial additional information has been collected. (ii) funding and other commitments have been obtained from or through the Department. and (iii) mechanisms have been developed by the members of the Association to supply any water required for the

Program over and above that committed herein. Nevertheless, the parties believe that they have made substantial progress in the development of the Program and wish to formalize the elements of the Program on which they have reached agreement to date in order to establish a framework for the Program and to facilitate further development of the Program in accordance with those agreements.

G. The parties wish to begin implementation of the Program to the maximum extent now feasible, and believe that phased implementation will provide them with valuable information about the effect of individual Program elements on the fish and wildlife resources of the Kings River. Accordingly, while the Program is not yet final, the parties wish to provide for the early implementation of certain elements of the Program pending the development of the remaining elements of the Program.

THEREFORE, the Association, the District and the Department agree as follows:

1. Program Elements. Recognizing that some elements of the Program have not yet been fully developed, the Program will include at least the following elements:

(a) Kings River Aquatic Resource Goals. The Program will be implemented to achieve the multi-species aquatic resource goals described on the attached Exhibit A.

(b) Adaptive Management. The Program will be further developed, implemented and managed in accordance with the attached Exhibit B (the "Adaptive Management Procedures"). All provisions of the Adaptive Management Procedures are hereby adopted by the parties. The Adaptive Management Procedures represent a framework for addressing fish and wildlife resource issues on the Kings River, and may be separately amended by the written agreement of the parties without the need to amend this Framework Agreement or the Program. As provided in the Adaptive Management Procedures, all aspects of Program development, implementation and management will be based on the best available scientific and technical information and will be responsive thereto. Program development, implementation and management will also proceed with appropriate public participation and involvement, and the parties specifically contemplate that the Adaptive Management Procedures may be amended to facilitate such public participation and involvement.

(c) Temperature Control Pool. Subject to (i) reaching an agreement acceptable to the Association's members on the maintenance of additional storage in Pine Flat Reservoir with Pacific Gas & Electric Company or (ii) the development of other arrangements acceptable to the Association's members which will permit the maintenance of such storage, the members of the Association will operate to maintain storage in Pine Flat Reservoir of not less than 100,000 acre feet, subject to conditions beyond the reasonable control of the Association or its members which would make it impossible to maintain such storage. It has been suggested that the best interests of Kings River fish and wildlife resources may be served by permitting that storage level to be temporarily reduced below 100,000 acre feet to provide flows for temperature maintenance downstream of Pine Flat Dam in certain circumstances, and the parties

will continue to discuss whether and how such temporary reductions should be allowed and/or implemented; provided, that in no event will the storage in Pine Flat Reservoir be permitted to remain below 100.000 acre feet for longer than 120 days following any such temporary reduction.

(d) Stream Temperatures. Utilizing the enhanced flows described on the attached Exhibit C, the members of the Association will use good faith efforts to maintain water temperatures from Pine Flat Dam to the Fresno Weir suitable for trout in furtherance of the applicable Kings River Aquatic Resource Goals described on the attached Exhibit A. However, the parties acknowledge that there may be infrequent circumstances in which the natural conditions of the Kings River prevent those goals from being achieved, notwithstanding the efforts of the Association and its members. Should that occur, the parties will jointly engage in targeted effort at the earliest opportunity permitted by the circumstances to recover any losses to the Kings River fishery resulting from the nonachievement of those goals. The parties also understand and agree that the physical and economic feasibility of temperature management of releases from Pine Flat Dam will be limited unless and until certain facilities at Pine Flat Dam which will permit such temperature management (more specifically, a turbine bypass line and a multi-level intake structure) are installed.

(e) Enhanced Flows. The members of the Association will operate to achieve increased minimum flows in the Kings River below Pine Flat Dam. Initially, those flows will be at the levels set forth on the attached Exhibit C and will be measured at Fresno Weir and Dennis Cut, as appropriate. The members of the Association will diligently endeavor to increase those minimum flows to the levels and at the locations set forth on the attached Exhibit D by October 1, 2005 to the extent the best available science demonstrates that such flows are required to achieve the goals of the Program. The parties recognize that achieving the Exhibit D flows will require the development and implementation of programs to provide the additional water required in a manner that avoids unacceptable impacts to beneficial water uses or injury to Kings River water users. Prior to providing Exhibit D flows, the members of the Association will exploit, when possible, opportunities to provide (on a temporary basis) higher flows than those set forth on Exhibit C to the extent (i) the best available science demonstrates that the goals of the Program will be advanced thereby and (ii) such flows can be provided without unacceptable impacts to beneficial water uses or injury to Kings River water users.

(f) Funding/Projects. The Association and the District will collectively provide $100.000 per year (in cash, in kind services, or a combination of both) for ten years commencing upon the execution of this Framework Agreement to design, install, operate and maintain selected physical improvements to the Kings River below Pine Flat Dam (including without limitation the creation of spawning sites, fish passage facilities, and fish habitat improvements) which will enhance fish and wildlife resources and the public's enjoyment thereof, all where appropriate, feasible and consistent with Corps of Engineers flood control requirements. The Department desires to participate in the funding of those projects at a level comparable to that

collectively provided by the Association and the District. Recognizing that the Department cannot commit funding from the State Legislature in the absence of an authorization and appropriation, to the extent legally permitted, the Department will diligently seek appropriations, grants and other sources of funding for at least $1,000,000 during that same ten-year period, the proceeds of which will be additive to the funding provided by the Association and the District and used for the same purposes. Private parties with interests in the Kings River fishery and/or recreation-based economy will be approached about additional funding mechanisms for specific program elements. All annual funding and project selection will be managed in accordance with the procedures and protocols set forth in the Adaptive Management Procedures attached as Exhibit B. All funding and services provided pursuant to this Section 1(f) will be in addition to funding and services routinely provided by each of the parties prior to the execution of this Framework Agreement.

(g) Rates of Change of Flow at Low River States. When releases from storage in Pine Flat Reservoir are being made at a rate of 300 cubic feet per second or less, changes in the rate of release will not exceed the following:

Rate of Release Prior to Change	Maximum Increase in Any One-hour Period	Maximum Decrease in Any One-hour Period
51 - 100 cfs	40 cfs	20 cfs
101 - 150 cfs	50 cfs	25 cfs
151 - 200 cfs	75 cfs	30 cfs
201 - 250 cfs	100 cfs	35 cfs
251 - 300 cfs	100 cfs	40 cfs

(h) Corps of Engineers Studies/Turbine Bypass Line. In addition to the funding described in Section 1(f), the Association and the District intend to continue to pay the local share of (i) the cost of studies (as scoped as of the date of this Framework Agreement) now being conducted by the United States Army Corps of Engineers to identify fishery enhancement programs on the Kings River (which local share is currently estimated to be approximately $1,000,000) and (ii) the installation of a turbine bypass line at Pine Flat Dam under the authority of Section 1135 of the Water Resources Development Act (which local share is now estimated to be approximately $1,250,000). Notwithstanding the payment of such amounts by the Association and the District, the Department will use good faith efforts to obtain funding to be contributed to the local share of such projects in addition to its obligations under Section 1(f).

(i) Enforcement Education and Awareness Program. The Department, in consultation with the Association, the District and appropriate local fishing organizations and public agencies, will (i) gather information about the resource-related law enforcement needs of the Kings River below Pine Flat Dam and (ii) develop and implement a comprehensive and effective program of law enforcement on the Kings River below Pine Flat Dam designed to provide resource protection and public safety

through compliance with all applicable laws and regulations. The parties acknowledge that the operations plan included in that law enforcement program must and will remain confidential to the Department. However, at a minimum, the program will include a targeted public information campaign directed at improving public awareness and compliance, improved signage on the Kings River setting forth relevant restrictions, enforcement activities as necessary to address identified law enforcement problems, and coordination with local fishing groups. The Department will evaluate and redirect its law enforcement program from time to time to address changes in the Kings River fishery and its utilization. The cost of enforcement will be borne by the Department.

(j) Stocking Program. The Department, in consultation with the Association, the District and appropriate local fishing organizations, will develop and implement a focused supplemental trout stocking program for Pine Flat Reservoir and the Kings River below Pine Flat Dam, consistent with the Kings River Aquatic Resource Goals attached as Exhibit A. That program will be designed to provide an attractive trout fishery and will emphasize (i) stocking in the main channel of the Kings River and channels which flow into or out of the main channel and (ii) planting "put and grow" sub-catchable fish and eggs which can mature into a sustaining population of adult fish whenever appropriate. The supplemental stocking program described in the preceding two sentences will be in addition to all existing stocking programs in Pine Flat Reservoir and in the Kings River below Pine Flat Dam, including existing programs of stocking "put and take" fish to provide recreational angling opportunities. The costs of the supplemental stocking program will be borne by the Department; provided that if, despite the Departments good faith efforts, that program is not adequately funded by the Department, the Association and the District may make contributions through the Adaptive Management Procedures to the costs of the program from the annual funds which would otherwise be provided by the Association and the District pursuant to Section 1(f).

(k) Development of Criteria/Monitoring. In consultation with appropriate experts and local fishing organizations, objective criteria will be developed to determine the health and status of the fishery in the Kings River below Pine Flat Dam. Thereafter, the Department, the Association and the District will diligently carry out a monitoring program to determine the effects of various elements of the Program and the overall status of the fishery in the Kings River below Pine Flat Dam. In addition, the Department, the Association and the District will develop and implement a flow monitoring program to confirm that the requirements of the Program are being satisfied. That aspect of the monitoring program will involve the establishment of new flow measurement stations in the Kings River, including measuring stations equipped with continuous water stage recorders suitable for measuring (i) minimum flow in Dennis Cut at a location immediately below the Dennis Cut control structure and (ii) minimum flows passing over the Fresno Weir in the main channel of the Kings River. The construction and installation costs of all new flow measurement stations will be paid from the funding provided by the parties pursuant to Section 1(f) and/or credited against the funding obligations under Section 1(f) of the party incurring

them. Other monitoring stations or devices will be installed as determined in accordance with the Adaptive Management Procedures attached as Exhibit B. Without limiting the foregoing it will be a goal of the Program to install a measuring station capable of measuring low flows in the main channel of the Kings River near Highway 180 in recognition of the public interest in the fishery between Fresno Weir and Highway 180; provided, that the parties recognize that channel configuration and other factors may make such a station difficult to design and install. Each party will bear its own ongoing monitoring expenses. However, if so determined in accordance with the Adaptive Management Procedures, some or all of such expenses may be paid from the funding provided by parties pursuant to Section 1(f) and/or credited against the funding obligations under Section 1(f) of the party incurring them. All final monitoring results will be available to the public.

(l) Regulations. The Department, in consultation with the Association, the District, appropriate local fishing groups and the public, will examine the desirability of new fishing regulations on the Kings River, including without limitation the imposition of fishing seasons and further restrictions on harvest and fishing equipment used. If new regulations are determined by the Department to have the potential to improve or preserve the enhanced trout fishery in the Kings River below Pine Flat Dam and/or the public's enjoyment thereof, the Department will diligently seek to cause those regulations to be prepared and adopted by the California Fish and Game Commission.

(m) Permitting. To the extent legally permissible, the Department will (i) cooperate with and assist the Association and the District in expediting and obtaining all necessary permits and consents to carry out the Program, and (ii) waive all fees imposed by the Department in connection therewith.

(n) Public Education/Involvement. It is the mutual desire of the Association, the District and the Department to involve members of the public in the implementation and development of Program elements. Therefore, upon the execution of this Framework Agreement and continuously throughout the term of the Program, the Association, the District and the Department will engage in public awareness and education activities relative to the Program, provide regular opportunities for representatives of affected sectors of the public to review and comment on the Program and its implementation, and provide a means for the Association, the District and the Department to consider public input received, all as a part of the Adaptive Management Procedures. Among other public education programs, subject to available funding, the parties will explore the engagement of an on-site public information officer assigned to further the public's enjoyment and understanding of the Kings River below Pine Flat Dam and the associated resources.

(o) Chemical Treatment. Chemical treatment of Pine Flat Reservoir will not be a part of the Program, and neither the Association nor the District will pursue that treatment so long as the parties have assurances that the claimed existence of white bass or other species in the reservoir or Kings River will not cause changes in Kings River operations or implementation of the Program which are unacceptable to the

Association and/or the District. In the absence of those assurances. or in the event the existence (or alleged existence) of white bass or other species in Pine Flat Reservoir or the Kings River poses a foreseeable threat to historic Kings River operations or the implementation of the Program. chemical treatment of Pine Flat Reservoir may again be pursued.

(p) Access. The Department. the Association and the District will work cooperatively to develop mutually acceptable programs to improve public access to the Kings River for fishing and other recreational pursuits.

2. 1964 Agreement. This Framework Agreement will supercede the 1964 Agreement in its entirety; provided, that upon suspension or termination the Program. the 1964 Agreement will thereupon again become effective. and the parties will resume enforcement thereof. However, no such suspension or termination will occur until the procedures for resolving conflicts set forth in the Adaptive Management Procedures have been completed.

3. Corps of Engineers. As an important adjunct to the Program. the parties will. to the maximum extent permitted by law. cooperate in and support the following aspects of the United States Army Corps of Engineers' Pine Flat Restoration Studies. to the extent each party determines them to be prudent. feasible and consistent with the express goals of this Framework Agreement: (i) expedited authorization and construction of the turbine bypass line. (ii) implementation of the Mendota Wildlife Area-Kings River Water Exchange. (iii) development of the wildlife habitat restoration projects identified by the Corps studies. and (iv) completion of the feasibility studies for raising Pine Flat Dam and installing a multi-level intake structure thereon. The parties recognize. however. that except for the construction of the turbine bypass line. the costs of constructing and implementing the projects subject to the Corps studies are likely to be significantly in excess of the payment capacity of the parties without substantial contributions of non-reimbursable funding and voter approval of long-term financing.

4. Interim Implementation. The parties acknowledge their commitment to the August 1, 1994 Statement of Intent and the Program as described in this Framework Agreement. and agree that the Program should be implemented to the extent possible notwithstanding the need for further detail and refinement. Therefore, subject only to the receipt of any required governmental consents, they agree to implement the Program as described herein upon the execution of this Agreement. with the express understanding and agreement that the Program will be modified and refined over time. Implementation of elements of the Program not described in this Framework Agreement will be accomplished through appropriate amendments of this Framework Agreement. and implementation of the final Program will be accomplished through the execution of appropriate documents by all of the parties describing the final Program and permanently replacing the 1964 Agreement. The parties also acknowledge that full implementation of the final Program. and implementation of some elements of the Program as set forth in this Framework Agreement. may require approval of other governmental agencies. and they will cooperate to obtain all necessary approvals. The parties recognize their reciprocal and mutual obligations under the Program as set forth above. and therefore agree that if a party does not discharge its obligations as set forth in this Framework Agreement or otherwise in the Program. the Program will be suspended until such obligations have been satisfied: provided. that no such suspension

will occur until the procedures for resolving conflicts set forth in the Adaptive Management Procedures have been completed.

5. Public Involvement. The parties will approach local fishing organizations, and particularly those parties with pending public trust complaints before the State Water Resources Control Board ("SWRCB"), and solicit their input in and support for the Program. Without limiting the foregoing, in addition to the public involvement opportunities provided by the Adaptive Management Procedures, the parties will jointly facilitate the creation of a public advisory group with membership offered to all interested parties and ensure that a duly authorized representative of that group is afforded the opportunity to address all public meetings held in accordance with the Adaptive Management Procedures. In addition, the parties anticipate that an annual operations plan for the administration of the Program will be developed each year, and they will offer the public the opportunity to participate in the development of each such annual operations plan.

6. Unintended Creation of Habitat. It is the express intent and goal of the parties that the Program will enhance and protect fish populations and improve aquatic habitat quality within Pine Flat Reservoir and the Kings River below Pine Flat Dam. The Program is not intended, and will not be implemented or managed, to create habitat for non-aquatic species or species other than those intended to be enhanced by the Program.

7. Assumptions by the Parties. The parties have adopted the Program in part to promote a greater level of certainty relative to the use and availability of Kings River water resources. The parties believe that greater certainty will benefit the public, the fisheries to be managed under the Program, the Department, the District, the Association and the Association's members. However, in order to achieve that desired certainty, important underlying conditions must remain substantially unchanged. Therefore, the parties acknowledge that, in implementing the Program they have assumed that the water supplies and operations of the member units of the Association will not materially change (other than as the result of natural conditions or the implementation of the Program), and that there will be no material change in the use of or access to water or facilities utilized by the District or the Association's members after the effective date of this Framework Agreement (other than as the result of natural conditions or the implementation of the Program). The parties have further assumed that there will be no litigation or contested administrative proceedings commenced against any of them by any party challenging the use of the waters of the Kings River or seeking to impose new restrictions on the use of Kings River water. The parties acknowledge that all such assumptions were material to their respective decisions to reach the agreements described in this Framework Agreement. In the event any of those assumptions prove to be incorrect, or upon the occurrence of any other event materially impacting such party and/or the agencies comprising such party which can be addressed through the modification of the Program or any of its elements, the parties commit to entering into negotiations in good faith and timely efforts to modify the Program and/or any appropriate elements. If after 180 days from the date a party provides notice of its desire to initiate negotiations under this Section 7 no agreement satisfactory to the parties has been reached, any of the parties may thereafter terminate this Framework Agreement.

8. The Parties' Joint Petition to the State Water Resources Control Board. The parties have mutually accepted that, as an enhancement program, the Program properly addresses public

trust values on the Kings River and is the most appropriate vehicle for balancing the competing needs and uses of the Kings River system while enhancing fish and wildlife resources associated with the Kings River. Without limiting the foregoing, in accordance with its responsibilities under Fish and Game Code Sections 711.7 and 1802, the Department believes that the Program establishes the proper vehicle to continue to conserve the public trust and to satisfy the obligations of the Association, its members and the District under Fish and Game Code Section 5937, the public trust doctrine and Water Code Section 13300, *et seq.* (the Porter-Cologne Water Quality Act). At a time to be determined by mutual agreement of the parties, they will jointly petition the SWRCB to accept the Program and agree to fully cooperate in and support the prosecution of that petition. The parties' joint petition to the SWRCB will request the SWRCB to issue such order(s) as are necessary to implement the Program, and will include a request that the SWRCB establish a schedule for providing the SWRCB with annual status reports on the progress of the Program. The joint petition will also include a request that the SWRCB order(s) expressly authorize the implementation of revisions in any feature or element of the Program adopted in accordance with the Adaptive Management Procedures upon notice to, but without further order of, the SWRCB. The Program and the Adaptive Management Procedures will automatically terminate upon the election of any party if the SWRCB declines to issue the order(s) described in this Section 8 and in Section 9 in a form satisfactory to all of the parties.

9. Disposition of the Water Rights Complaints. The petition filed by the Parties pursuant to Section 8 will include a request for an order suspending processing of (rather than dismissing) the public trust complaint filed by the Lower Kings River Committee, Inc., et. al. on April 15, 1991 relative to Kings River operations and all other similar pending complaints addressing the Kings River. Prior to preparing and filing such petition, the parties will jointly approach the complainants and request their joinder therein. The petition will request that the suspension on processing the pending complaints remain in effect until the earlier of (i) the termination of this Framework Agreement, or (ii) the issuance of an order by the SWRCB on a petition by a complainant finding one or more material but uncured breaches of this Framework Agreement by any of the parties or (iii) the dismissal of all such complaints upon motion by one or more of the complainants. Upon the occurrence of any of the events described in clauses (i) or (ii) of the preceding sentence, the parties, or any of them, may petition the SWRCB to dismiss any or all such complaints on such terms and conditions as the petitioner(s) may deem appropriate. Should the processing of any such complaints be recommended by the SWRCB, it will be deemed an event permitting the parties to invoke the provisions of Section 7 of this Framework Agreement. The election of the parties not to seek dismissal of the referenced complaints will not be deemed to be their agreement with any of the allegations contained therein.

10. CEQA Compliance. Notwithstanding any provision of the Framework Agreement or the Adaptive Management Procedures, all actions proposed as a part of the Program will be subject to any required compliance with the California Environmental Quality Act ("CEQA"). The Parties, in consultation where appropriate with the SWRCB, will determine whether and to what extent the entire Program requires (or might be subject to) programmatic CEQA compliance, and the Parties will thereafter analyze each project (as defined in CEQA) proposed to be undertaken as a part of the Program to determine what, if any, CEQA compliance is required.

11. Jurisdiction. Notwithstanding any provision of this Framework Agreement or any other aspect of the Program, nothing set forth herein or therein will be construed as expanding the jurisdiction of the SWRCB or the Department beyond that provided by California law.

12. Termination. This Framework Agreement and the Program may only be terminated (i) upon the mutual consent of the parties, (ii) by a non-defaulting party in the event of a default by any other party which remains uncured for 30 days after written notice of such default to the defaulting party, or (iii) as otherwise as expressly provided herein. Wherever possible, the parties will pursue remedies other than termination as the remedy of choice for issues, disputes, and defaults, and will utilize the dispute resolution mechanisms described in the Adaptive Management Procedures. In the event one or more of the parties elect to terminate the Program and the Adaptive Management Procedures, such termination will become effective only after 180 days written notice to all parties.

IN WITNESS WHEREOF, the parties have executed this Framework Agreement as of the date first above written.

KINGS RIVER WATER ASSOCIATION

By: Dean L. Jensen
Chairman

KINGS RIVER CONSERVATION DISTRICT

By: Jeff L. Taylor
General Manager

CALIFORNIA DEPARTMENT OF FISH AND GAME

By: Robert C. Hight
Director

"Exhibit A"
Aquatic Resource Enhancement Goals for the Lower Kings River and Pine Flat Reservoir

Providing for Long-Term Aquatic Resource Enhancement:

In August, 1994, the Kings River Water Association, Kings River Conservation District and Department of Fish and Game jointly executed a Statement of Intent, regarding cooperation on fishery improvements within Pine Flat Reservoir and the lower Kings River. Among other commitments, the parties committed to: (i) support and pursue in an expeditious manner a cooperative program to improve and manage fisheries and aquatic habitat conditions; (ii) cooperatively seek and develop a broad scope of habitat improvement alternatives, emphasizing opportunities for voluntary conjunctive or sequential water uses for continued enjoyment of the full range of on-stream and off-stream beneficial uses; (iii) to minimize and, where possible, avoid adverse effects of any changes on the holders of water storage and/or use rights, and on the public who beneficially use the waters of the Kings River; and (iv) to co-sponsor projects and programs which further the purposes of the Statement of Intent.

The following Aquatic Resource Enhancement Goals identify a set of desired future conditions, for the different segments of the Kings River watershed. They are intended to serve as initial "targets" for such projects and programs as may be undertaken, in furtherance of the Statement of Intent. They should not be interpreted as requirements or standards, but rather as general guidance for programmatic decisions, with respect to divergent opportunities that may present themselves today and in the future. As such, they are likely to be adjusted to reflect changing needs, opportunities and constraints, as tempered by experience. Retaining the flexibility to adapt and refocus the program in this manner is considered desirable, for it increases the overall responsiveness and efficiency of the program.

There are known inherent conflicts among and between these goals, which will require prioritization. Such decisions will need to consider the needs of the entire scope of off-stream and on-stream river users at the time, and impart proper balance, so as to minimize harm. In particular, the management of the river and its channels in a manner which provides safe passage of flood-waters was the fundamental purpose in constructing Pine Flat Dam and certain downstream channel improvements. The maintenance and proper functioning of said flood management features shall therefore take precedence over these goals to enhance the fishery, to the extent it is necessary to protect life, health and property.

It is acknowledged that portions of these initial goals may not be fully realized to the satisfaction of everyone. Expectations in this process must, therefore, be reasonable, respecting the natural physical limitations imposed by the river and watershed, as well as the broad range of beneficial water uses. Finally, it is desired that aquatic resource enhancements proceed on a consensus basis; respecting the importance of communication and cooperation in the pursuit of these goals.

Cooperative Strategies:

- Consider the natural variation in water availability when establishing flow, temperature and reservoir carryover storage targets.

- Cooperate in using high-quality, up-to-date scientific information and techniques to identify desired water flows, temperatures, habitat characteristics, and reservoir storage volumes and/or the operations needed to provide them.

- Work together to balance the needs of trout fisheries, native species and reservoir fisheries with the other on-stream and off-stream beneficial uses.

- Cooperatively identify fishery management objectives which take maximum advantage of opportunities for conjunctive and or sequential uses of water

- Use consensus as the primary tool for decision-making, regarding proposed aquatic resource improvements.

Planning Area Segments:

A: Pine Flat Reservoir: PG&E Kings River Powerhouse to Pine Flat Dam

B: River Reach 1: Pine Flat Dam to Cobbles Weir

C: River Reach 2: Cobbles Weir to Fresno Irrigation District Weir

D: River Reach 3: Fresno I.D. Weir to Reedley Narrows Gauging Station

E: River Reach 4: Reedley Narrows Gauging Station to Peoples Weir

F: River Reach 5: Peoples Weir downstream to Empire Weir No. 2 (at Highway 41)

A: *Pine Flat Reservoir*

Emphasis: All-year mixed fishery opportunity

A-1 Maintain warm-water fisheries throughout the year, with sufficient year-to-year continuity to allow for trophy size fish to survive and support angling use

A-2 Provide seasonally stocked catchable trout fisheries in Pine Flat Reservoir each year.

A-3 Consistent with other fishery priorities, beneficial uses and flood control requirements, seek to maintain a volume of cool and well-oxygenated water sufficient to support carryover "put-and-grow" reservoir trout fisheries from year to year, to support trophy fisheries in the reservoir and upstream

A-4 Manage and monitor non-native fishes to provide recreational angling, in a manner consistent with: (i) protection of native fish populations, (ii) the broadest public interest, and (iii) the provisions and requirements of applicable State and Federal laws and regulations.

A-5 Improve angler access, to the extent it can be accomplished: (i) without exercise of eminent domain authority, (ii) consistent with public safety and private property rights, and (iii) without adversely affecting fishery and/or riparian habitat values.

A-6 Within the constraints imposed by water operations and other fisheries goals, use reasonable efforts to manage water surface elevations in Pine Flat Reservoir to provide surface stability in warm-water fish spawning seasons.

A-7 Within the constraints imposed by water operations and without creating a risk of future endangered species conflicts, provide in-reservoir habitat improvement for warm-water fish.

B: *River Reach 1: Pine Flat Dam to Cobbles Weir*

Emphasis: All-year high-yield trout fishery

B-1 Seek to cooperatively provide habitat that is conducive to trout fisheries; including appropriate levels of conjunctive stream flow, desirable temperature regimes, satisfactory food production, usable spawning substrates and other habitat characteristics.

B-2 Utilize supplemental trout stocking to provide intensive recreational fishing, to the extent stocked fish do not damage natural trout populations which may be present.

B-3 Manage and monitor non-native fishes to provide recreational angling, in a manner consistent with: (i) protection of native fish populations, (ii) the broadest public interest. and (iii) the provisions and requirements of applicable State and Federal laws and regulations.

B-4 Improve angler access. to the extent it can be accomplished: (i) without exercise of eminent domain authority, (ii) consistent with public safety and private property rights, and (iii) without adversely affecting fishery and/or riparian habitat values.

B-5 Improve riparian habitat. water shading and aesthetics to the extent possible; to be constrained by necessary channel capacity and maintenance for safe flood-water management.

C: River Reach 2: Cobbles Weir to Fresno Irrigation District Weir:

Emphasis: All-year premium-quality trout fishery

C-1 Seek habitat suitability and focused management (to include appropriate flows. temperatures. spawning substrates. cover and other habitat features) to promote continuous trout fisheries. characterized by trophy trout of older age-classes. Promote self-reproducing trout fisheries to the extent they can be maintained consistently with other fishery goals and Kings River beneficial uses.

C-2 Utilize supplemental fish stocking on an as-needed basis to sustain or recover acceptable fishery quality; to the extent stocked fish do not compete adversely with naturally occurring populations.

C-3 Develop and implement reduced-catch protective regulations to protect the self-reproducing trout stocks.

C-4 Provide habitat and management for native species to assure their continued survival within the Kings River system.

C-5 Manage and monitor non-native fishes to provide recreational angling. in a manner consistent with: (i) protection of native fish populations. (ii) the broadest public interest. and (iii) the provisions and requirements of applicable State and Federal laws and regulations.

C-6 Improve angler access. to the extent it can be accomplished: (i) without exercise of eminent domain authority. (ii) consistent with public safety and private property rights. and (iii) without adversely affecting fishery and/or riparian habitat values.

C-7 Enhance riparian habitat. water shading and aesthetics to the extent possible; to be constrained by necessary channel capacity and maintenance for safe flood-water management

D: River Reach 3: Fresno I. D. Weir to Reedley Narrows Gauging Station

Emphasis: Native fish maintenance and management
Opportunistic trout angling

D-1 Emphasize provision of habitat and management for native aquatic species to assure their continued survival in the Kings River system.

D-2 Maintain warm-water fish populations in seasons and locations where they currently exist, to the extent they do not adversely affect native aquatic species.

D-3 Maintain trout fisheries on an opportunistic basis, in locations where, and in seasons or years when conducive water temperatures and flows can be provided, without adversely affecting water operations, other beneficial uses, or the achievement of other (i.e., native transitional species) fishery goals.

D-4 Utilize supplemental cool-season trout stocking on a prescriptive basis to enhance angling opportunities.

D-5 Manage and monitor non-native fishes to provide recreational angling, in a manner consistent with: (i) protection of native fish populations, (ii) the broadest public interest, and (iii) the provisions and requirements of applicable State and Federal laws and regulations.

D-6 Improve angler access, to the extent it can be accomplished: (i) without exercise of eminent domain authority, (ii) consistent with public safety and private property rights, and (iii) without adversely affecting fishery and/or riparian habitat values.

D-7 Enhance riparian habitat, water shading and aesthetics to the extent possible: to be constrained by necessary channel capacity and maintenance for safe flood-water management.

E: River Reach 4: Reedley Narrows Gauging Station to Peoples Weir

Emphasis: Native species maintenance and protection

E-1 Emphasize provision of habitat and management for native aquatic species to assure their continued survival in the Kings River system.

E-2 Maintain warm-water fish populations in seasons and locations where they currently exist, to the extent they do not adversely affect native aquatic species.

E-3 Maintain trout fisheries on an opportunistic basis, in locations where, and in seasons or years when conducive water temperatures and flows can be provided, without adversely affecting water operations, other beneficial uses, or the achievement of other (i.e., native transitional species) fishery goals.

E-4 Manage and monitor non-native fishes to provide recreational angling, in a manner consistent with: (i) protection of native fish populations. (ii) the broadest public interest. and (iii) the provisions and requirements of applicable State and Federal laws and regulations.

E-5 Improve angler access. to the extent it can be accomplished: (i) without exercise of eminent domain authority, (ii) consistent with public safety and private property rights. and (iii) without adversely affecting fishery and/or riparian habitat values.

E-6 Enhance riparian habitat. water shading and aesthetics to the extent possible; to be constrained by necessary channel capacity and maintenance for safe flood-water management.

F: River Reach 5: Peoples Weir to Empire Weir No. 2 (at Highway 41)

Emphasis: Native species maintenance
Opportunistic warm-water angling

F-1 Maintain habitat and management for native aquatic species to assure their continued survival in the Kings River system.

F-2 Maintain and manage for native species and warm-water fisheries in periods of adequate water availability (i.e.. when normal conveyance of water to water rights holders provides instream flows of sufficient magnitude. Flows will not be specifically provided to sustain these fisheries during periods when water is not released for other conjunctive purposes. due to extensive percolation losses below Peoples Weir and the impact of this excessive water demand on other beneficial uses. including other fishery purposes). Seek. where possible. to develop future conjunctive downstream water uses to support these fisheries at improved levels.

F-3 Manage and monitor non-native fishes to provide recreational angling. in a manner consistent with: (i) protection of native fish populations. (ii) the broadest public interest. and (iii) the provisions and requirements of applicable State and Federal laws and regulations.

*****

"Exhibit B"

Adaptive Management Procedures to be used in connection with The Kings River Fisheries Management Program

THESE ADAPTIVE MANAGEMENT PROCEDURES have been developed by and between the Kings River Water Association (the "Association"), the Kings River Conservation District (the "District"), and the State of California, represented by and through the Department of Fish and Game (the "Department"), which are jointly referred to hereinafter as the "Parties" and individually as a "Party." These Adaptive Management Procedures have been developed with reference to the following facts, findings and provisions, all of which are a material part hereof, for the purpose of implementing a comprehensive program to enhance and maintain the fish and wildlife resources associated with the Kings River referred to as the "Kings River Fisheries Management Program" (the "Program"). These Adaptive Management Procedures will initially be employed to implement and manage the Program as described in that certain Framework Agreement between the Parties dated as of May 28, 1999 (the "Framework Agreement") to which these Adaptive Management Procedures are attached; provided, that it is the intent of the Parties that these Adaptive Management Procedures will be employed to implement and manage the Program as it may be modified over time.

STATEMENT OF PURPOSE:

As duly appointed representatives of the public interests in the Kings River and Pine Flat Reservoir, the Parties have developed these Adaptive Management Procedures and the Program in order to (i) advance what they have agreed to be the most reasonable mix of ongoing beneficial uses of Kings River water, (ii) comply with all applicable laws and regulations associated with the use of Kings River water, (iii) fully conserve the public trust in the fish, wildlife and water resources associated with the Kings River, (iv) protect individual property and water rights, and (v) assure the economic and aesthetic well-being of the Kings River service area and, to applicable extent, the State. Therefore, the Parties have committed to advance, participate in, implement and defend the Program as implemented and managed in accordance with these Adaptive Management Procedures.

These Adaptive Management Procedures are intended to establish a framework for future adaptive management of the lower Kings River, and for cooperation among the Parties, the public and the California State Water Resources Control Board (the "SWRCB"). The Program, as described in the Framework Agreement, is intended to provide immediate benefits to the fish and wildlife resources of the Kings River while also instituting a definitive process utilizing these Adaptive Management Procedures to pursue additional improvements over time. An important aspect of the Program will be ongoing dialogue and discussion between representatives of the Department, the Association and the District. Through that dialogue and discussion, elements might be added, deleted, modified or refined based on new information developed and/or as circumstances warrant. These Adaptive Management Procedures include the procedures for conducting that ongoing dialogue and discussion.

ADAPTIVE MANAGEMENT PROCEDURES:

I. Mutual Values:

In connection with the implementation and management of the Program in accordance with these Adaptive Management Procedures, the Parties will conform their actions to the following mutual values:

a. The utmost value is placed on the development of valid scientific and technical information, and the use and incorporation of that information in the processes of developing and implementing all aspects of the Program and making associated operational decisions.

b. The Program will be implemented and managed using appropriate scientific methods, conducted by qualified personnel, and to maintain the highest of professional ethics in developing and advancing scientific information and conclusions.

c. The Parties mutually acknowledge each other's legitimate interests in the Kings River.

d. The highest goal of the Program and these Adaptive Management Procedures is the cooperative pursuit of the most reasonable mix of uses of the limited Kings River water resource, recognizing: (i) the longstanding and vested water rights of the historic users of that resource, (ii) the desirability of maintaining recreational fisheries in Pine Flat Reservoir and in the Kings River below Pine Flat Dam, (iii) the desirability of maintaining the Kings River as a multi-species aquatic resource, (iv) the practical, operational and economic limitations on the Parties and those they represent, and (v) the importance of the Kings River to the local, state and national economies. The Program will be pursued utilizing conjunctive water use and re-use whenever reasonable, prudent and feasible.

e. The Parties mutually accept and represent the implementation and management of the Program in accordance with these Adaptive Management Procedures to constitute full legal compliance with all laws and regulations of the United States of America and the State of California, and more specifically, to represent appropriate conservation of the public trust in the fishery resources of the lower Kings River and Pine Flat Reservoir.

f. The Program is mutually held by the Parties to provide net overall enhancement of the trout fisheries of Pine Flat Reservoir and the lower Kings River. As such, additional or improved features which may be added to the Program as initially described in the Framework Agreement in the future, are considered as non-obligatory enhancement measures, and their incorporation will depend on the development of mutually acceptable conjunctive water uses or other mutually agreed features.

g. The Parties believe that, whenever practical, real-time management should take precedence over prior agreed-to measures, as may be needed to react to immediate threats to the fishery or other emergency situations in a manner consistent with the goals of the Program. For purposes of these Adaptive Management Procedures, "real-time management" refers to specific actions and activities undertaken in response to specific events or as unique circumstances dictate, rather than on a programmatic or long-term basis. The Parties also understand that real-time management is not always practical, especially when divergent interests attempt to allocate scarce water resources during emergencies. Nevertheless, the Parties will, in good faith, pursue efforts to engage in real-time management using the best available science and technology in connection with the Program.

h. All Parties must be responsive to unique opportunities and/or hardships that might develop and be prepared to act on them. For example, in wet years, opportunities to import water into the Kings River Service Area for fisheries purposes will be explored and different (higher) flow regimes will be considered. In dry years, relaxation of established standards will be considered if necessary to avoid unreasonable hardships on water users and/or to avoid depletion of cold water resources in Pine Flat Reservoir.

i. The Parties do not intend that fish screening or similar projects will be a part of the Program, and the Department makes no finding that fish screens or similar devices are required at any point of diversion impacted by any element of the Program. The Department prefers to rely on the implementation of the Program to address fisheries values potentially impacted by fish entrainment to the extent practicable. However, to the extent the Department is legally precluded from relinquishing its responsibility to make findings, pursuant to State Fish and Game Code Sections 6100 et. seq., no such responsibility is relinquished hereby.

j. The Program entails a certain degree of risk. In the event of circumstances which result in the loss of any of the enhancements achieved, the Parties will diligently work to recover any lost improvements in the fishery through prescribed stocking of trout, in kind, and other mutually

agreeable activities. The Parties understand that any environmental enhancement program involves unknowns, and the Parties will commit themselves to working together to address issues as they arise.

k. The Program is intended to be comprehensive in nature. Accordingly, it consists of a number of balanced and interrelated elements, none of which can be modified in isolation. The Parties therefore recognize that the Program is a "package" and that changes in any element thereof could necessitate revision or deletion of other elements.

II. <u>Procedures</u>:

a. Respecting the uncertainty inherent in the biological responses of fish populations to any program of habitat enhancement, and changing human interests and needs over time, the Parties intend the Program to be implemented on an *adaptive management* basis. As the Program proceeds, the Parties will monitor the physical and biological outcomes to objectively determine if the measures provided are effective, adequate and/or necessary. At any time, changes may be made to any aspect of the Program, subject to mutual agreement of the Parties and in accordance with the procedures contained herein, to reflect available fishery limiting factor analysis, species status information, and real-time management needs. In addition, the Parties will actively and diligently pursue new operational opportunities (such as water exchanges) which have potential to result in further conjunctive, step-wise aquatic resource benefits of mutual benefit.

b. The Parties mutually recognize the need to assure that in the long-term process of making *adaptive management* amendments to the Program (i) the rights of all parties will remain protected, (ii) the reasonably intended benefits will accrue to the fishery, (iii) the maximum efficiency in cost will be practiced and (iv) reasonable beneficial use of the Kings River water resources will continue to occur. To provide such assurance, the Parties will diligently adhere to the procedures outlined herein, for making amendments to the Program and its attendant elements, and for guiding implementation decisions.

c. While it is not the intent of any of the Parties to eliminate any feature of the Program considered by any other Party to be essential for the protection or management of the Kings River fishery or ecosystem, it is probable that some program re-direction may occur in response to new scientific information and/or experience. Fishery enhancement features which are not cost effective may be re-conformed into alternative measures or eliminated altogether, based on a consensus of the Parties, in the manner described herein.

III. <u>Adaptive Management Decisions</u>:

It is the policy of each of the Parties that voluntary efforts to improve and enhance the fisheries of the Kings River should be ongoing and consistent with the need for reliability and certainty of Kings River water supplies to downstream water rights holders. Although the Parties' joint scientific program has identified numerous opportunities for initially modifying water uses in a manner that benefits the created tail-water trout fisheries and other native fish populations, it cannot be predicted whether existing on and off-stream water uses will continue, or how they may change. The Parties also cannot predict biological responses, legal changes, or human demographic changes which may place changing demands upon the Kings River waters and/or its fish populations. The Parties therefore recognize the need for any long-term program of fishery improvements to be flexible, and to adopt adaptive management strategies whenever practical.

Accordingly, the Parties agree that the Technical Steering Committee (defined below), under the direction of the Executive Policy Committee (also defined below) will engage in regular evaluation of each project or element of the Program to determine whether it should be retained, eliminated, augmented or revised, all with a view to refining the Program to include the most reasonable goals and effective measures practical. The Parties understand that as each new project or element is undertaken, adequate time must be allowed to monitor its results and to assess its impacts. The Parties intend for the process of implementation, followed by monitoring,

followed by evaluation and refinement to be ongoing and a central feature of the Program as implemented in accordance with these Adaptive Management Procedures.

IV. Procedures for Adaptive Management:

A. Technical Steering Committee (TSC):

1. TSC Membership:

The Parties will participate in a three-member Technical Steering Committee (TSC), composed of one member representing each Party. Each Party will have responsibility to appoint its representative, who must have appropriate qualifications in either Natural Sciences or Engineering. TSC members will also be in a capacity to supervise or direct the work of the technical staff of the Party which they represent. The cost of maintaining each respective member will be borne by the individual appointing authorities. Meetings of the TSC will be conducted as needed, without public notice, at such times and places as the members of the TSC agree. Except as otherwise directed by the Executive Policy Committee (defined below and hereafter referred to as the "ExCom"), meetings need not be open to the public.

2. TSC Role:

a. The TSC will provide oversight regarding all joint science undertaken by the Parties as a part of the Program. While each Party will retain direct supervision authority over its participating member, the TSC will consider and decide, as one body, on the scope, extent, methods and participation regarding needed joint scientific work. The TSC will also review scientific outputs and reports as produced by the scientific staffs of each participating Party, and arrange for outside peer review of results, as appropriate.

b. The TSC will review available science and recommend in writing to the ExCom: (i) changes in the biological monitoring programs, (ii) amendments to the Program, (iii) engineering studies, (iv) budgeting of the biological or technical work, (v) scheduling of expenditures under the Program, (vi) new management concepts, features, or needs, (vii) new constructed features and/or (viii) any other changes, features, or issues requiring ExCom approval.

c. Through the Parties' respective members, the TSC will participate closely with the technical and environmental staffs of the Parties, to assure commonality to the work programs undertaken. It will be the responsibility of each TSC member to communicate to the other TSC members about scientific programs that are ongoing between and among the Parties, and to assure that broad technical and scientific review is appropriately applied, so as to ensure general credibility to the scientific programs and efforts.

d. Upon request of any member of the ExCom, specified TSC members will attend the meetings of the ExCom, and report to said ExCom both verbally and in writing on the progress, problems and results of the scientific programs. The TSC will request, through its members, preparation of formal or informal reports of the technical programs of the respective Parties, to the extent said reports have relevance to the Program.

e. The TSC will comply with work or reporting requirements of the ExCom, and produce such technical support materials as the ExCom may request, as needed for the conduct of the business of either Committee. In the event such requests or assignments represent conflicts between the joint and separate roles and rights of the Parties, the ExCom will be made immediately aware and will decide said issues in accordance with the procedures below.

f. All proceedings and/or writings of the TSC, as well as any written minutes of regularly scheduled meetings, will be regarded as preliminary information and internal memoranda of the separate Parties originally generating the information, until said information becomes finalized and approved in writing by the ExCom, acting as a joint body. None of such materials will be released

by the individual Party or Parties responsible for the generation of the material without ExCom approval. The TSC members, and their accountable technical personnel, will therefore make no voluntary public comments about the results of technical studies or transactions, until they are finalized and approved by the ExCom.

3. TSC Decisions and Technical Disagreements:

The TSC will decide, as one body, on recommendations or requests to be made to the ExCom. A full consensus (i.e., one hundred percent consensus) is required to transact the TSC business. All reports, recommendations and other actions of the TSC will require unanimous approval of the three TSC members.

4. Separate Supervision of Technical-Scientific Staff:

The Program will have no scientific or technical staff, except through the participation of the personnel of the respective Parties or as the Ex Com unanimously agrees. As such, each Party will retain separate and independent supervision and direction of its respective personnel, and will not be obligated in any way to compromise said supervision on behalf of any TSC or other joint action. Neither a Party nor the TSC will possess authority to supervise, assign, schedule, train, admonish, direct, re-direct, correct or otherwise affect the work of any other individual Party's personnel, regardless of TSC representation. As such, no liability for said personnel or its direction is to be shared as a product of these Adaptive Management Procedures.

B. Executive Policy Committee (ExCom):

1. ExCom Membership:

The Parties agree to participate in the ExCom. Each Party will be allowed one member of the ExCom, to consist of a Managerial-level person, designated by each respective Party. In most cases, these would consist of the Regional Manager, representing the Department: the Watermaster or Assistant Watermaster of the Association: and the General Manager or Assistant General Manager of the District.

The Parties acknowledge that they cannot delegate general authority to their respective ExCom members to bind the Parties on decisions made by the ExCom until each decision is reviewed by such Party. Therefore, each appointing Party retains full authority over its respective ExCom member's involvement in ExCom business, and each ExCom member will receive the required authorizations from his/her appointing Party prior to casting a vote on the ExCom. Any Party may replace its ExCom member, or require advance approval of any vote to be cast by said member. The cost of supporting each Party's participant will be borne by the individual appointing Party.

2. ExCom Decisions:

a. All decisions of the ExCom will be by full consensus (i.e., one hundred percent consensus among the voting Parties and entities). This creates a veto power for each voting member, which is agreed to be necessary to encourage and preserve partnership among the Parties. At the request of any member, any decision may be reasonably continued to enable that member an opportunity to seek direction from his or her appointing authority, prior to casting a vote. In the event of emergency decisions, all parties will expedite such continuations in good faith, to prevent damage to any Party or individual, or to the fishery.

b. In the event the ExCom cannot reach a full consensus on any issue, it has the following options: (i) not decide the issue, or (ii) continue the issue, to allow additional information to be developed, or (iii) change or amend the proposal or issue. If none of the foregoing options results in full consensus, the Parties will jointly engage a mutually agreed upon mediator in a good faith effort to achieve consensus.

3. Roles of the ExCom:

a. The ExCom will be the only appropriate authority to review and adopt proposed amendments either to these Adaptive Management Procedures or to any other element of the Program. The ExCom will review proposed amendments and make decisions whether to adopt, modify, or reject said amendments. On elements previously approved by the SWRCB, the SWRCB will be consulted prior to making amendments or modifications, and any required SWRCB approvals will be diligently pursued. However, the ExCom may not undertake any amendment which is inconsistent with any substantive recommendation made by the TSC in the absence of overriding factors specifically described by the ExCom. This is intended to assure the professional-scientific fidelity and credibility of the Program. The ExCom may initiate amendments, by requesting the TSC to develop and propose them in technically sound form. Similarly, any individual Party may initiate amendments through its TSC member directly.

b. The ExCom will be the final decision and approval authority for any expenditures of moneys made available for use in the Program. Proposals for expenditures may originate from any source. The Parties anticipate that all such proposals will be evaluated as part of an operations planning process to occur each year with public participation. Any Party or member of the public will be permitted to advance proposals for inclusion in such planning process. Prior to consideration by the ExCom, all proposals will be evaluated by the TSC. ExCom consideration of such proposals will be based on the best scientific and technical information available at the time, in balance with the public interest, as may be determined by the ExCom. Any proposal advanced as a part of the annual planning process will include (i) a description of the intended action, (ii) the expected benefits and the timetable for the accrual of said benefits, (iii) an analysis of alternative actions, and (iv) the most precise estimate of the cost of the proposal available at the time. Upon receipt of a proposal, the ExCom may consider alternative approaches, different timing, and various funding options. It may accept or reject any proposal, provided that if the proposal is for a project or activity previously approved by the SWRCB, the ExCom may not reject the proposal outright absent first obtaining approval of the SWRCB, and must instead seek satisfactory revision of such proposal consistent with the applicable SWRCB approval.

c. The ExCom will be the final approval authority for amendments to the goals for the Program; however, the ExCom may not undertake any such amendment or restructuring of said goals which are inconsistent with any substantive recommendation made by the TSC in the absence of overriding factors specifically described by the ExCom. This is intended to assure the professional-scientific fidelity and credibility of the adopted goals. However, the ExCom may initiate amendments, by requesting the TSC to develop and propose them in technically sound form. Similarly, any Party may initiate amendments through its TSC member directly. On features previously approved by the SWRCB, the SWRCB will be consulted prior to making amendments or modifications, and any required SWRCB approvals will be diligently pursued.

d. The ExCom will direct the TSC's actions, and will receive any and all TSC-endorsed work products, reports and recommendations. The ExCom will hold the TSC jointly accountable to meet deadlines and to provide the materials and reports requested. The ExCom members will exercise their separate authorities, as needed, to hold their individual TSC appointees and technical support personnel accountable for timely completion of the ExCom's assignments.

e. The handling of scientific and technical information and products will be considered sensitive, and be undertaken in the most professional, ethical manner possible by all Parties. The ExCom will be the sole dispensary of technical information which it requests from the TSC, or which is produced by the TSC operating as a committee. All technical materials and/or information will be regarded as draft and preliminary, prior to ExCom approval. The ExCom or its members will not suppress approval of technically valid or "best-available" information, if said information is a contributing part of any interpretation of the needs of the fishery resource, or if it represents any reasonably available remedy to a perceived or acknowledged fishery problem. Conversely, but consistent with all applicable laws, the ExCom will not dispense or provide to the public any technical product which has been rejected by the TSC, as either preliminary, incomplete, inaccurate, or misleading. Regarding decisions to dispense ExCom-requested

technical information, the ExCom or its members have the following options: (i) approve and dispense the information, (ii) request additional supporting information, (iii) return the product to the TSC for reconsideration, or (iv) release the products or information, with an accompanying ExCom statement regarding its limitations. All California Public Records Act requests or Federal Freedom of Information Act requests must be addressed to individual ExCom members (persons), acting through the Parties' separate jurisdictions. For this purpose, the ExCom will not be regarded as a governmental entity. The TSC information and other ExCom materials will be released in accordance with any and all pertinent statutes and doctrines of law.

f. It is the mutual desire of the Parties to involve members of the public in the implementation and development of features of the Program. Therefore, the ExCom will engage in public awareness and education activities relative to the Program and provide regular opportunities for representatives of affected sectors of the public to propose, review and comment regarding all relevant aspects of the Program and its implementation. All meetings of the ExCom will be open to the public, and members of the public will be provided an opportunity to address the ExCom at regular intervals on issues within the jurisdiction of the ExCom. The ExCom will be the primary public liaison for the Program, and will therefore convene noticed public meetings as often as necessary, but at least once per calendar year, for the purpose of maintaining contact and communication with the interested public. In the notice of said meetings, the ExCom may elect to accept public comments and input, or may designate the meetings informational, at which only public questions will be received and responded to. In either case, the ExCom will make every effort to record the public input accurately and to take appropriate actions of record, based on any received information. All such ExCom meetings will be conducted substantially in accordance with meeting notices.

The ExCom or its members may elect to contact the general public at large, or any of the separate and particular entities comprising said public, in order to provide or gather information. This may be through meetings, questionnaires, letters, or other media of the ExCom's choosing. Such queries or presentations will be the result of formal ExCom decisions, and the results will be reported to the public at the next subsequent ExCom meeting.

The ExCom may request the TSC members, or others, to attend any noticed public meeting for the purpose of providing clarification and information, or to collect public input, as may be needed in TSC direction.

g. The ExCom will maintain a liaison with the staff and/or appointees of the SWRCB for the purpose of informing them of the progress and performance of the Program. The ExCom will be responsive to requests for information made by the SWRCB or its staff, and will be accountable to meet any and all deadlines for such information, as the SWRCB may impose.

h. The ExCom will be the seat of resolution of any and all disputes among the Parties, which will be undertaken in accordance with Section IV.B.2.

4. ExCom Regular Meetings:

In addition to the meetings held for purposes of receiving public input described in Section IV.3, the ExCom will meet as needed, but not less than three times per calendar year, in public regular session, to consider proposals from the TSC, or to consider actions recommended by the public. The ExCom may elect or appoint an executive officer, who may be an ExCom member or a mutually agreed designee. Said officer will assist the ExCom by preparing agendas, noticing meetings, arranging locations and dates, conducting meetings, maintaining a record of proceedings, overseeing preparation of Executive Summary information by the TSC or its members, and performing other duties as the ExCom may require.

5. ExCom Members' Joint and Separate Rights:

ExCom members, by their required qualifications will have acknowledged combined roles: (i) The role of ExCom members, and (ii) the role as managers of the individual Parties. These Adaptive Management Procedures make no requirement or supposition that any assignment or appointment to any committee associated with the Program, will impose undue limitations upon the role of Parties in managing their separate interests. The Parties' individual rights to obligate their managers and/or personnel to particular positions or policies remain unabridged by their participation in the Program or these Adaptive Management Procedures. All rights of the separate Parties are hereby retained.

****

Exhibit "C"

Kings River Fish Flow Requirements
and Division of Flow Downstream
(in cubic feet per second)

Season	Total Flow at Piedra	Minimum Flow in Dennis Cut	Minimum Flow to Fresno Weir	Water Divertable in China Slough	Required Flow Over Fresno Weir
Oct 1 - Nov. 15	100	5	95	10	40
Nov. 16 - March 31	100	5	95	5	45
April 1 - Sept. 30	100	5	95	15	35

The Total Flow at Piedra is the "Kings River For Distribution" as published in the Kings River Water Association Watermaster Report. At least 50 cfs of the Total Flow at Piedra shall originate at Pine Flat Dam. This flow may be altered as necessary to facilitate monitoring, construction of Program features, flood control activities of the Corps of Engineers, or other actions of overriding importance approved by the Executive Policy Committee. This flow may also be altered on an adaptive management basis by the Executive Policy Committee to address temperature considerations, provided that increases in Total Flow at Piedra to provide desired temperatures will be accompanied by offsetting reductions in Total Flow at Piedra, or other accommodations as determined by the Executive Policy Committee, at the earliest practicable date.

The Minimum Flow in Dennis Cut is for instream fishery purposes and shall be at least 5 cfs at all times. None of that flow will be diverted in the Alta Canal. When diversions into Dennis Cut exceed 5 cfs and as a result the Minimum Flow to Fresno Weir would be less than 95 cfs, there shall be an additional release from Pine Flat Dam to ensure that the Minimum Flow to Fresno Weir is maintained at 95 cfs.

The Minimum Flow to Fresno Weir is the Total Flow at Piedra less diversions above Fresno Weir.

The Water Divertable in China Slough is the maximum portion of the Minimum Flow to Fresno Weir that may be diverted in China Slough (all of which is diverted via the Consolidated Canal). Any diversions into China Slough in excess of the Water Divertable in China Slough will not be included in or credited against the Required Flow Over Fresno Weir.

The Required Flow Over Fresno Weir is the minimum portion of the Minimum Flow to Fresno Weir that should arrive at the Weir and not be diverted in the Fresno Canal, Consolidated Canal or in China Slough. Appropriate flow measurements shall be made to verify that the Required Flow Over Fresno Weir is present. Unavoidable measurement errors within accepted industry standards will not be deemed violations of the standards described above. Any short-term operational deviation affecting Required Flow Over Fresno Weir will be reviewed by the Executive Policy Committee as soon as reasonably possible after the occurrence and determined to either be reasonable under the applicable circumstances (and therefore not a violation of the standards described above) or unreasonable (in which case remedial measures will be developed where appropriate).

Rates of change of flow at low river stages shall be governed by Section 1(g) of the Framework Agreement to which this Exhibit C is attached.

****

Exhibit "D"

Kings River Fish Flow Goals
For Implementation by October 1, 2005

By October 1, 2005, and subject to Section 1(e) of the Framework Agreement to which this Exhibit D is attached, the members of the Association will diligently endeavor to increase the Minimum Flow to Fresno Weir (as defined in Exhibit C) as follows, subject to any adjustments by the Executive Policy Committee implemented pursuant to the Adaptive Management Procedures:

1. For each water year (defined as October 1 through September 30) that Kings River runoff exceeds 2,100,000 acre feet, the Minimum Flow to Fresno Weir will be at least 250 cubic feet per second for one "enhanced minimum flow period" beginning on the date the Minimum Flow to Fresno Weir would otherwise have fallen below 250 cubic feet per second through the next March 31.

2. For each water year (defined as October 1 through September 30) that Kings River runoff exceeds 1,555,000 acre feet, but is less than 2,100,000 acre feet, the Minimum Flow to Fresno Weir will be at least 130 cubic feet per second for one "enhanced minimum flow period" beginning on the date the Minimum Flow to Fresno Weir would otherwise have fallen below 130 cubic feet per second through the next March 31.

3. For each water year (defined as October 1 through September 30) that Kings River runoff is 1,555,000 acre feet or less, instream flows for fisheries management will be governed by Exhibit C.

4. Each "enhanced minimum flow period" described in Sections 1 and 2 may be before, during, or within five years after the water year in which the runoff requiring the applicable flows occurs.

5. Notwithstanding the provisions of Sections 1 and 2, the Minimum Flow to Fresno Weir resulting from a water year described in Section 2 may be increased during an enhanced minimum flow period from 130 cubic feet per second by up to 60 cubic feet per second at the election of the Kings River Water Association. Provided such increase is maintained for the entire enhanced minimum flow period, the members of the Association will receive a "credit" for the amount of the increase which may be applied against the flows required during an enhanced minimum flow period described in Section 1 of this Exhibit D. By way of example, if the Kings River Water Association elected to increase the Minimum Flow to Fresno Weir from 130 cubic feet per second to 175 cubic feet per second in a minimum flow period described in Section 2, it would be entitled to reduce Minimum Flow to Fresno Weir from 250 cubic feet per second to 205 cubic feet per second during the next minimum flow period described in Section 1.

6. The minimum portion of the Total Flow at Piedra (as defined in Exhibit C) which will originate at Pine Flat Dam during enhanced minimum flow periods described in Sections 1 and 2 of this Exhibit D, and other permitted distributions and diversions of the flows provided for in Sections 1 and 2, will be determined by the Executive Policy Committee. All such determinations will be made before any of the enhanced flows described in Sections 1 or 2 will be provided by members of the Association, recognizing that such determinations must accommodate the program(s) utilized by the members of the Association to develop the water to provide the enhanced flows described in Sections 1 and 2.

7. Without limiting the powers of the Executive Policy Committee to adjust flows under the Program, the flows described in Sections 1 and 2 may be altered as necessary to facilitate monitoring, construction of Program features, flood control activities of the Corps of Engineers, or other considerations of overriding importance approved by the Executive Policy Committee. Those flow may also be altered on an adaptive

management basis by the Executive Policy Committee to address temperature considerations, provided that any increases in Total Flow at Piedra or Minimum Flow to Fresno Weir to provide desired temperatures will be accompanied by offsetting reductions in Total Flow at Piedra and/or Minimum Flow to Fresno Weir, as appropriate, or other accommodations as determined by the Executive Policy Committee, at the earliest practicable date.

8. Rates of change of flow at low river stages will be governed by Section 1(g) of the Framework Agreement to which this Exhibit D is attached.

****

Appendix B

Multi-species Benefits of the Pine Flat Dam Multilevel Intake Structure

Multi-species Benefits of the Pine Flat Dam Multi-Level Intake Structure

Species Benefitted	Location Benefitted	Benefits Created by Multi-level Intake Structure (MLI)
Rainbow Trout O. mykiss	Kings River above PFR[1] Kings River below PFR Within PFR	Improved cold water habitat in PFR improves over-summer survival in PFR for upstream migrants. Improved cold temperature regime. MLI relieves temperature stress periods in all years. Improved cold water volume in PFR promotes better over-summer survival.
Kokanee Salmon O. nerka	Rare or absent throughout system (Introduced historically)	Same benefits as Rainbow Trout.
Silver Salmon O. kisutch	Rare or absent throughout system (Introduced historically)	Same benefits as Rainbow Trout.
Chinook Salmon O. tshawytscha	Introduced into PFR Migrates from PFR upstream.	Improved cold water volume in PFR promotes better over-summer survival. Improved cold water habitat in PFR improves over-summer survival in PFR for upstream migrants.
Brown Trout Salmo trutta	Kings River above PFR Kings River below PFR	Improved cold water habitat in PFR improves over-summer survival in PFR for upstream migrants. Improved cold temperature regime (The MLI relieves temperature stress periods in all years). Brown trout have been periodically stocked as eggs or juveniles into the lower Kings River. The summer temperature regime is usually too warm to enable ovarian development for normal fall reproduction. The MLI will improve those conditions. Brown trout are currently present on a put and-grow basis.
Golden Trout O. aguaboinita	Rare or absent throughout system Occasional fish may appear, emigrating from upstream headwaters.	Same benefits as rainbow trout (if present).
Brook Trout S. fontinalis	Stocked into lower Kings River Occasional fish may also appear, emigrating from upstream headwaters.	Same benefits and limitations as brown trout.
Arctic Grayling Thymailus arcticus	Historically unsuccessfully introduced. No longer present.	Same benefits as Rainbow Trout (if present).

[1] Pine Flat Reservoir

Kern Brook Lamprey Lampetra hubbsi	Native to entire system below 1,500 m. elevation. Now present:	
	Kings River above PFR	Same benefits from MLI as rainbow trout.
	PFR (probably as larvae)	Better cold water management will benefit over-summer survival and upstream /downstream dispersal.
	Downstream of PFR	Better cold-water management will benefit reproduction and survival of this desirable native species.
Pacific Lamprey Lampetra tridentata	Native to entire system below 1,500 m. elevation. Now present (and rare) only within lower Kings River	
	Downstream of PFR	Better cold-water management will benefit reproduction and survival of this native species.
Largemouth Bass Micropterus salmoides	Downstream of PFR, below Fresno Weir.	Distribution could be reduced by operation of MLI. This would be beneficial, given Largemouth Bass populations are introduced (albeit popular) and have adverse effects on native species. Colder water would discourage LMB reproduction and potentially move the population further downstream.
	Within PFR	This is a popular introduced gamefish which will be benefitted in the reservoir by enabling higher water levels to be maintained at critical times. (Better thermal mixing at the outlet will conserve water without need to draw the reservoir down so substantially).
	Occasionally above PFR for a short distance upstream of PFR	Benefits would be inconsequential, given the small and seasonal distribution of LMB above PFR.
Spotted Bass M. punctulatus	Downstream of PFR, below Fresno Weir.	Distribution could be reduced by operation of MLI. This would be beneficial, given Spotted Bass populations are introduced (albeit popular) and have adverse effects on native species. Colder water would discourage SPB reproduction and potentially move the population further downstream.
	Within PFR	This is a popular introduced gamefish which will be benefitted in the reservoir by enabling higher water levels to be maintained at critical times. (Better thermal mixing at the outlet will conserve water without need to draw the reservoir down so substantially).
	Occasionally above PFR for a short distance upstream of PFR	Benefits would be inconsequential, given the small and seasonal distribution of LMB above PFR.
Smallmouth Bass M. dolomieui	Downstream of PFR, below Fresno Weir.	Distribution could be reduced by operation of MLI. This would be beneficial, given Smallmouth Bass populations are introduced (albeit popular) and have adverse effects on native species. Colder water would discourage SMB reproduction and potentially move the population further downstream.
	Within PFR	This is a popular introduced gamefish which will be benefitted in the reservoir by enabling higher water levels to be maintained at critical times. (Better thermal mixing at the outlet will conserve water without need to draw the reservoir down so substantially).
	Occasionally above PFR for a short distance upstream of PFR	Benefits would be inconsequential, given the small and seasonal distribution of LMB above PFR and the eurythermal nature and migratory behaviors of SMB.

Green Sunfish Lepomis cyanellus	Same as smallmouth bass	Same as smallmouth bass.
Bluegill Sunfish Lepomis macrochirus	Same as smallmouth bass	Same as smallmouth bass.
Redear Sunfish Lepomis microlophus	Same as smallmouth bass	Same as smallmouth bass.
Warmouth Sunfish Lepomis gibbosus	Same as smallmouth bass	Same as smallmouth bass.
Black Crappie Pomoxis nigromaculatus	Same as smallmouth bass	Same as smallmouth bass.
White Crappie Pomoxis annularis	Same as smallmouth bass	Same as smallmouth bass.
White Bass Morone chrysops	Within PFR (introduced - rare)	Species was unlawfully introduced into PFR. It has serious potential to adversely affect downstream fisheries in the Kings River, San Joaquin River and Delta. Management is to eliminate this species. MLI will potentially help reduce white bass populations, by allowing better water temperature management, both in PFR and better control of temperatures at the outlet facility (to limit survival). Colder downstream temperatures will discourage white bass from surviving to migrate downstream.
Striped Bass Morone saxitalis	Historically introduced into PFR Present in Mendota Pool, James Bypass, Crescent Weir and other downstream waters. Periodically invades lower Kings River upstream to Army Weir.	Not now present. No effect from MLI.
Sacramento Perch Archoplites interruptus	Native to Kings River at low elevations.	No longer present.
Channel Catfish Ictalurus punctulatus	Periodically stocked into PFR. Present in lower Kings River at lower elevations.	No effect from MLI.
White Catfish Ictalurus catus	Periodically stocked within PFR Present within lower Kings River in lower elevations.	Will benefit from better PFR water level management and temperature management due to MLI. No effect from MLI.

Brown Bullhead Ictalurus nebulosus	Historically introduced into lower Kings R. Present at low elevations Present within PFR	No effect from MLI. Will benefit from better PFR water level management and temperature management due to MLI.
Black Bullhead Ictalurus melas	Historically introduced into lower Kings R. Present at low elevations Probably present within PFR	No effect from MLI. Will benefit from better PFR water level management and temperature management due to MLI.
Threespine Stickleback Gasterosteus acculeatus	Below PFR in lower Kings R.	Will benefit from cooler temperature management afforded by MLI.
Sacramento Sucker Catostomus occidentalis	Below PFR in lower Kings R. Within PFR Upstream of PFR	Will benefit from cooler temperature management afforded by MLI. Populations seasonally use cool water strata of PFR as a winter habitat, then migrate upstream to reproduce in tributary streams. Cooler water management in PFR will benefit this native species. Seasonal migratory populations of this transition zone fish will be benefitted by cooler water management and higher water levels in PFR.
Hardhead Mylopharodon conocephalus	Below PFR in lower Kings R. Within PFR Upstream of PFR	Will benefit from cooler temperature management afforded by MLI Populations seasonally use cool water strata of PFR as a winter habitat, then migrate upstream to reproduce in tributary streams. Cooler water management in PFR will benefit this native species. Seasonal migratory populations of this transition zone fish will be benefitted by cooler water management and higher water levels in PFR.
Sacramento Pikeminnow Ptychocheilus grandis	Below PFR in lower Kings R. Within PFR Upstream of PFR	Will benefit from cooler temperature management afforded by MLI Populations seasonally use cool water strata of PFR as a winter habitat, then migrate upstream to reproduce in tributary streams. Cooler water management in PFR will benefit this native species. Seasonal migratory populations of this transition zone fish will be benefitted by cooler water management and higher water levels in PFR.
Sacramento Blackfish Orthodon microlepidotus	Below PFR in lower Kings R. Within PFR Upstream of PFR	Occasional or absent. Where present,will benefit from cooler temperature management due to MLI Populations seasonally use cool water strata of PFR as a winter habitat, then migrate upstream to reproduce in tributary streams. Cooler water management in PFR will benefit this native species. Seasonal migratory populations of this transition zone fish will be benefitted by cooler water management and higher water levels in PFR.

Hitch Lavinia exilicauda	Below PFR in lower Kings R. Within PFR	Occasional. Where present, will benefit from cooler temperature management afforded by MLI Populations use cool water strata of PFR as a winter habitat, then migrate upstream to reproduce in tributary streams. Cooler water management in PFR will benefit this native species.
Thicktail Chub Hila crassicauda	Now extinct (Historically common in lower Kings River)	No effect from MLI.
Tule Perch Hysterocarpus traski	Now extirpated from Kings River	No effect from MLI.
California Roach Hesperoleucus symmetricus	Below PFR in lower Kings R. Upstream of PFR in tributaries	Will benefit from cooler temperature management a fforded by MLI. No effect from MLI.
Carp Cyprinnus carpio	Present throughout system below PFR inlet.	Would be benefitted (undesirably) in PFR by better water level management. Undesirable introduced species.
Goldfish Cyprinnus auratus	Present throughout system below PFR inlet.	Would be benefitted (undesirably) in PFR by better water level management. Undesirable introduced species.
Riffle Sculpin Cottus gulosus	Below PFR in lower Kings R. Within PFR Upstream of PFR	Will benefit from cooler temperature management afforded by MLI. Populations may seasonally use cool water strata of PFR as winter habitat, then migrate upstream to reproduce in tributary streams. Cooler water management in PFR will benefit this native species Seasonal migratory populations of this transition zone fish will be benefitted by cooler water management and higher water levels in PFR.
Prickly Sculpin Cottus asper	Below PFR in lower Kings R.	Will benefit from cooler temperature management afforded by MLI management and higher water levels in PFR.
Threadfin Shad Dorosoma petenense	Introduced into PFR Downstream migrants present in lower Kings R.	Would benefit from water level management enabled by MLI. Would be discouraged (desirably) by cooler water management in river due to MLI.
Golden Shiner Notemigonus chrysoleucus	Below PFR in lower Kings R. Within PFR	Occasional. Where present, will be discouraged (desirably) from cooler temperature management afforded by MLI. Populations use warmer water strata of PFR. Cooler water management in PFR will discourage (desirably) this introduced species.

Speckled Dace Rhinicthys oscusus	Reported present in lower Kings River	Will benefit from cooler temperature management afforded by MLI
Bigscale Logperch Percina macrolepida	Native to lower Kings River in warmer water reaches	No effect from MLI.
Inland Silversides Menida beryllina	Introduced to lower Kings R. within warmer water reaches	No effect from MLI.
Mosquitofish Gambusia affinis	Introduced into lower Kings R. within warm water reaches	No effect from MLI.
Freshwater mussels Margaritifera sp. (Several sp.)	Common throughout the Kings River system in all reaches up to 1,500 m. elevation. Downstream of PFR Upstream of PFR	 Will benefit by cooler water regime in summer and fall months. No effect from MLI.
Freshwater clams (several native species are known, but unsurveyed)	Downstream of PFR	Will benefit by cooler water regime in summer and fall months.
Macro-invertebrates (many species)	Downstream of PFR	Many species of caddisfly, stonefly, mayfly, and dobsonfly will be benefitted by the cooler water management in summer and fall months. Because these are keystone organisms in the trophic chain for nearly all aquatic species, the benefits are far reaching within the aquatic ecosystem.
Herons and Egrets Kingfishers and other fish-eating birds (many species)	Downstream of PFR Within PFR	Will benefit from cooler water management in summer and fall months by increased prey populations Will benefit from better water level and temperature management due to MLI
Bald Eagle, Osprey	Present throughout watershed	Would benefit below Pine Flat Dam by increased fish production due to managed temperatures
Passerine Birds, neotropical migrant bird species	Present throughout watershed	Will benefit from increased and more consistent macro-invertebrate production due to managed water temperatures. Insects comprise a major food source for these birds, which frequent riparian corridors
Mink	Downstream of PFR	Will benefit from higher populations of fish, mussels and invertebrates,representing the principal food source, as a result of thermal management due to MLI.
Beaver, Muskrat	Downstream of PFR	No effect from MLI
Bats and other insectivores	Downstream of PFR	Will benefit from more consistent macro-invertebrate production, due to managed water temperatures

Appendix C

Basis of Design and Cost Estimate

(will be provided as requested)

Appendix D

Cost Effectiveness and Incremental Cost Analysis

PINE FLAT DAM
FISH AND WILDLIFE HABITAT RESTORATION

COST EFFECTIVENESS AND INCREMENTAL COST ANALYSES

Table of contents

PINE FLAT DAM FISH AND WILDLIFE HABITAT RESTORATION

COST EFFECTIVENESS AND INCREMENTAL COST ANALYSES

MULTILEVEL INTAKE STRUCTURE

Description of Formulation

Eight multilevel intake structure port configurations were evaluated to associate the number and elevation of intake openings or withdrawal ports that would optimize the structure's release temperature effectiveness for coldwater fish survival in the lake and river below the dam. The eight configurations included C0 for no installation of the multilevel intake structure on the upstream side of the dam to regulate water flow for maximum coldwater fishery survival. C1 is for 9-port straight-configuration with an output of about 10 Weighted Usable Area (WUA). C2 is for 9-port straight-configuration with an output of about 20 WUA. C3 is for 9-port straight-configuration with an output of about 30 WUA. C4 is for 9-port staggered-configuration with an output of about 40 WUA. C5 is for 12-port straight-configuration with an output of about 40 WUA. C6 is for 12-port staggered-configuration with an output of about 40 WUA. C7 is for 21-port staggered-configuration with an output of about 40 WUA.

The port configuration analysis were summarized in two reports: (1) "Water Temperature Modeling Study for the Multi-Level Intake Structure," September 1998. In this report KRCD utilized a calibrated CE-QUAL-W2 computer model developed for Pine Flat Reservoir to evaluate water temperatures in the reservoir and downstream releases through a multi-level intake structure design. (2) "Multi-Level Intake Structure, Port Configuration Analysis," March 1999. In this report KRCD determined the number and elevation of intake openings or withdrawal ports that would optimize the multi-level intake structures' release temperature effectiveness and summarized the result of the analysis in selecting the most effective intake port configuration. The CE-QUAL-W2 computer model used 1988 for dry water year, 1992 for critically dry water year, and 1994 for normal water year.

With the three straight 9-port configurations, the computer model projected a 6- to 10-degree C temperature change when releases were switched from port to port. Such a sudden change in water temperatures would result in reduced potential WUA benefits and could be detrimental to trout survival. With the 11 staggered 9-port configurations, the model showed no similar temperature change with port switches. All of the configurations appeared to effectively manage release temperatures, but the configuration which provided the maximum WUA was determined to be elevation placement 857.5, 829.5, 801.5, 773.5, 745.5, 717.5, 652.5 lowest port. Two 12-port configurations were also evaluated. Although the model showed that these configurations provided more flexibility in terms of releases, they did not provide any additional WUA, and both had increased costs. Finally, a 21-port configuration was evaluated, but determined to be impractical in terms of existing available space, higher costs, and no increase in WUA.

Each configuration was characterized in terms of implementation costs and expected benefits in WUA. Implementation costs are a function of the number of port openings required to optimize the release temperature output for coldwater fishery survival, the resulting release temperature modeling, and the maximum number of fishery benefits (expressed as WUA) at the least cost. The WUA were derived by the USFWS using computer models PHABSIM AND SNTEMP and the information provided by KRCD's calibrated CE-QUAL-W2 computer model.

Description of Costs

The costs for the various port configuration were based on the labor rates, construction mobilization and demobilization, site preparation, construction materials, engineering design, realignment of some of the existing utilities, computer modeling simulation and most optimum port configuration location, administration during construction, and other related expenses. Summary of the costs and associated habitat values, WUA, are shown in Table 1. Each configuration was calculated and average annual equivalent cost was based on a 50-year project life, using a 6 3/8 percent interest rate, and October 2000 price level.

Table 1. Costs and Habitat Values for Multilevel Intake Structure

Port Configuration Design (ports)	WUA Output	Total Cost ($Million)	Cost/WUA ($Million/WUA)	Average Annual Cost ($Million)	Port Configuration (Elevation placement in feet)
0 (C0)	0	0	0	0	0
9 (C1)	10	39.135	3.91	2.67	Straight 850, 750, 652.5
9 (C2)	20	39.135	1.96	2.67	Straight 870, 750, 652.5
9 (C3)	30	39.135	1.30	2.67	Straight 900, 760, 652.5
9 (C4)	40	39.135	0.98	2.67	Staggered 857.5, 829.5, 801.5, 773.5, 745.5, 717.5, 652.5 lowest port.
12 (C5)	40	52.18	1.30	3.54	Straight 910, 810, 730, 652.5
12 (C6)	40	52.18	1.30	3.54	Staggered
21 (C7)	40	91.31	2.28	6.15	Staggered

Description of Environmental Benefits

The benefit of each configuration was characterized in terms of aquatic habitat units' output based on the USFWS WUA (Weighted Usable Area) analysis. This analysis used an aquatic HEP (similar procedure as terrestrial HEP) analysis, PHABSIM AND SNTEMP, to determine the habitat units in weighted useable area (WUA) for fish. Rainbow trout was used as the indicator species for the coldwater fishery in this study due to the extensive studies, modeling and large amount of available information on this

species. The weighted usable area, WUA, is defined as the amount of usable habitat in a river for juvenile, adult, and other life cycle stages of rainbow trout based on association between fish and average water velocities, depths, and substrate size, expressed as habitat suitability curves. Changes in the WUA as a function of water discharge (m3/s) and the closely related variable river channel width (m), can be used to illustrate the importance of discharge to different life cycle stages of rainbow trout in maintaining diversity in channel form and flow. Several life stages of rainbow trout were used as an evaluation species in the 1998 aquatic HEP analysis.

The WUA are aquatic habitat units from an Instream Flow Incremental Methodology (IFIM) study and are similar to, but not comparable with, HU's or AAHU's in HEP, which are terrestrial habitat units (Brian Cordone, USFWS, personal communication, 2000). The primary differences are that in IFIM, a) there is no time function because the value changes are instantaneously effected by flow and derivative factors (temperature), and b) the suitability indexes for depth, substrate, and flow, are site-specific. IFIM also takes advantage of hydraulic principles to simulate WUA over a range of discharges from field measurements at several points, but the principle is the same as HEP: take an area and weight it by an index. A modification of IFIM to further adjust WUA by a temperature-based preference factor is ideally suited to the proposed multi-level intake structure because of the available model predictions for reservoir outlet temperature, downstream temperature, and physical habitat (unadjusted WUA) from the 1991 Trihey IFIM study. (Steve Schoenberg, USFWS, memo, 2001)

The WUA and related models are well known for use in aquatic interface/flood plain areas. The model used for the Pine Flat evaluation has been in use for over 25 years and is well documented as to appropriateness and satisfactory use in riverine environments. Further, this model was selected for use in the evaluation of alternatives because it effectively incorporates aspects such as water quality; changes in flow and related temperature, and habitat areas/types. This model was developed around trout as an indicator species. Since other aquatic species benefit from trout type habitat and the trout model is well documented, it was agreed that use of the WUA model as a measurement for restoration outputs is appropriate.

The benefits of the multilevel intake structure are: (1) more stable temperature both in the lake and downstream in the Kings River for coldwater fish survival, (2) less stress to the fish during dry and critical dry water years, (3) reduce competition of nonnative fishery for habitat, (4) increase the diversity of fish in the Pine Flat watershed basin, (5) water temperature blending for species that do poorly in extremely cold conditions, (6) improved sustainability of the native coldwater fishery in the lake and in the Kings River downstream of the dam, (7) improved survival rate of the coldwater fishery, (8) improved aquatic habitat for coldwater fishery, (9) improved food source for the fishery, (10) reduction in the habitat for nonnative fish and their survival, and (11) improved floodplain and aquatic ecosystem in the Kings River watershed.

Without the water temperature modification of the multi-level intake structure, the current tailwater fishery is subjected to extreme temperature changes, which could

eliminate the native coldwater fishery in favor of a variety of more temperature tolerant nonnative species. Temperature modification can have widespread benefits to a variety of riverine species including coldwater fish species.

Cost Effectiveness Analysis

The average annual equivalent costs and benefits were used to conduct cost effectiveness and incremental cost analyses (CE/ICA). IWR-PLAN Decision Support software version 3.0 was used for the analyses. Because only eight scenarios of port configuration were considered with each mutually exclusive, the CE/ICA was relatively straightforward. Cost effectiveness analysis indicates that only the staggered 9-port configuration was the most cost effective. "Cost effective" means that no other plan provides more WUA output for the same or less cost. Table 2 below shows average annual costs, average costs, and output for each configuration. See Figure 1 for display of the same information graphically.

Table 2. Multilevel Intake Structure: Results of Cost Effectiveness Analysis

Incremental Evaluation	Average Annual Costs ($Million)	Average Cost ($Million/WUA)	Output WUA
C0 No Action	0	0	0
C1 (9-Port Straight)	2.67	3.91	10
C2 (9-Port Straight)	2.67	1.96	20
C3 (9-Port Straight)	2.67	1.30	30
C4 (9-Port Staggered)	2.67	0.98	40
C5 (12-Port Straight)	3.54	1.30	40
C6 (12-Port Staggered)	3.54	1.30	40
C7 (21-Port Staggered)	6.15	2.28	40

Incremental Cost Analysis

The result of the incremental analysis evaluation showed two Best Buy plans, C0 and C4. But the C0 plan would not meet the main objective of providing suitable water temperature range for coldwater fishery survival. As shown in Table 2, the next lowest average cost per WUA is the staggered 9-port configuration, which provides a cost of $0.98 million per WUA. This configuration is also shown to be the "Best Buy" plan in Figure 1. All other configurations have about the same or higher costs, but have lower habitat values. Attachment 1 summarizes information from the incremental analysis of the Multilevel Intake Structure port configurations.

In summary, the results of cost effectiveness analysis indicate that the only least cost and best buy plan for the multilevel intake structure is C4, staggered 9-port configuration. See Table 3.

Table 3. Multilevel Intake Structure: Selected Best Buy Plan

Incremental Evaluation	Average Annual Costs ($Million)	Average Cost ($Million/WUA)	Output WUA
C4	2.67	0.98	40

BYRD SLOUGH HABITAT RESTORATION

Description of Formulation

Four levels of ecosystem restoration to the Byrd Slough site were evaluated to determine the most optimum restoration plan that could be achieved with the least cost. The analysis evaluates various levels of planting intensity by which restoration could occur. The ecosystem restoration included A0 for no restoration to the site. A1 is for fencing the area to keep cattle from further grazing. A2 is for fencing, structures, and moderate planting with irrigation. A3 is for fencing, structures, and high intensity planting with no irrigation.

The ecosystem restoration analysis was summarized in the USFWS report, which is included in the EIS/EIR as a separate document. In the A0 analysis, there would be no improvement to the site and the cattle are allowed to graze. There would also be no zoning restriction to this site for future urban development. In the A1 analysis, there would be fencing to the site to restrict cattle grazing, some structures would be installed for birds and other wildlife, and the riparian and shaded riverine aquatic vegetation are allowed to rejuvenate naturally. In addition to A1, the A2 analysis would include moderate planting and installation of an irrigation system to shorten the time required to restore the riparian and shaded riverine aquatic habitat to this site. In the A3 analysis, high intensity planting without irrigation is added to the fenced area with structures.

Each analysis was characterized in terms of implementation costs and expected benefits in Average Annual Habitat Unit (AAHU). Implementation costs include construction materials, labor, and other related expenses for this analysis. The AAHU were derived by the USFWS using the Habitat Evaluation Program (HEP).

Description of Costs

The costs for the various ecosystem restoration analysis were based on the labor rates, construction mobilization and demobilization, site preparation, planting and tool materials, planting design, realignment of some of the existing utilities, administration during construction, and other related expenses. Summary of the costs and associated habitat values, AAHU, are shown in Table 4. Each analysis was calculated and average annual equivalent cost was based on a 50-year project life, using a 6 3/8 percent interest rate, and October 2000 price level.

Table 4. Costs and Habitat Values for Byrd Slough Habitat Restoration

Restoration Design	AAHU	Total Cost ($)	Cost/AAHU ($/AAHU)	Average Annual Cost ($)	Restoration Features
A0	19.53	0	0	0	None
A1	42.39	112,050	2,643	7,484	Fence and structure
A2	84.56	958,000	11,329	64,000	Fence, structure, moderate plantings, and irrigation
A3	77.38	1,274,900	16,475	85,151	Fence, structure, and high intensity planting

Description of Environmental Benefits

The benefits of each of the restoration plans were characterized in terms of the habitat values output and the time required to achieve this ecosystem restoration.

The A0 plan of no restoration would result in riparian and SRA habitat at the Byrd Slough Habitat Restoration site that would continue to be degraded due to cattle grazing. This will continue to limit the number, abundance, and quality of fish and wildlife survival rate, food resources, and shelter along the lower Kings River. The potential future land use of the Byrd Slough habitat restoration site might continue to be cattle grazing. The potential loss due to intensified development or cattle grazing would be the loss of limited ecosystem habitat for the survival of fish and wildlife in the Central Valley area.

The A1 plan would consist of repairing perimeter fences and installing revegetation signs at the proposed Byrd Slough riparian and SRA habitat site. This plan would meet some of the ecosystem restoration objectives and would have some habitat value. However, since success of natural regeneration depends on environmental factors, this design would take significantly longer to achieve the ecosystem restoration objective of increasing riparian and SRA habitat than the other measures. The success rate for this plan might not be achievable without the assistance of additional planting and irrigation in the future.

The A2 plan would consist of fencing, wildlife structures, moderate planting, design and construction of an irrigation system, and irrigation for 3 to 5 years to establish the vegetation at the proposed Byrd Slough site. The benefits of this plan is the fencing of the site to protect further cattle damage to the vegetation, planting of vegetation to replace the lost vegetation due to cattle grazing and other human disturbance, and the initial irrigation to establish the vegetation to ensure quick habitat value benefit and overall ecosystem benefit. The initial irrigation will offset the cost of higher planting density without irrigation. This plan meets the restoration objective and has the greatest habitat value. The diversity of plant species in this community provides a variety of foods and microhabitats for fish and wildlife. The SRA habitat would help in reducing the Kings River temperatures for coldwater fisheries, and the vegetation and overhanging

riparian cover would provide refuge for juvenile fish from predators. The riparian vegetation would also provide refuge, food, and shelter for wildlife. The temporary irrigation system would promote quicker growth of the planted native species.

The A3 plan would consist of fencing, wildlife structures, and high density planting at the Byrd Slough site. This plan meets some of the ecosystem restoration objectives and would have some intermediate habitat value. Without the benefit of irrigation in the first 3 to 5 years, higher density of planting is required in the initial planting to provide the desired survival of the riparian and SRA vegetation. As a result, this plan would provide some benefit, but at a higher restoration cost.

Cost Effectiveness Analysis

The average annual equivalent costs and benefits from Table 3 were used to conduct cost effectiveness and incremental cost analyses (CE/ICA). IWR-PLAN Decision Support software version 3.0 was used for the analyses. Cost effectiveness analysis indicates that of the four restoration plans, three of the plans are considered cost effective, including the No Action plan. "Cost effective" means that, for a given level of restoration benefits, no other plan costs less. Similarly, no other plan yields more restoration benefits for less money. Each of the "Best Buy" plans is therefore a cost effective plan in producing its associated level of benefit. Table 5 below shows annual benefits, annual costs, and average costs for each plan. See Figure 2 for a display of the same information graphically.

Table 5. Byrd Slough Habitat Restoration: Results of Cost Effectiveness Analysis

Incremental Evaluation	Average Annual Costs ($)	Average Cost ($/AAHU)	Output AAHU
A0 No Action	0	0	19.53
A1	7,484	2,643	42.39
A2	64,000	11,329	84.56
A3	85,151	16,475	77.38

Incremental Cost Analysis

After conducting cost effectiveness analysis, incremental cost analysis examines the changes in costs and changes in environmental outputs for each additional increment of output. The first step is, starting from the No Action plan, to calculate the incremental change in costs and the incremental change in outputs of moving from the No Action plan to each of the cost effective plans. The change in costs divided by the change in outputs is calculated to generate an average cost per unit of output for each of the cost effective plans. The plan with the lowest overall average cost per unit of output is the first "Best Buy" plan. Table 4 shows that the plan with the lowest overall average cost is the No Action plan. This No Action plan, A0 has an average cost of $ 0 per AAHU. The second "Best Buy" plan is the A1 plan, which has an average cost of $2,643 per AAHU.

The third "Best Buy" plan is the A2 plan, which has an average cost of $ 11,329 per AAHU.

After the first Best Buy plan, A0 is identified, subsequent incremental analyses calculate the change in costs and change in outputs of moving from the first Best Buy plan to all remaining cost effective plans. Again, changes in costs are divided by changes in outputs for each increment to identify the plan with the next lowest incremental cost per unit of output. The plan thus identified is the second Best Buy plan, and the process continues. For the Byrd Slough habitat restoration, the second Best Buy plan with the next lowest incremental cost per unit of output (as output is increased) is the A1 plan This second Best Buy plan, costs an additional $4,901 over the first Best Buy plan, A0, per output. The third Best Buy plan, A2, costs an additional $20,060 over the A1 plan per output. Attachment 2 summarizes information from the incremental analysis of the Byrd Slough restoration plans.

As shown in Table 5 and Figure 2, the most habitat value that can be obtained from the first Best Buy plan, A0, is about 20 AAHU for no cost. Even though the first Best Buy plan, A0, shows habitat values up to 20 AAHU, these habitat values are considered the most optimistic for this site. The habitat value doubles on the second Best Buy plan, A1, from the first Best Buy plan, A0, for an incremental cost of $4,901 per AAHU. A2 provides twice as many AAHU as A1.

Each restoration plan was characterized in terms of implementation costs and expected output benefits. The resulting analysis indicated that the highest cost was A3 with the high density planting to offset losses due to lack of initial irrigation. The less complex design of A1 was determined to be the most cost-effective design. However, this design would depend on natural environmental factors and could take more than 20 years to meet the project objectives of increasing riparian and SRA habitats, and reestablishing native historic plant and wildlife communities along the lower Kings River. The "best buy" plan with the most habitat values gain and the shortest time required for ecosystem restoration was A2 with moderate planting and initial short term irrigation. See Table 6.

Table 6. Byrd Slough Habitat Restoration
Incremental Cost of Best Buy Plan Combination (Order By Output)

Scenario	AAHU	Cost $	Avg. Cost $/AAHU	Inc. Cost $	Inc. Output (AAHU)	Inc. $ Per Output
1 A0	19.53	0	0	0	19.53	0
2 A1	42.39	112,050	2,643	112,050	22,86	4,900
3 A2	84.56	958,000	11,329	845,950	42,17	10,060

In summary, the results of cost effectiveness analysis indicate that three of the four restoration plans are cost effective. Incremental cost analysis indicates that the second Best Buy plan, A2, would provide the most habitat values. See Tables 6 and 7.

Appendix E

Real Estate Plan

REAL ESTATE PLAN

PINE FLAT DAM FISH AND WILDLIFE HABITAT RESTORATION PROJECT
Feasibility Study

1. **Introduction.**

This Plan is prepared in accordance with ER 405-1-12, 12-18, Real Estate Plan and ER 405-1-12 for the PINE FLAT DAM FISH AND WILDLIFE HABITAT RESTORATION PROJECT located in Fresno County, California.

The Corps' Authority to conduct the Pine Flat Dam Fish and Wildlife Habitat Restoration study comes from the 1964 Congressional Resolution of the House Committee on Public Works. A reconnaissance investigation was initiated in 1987 and was completed in 1989.

The Kings River Conservation District (KRCD) is the non-Federal sponsor for the Pine Flat Dam Fish and Wildlife Habitat Restoration Project.

The study area for the project Feasibility Report is located in portions of Fresno, Kings, and Tulare Counties in the San Joaquin Valley. The Kings River basin encompasses the study area and includes parts of the valley and the western slopes of the Sierra Nevada. The largest city near the study area is Fresno.

Pine Flat Dam was built by the Corps in 1954 for flood control and water conservation. The dam is a concrete-gravity structure, which is 429 feet high and 1,820 feet long at the crest. The reservoir has a storage capacity of about 1 million acre-feet of water at gross pool elevation of 951.5 feet (msl). In addition to the dam, the Corps' Pine Flat project included penstocks for hydropower, downstream improvements to control flooding, and diversion of flows between the Kings River North and Kings River South. Downstream channel clearing and construction of levees and weirs were completed in 1976.

The restoration project consists of (1) a multi-level intake structure at Pine Flat Dam so that colder water(s) can be released to downstream channels throughout the year, and (2) the restoration of 143.5 acres of land downstream of the dam to restore and preserve riparian and valley oak habitats. The objective of the proposed project is to enable the release of colder water(s) from the dam to the downstream channel(s) throughout the year, especially in August and September, to sustain the trout fishery in the Kings River downstream of the dam, and to restore riparian, valley oak woodland, and shaded riverine aquatic habitats.

2. **General Description of Real Estate Requirements.**

Acquisition of lands in Fee Simple Title is required of the Byrd Slough Habitat Restoration area for the Preferred Plan.

FEE SIMPLE TITLE: The site for this project is known as the Fresno County Kings River Green Belt Park. The 143.5 acre restoration site is situated downstream of Pine Flat Dam just southwest of the Friant-Kern Canal within the Kings River basin and northeast of the City of Sanger, Fresno County, California. The site, owned by Fresno County, is currently vacant but has been used for grazing.

The site, also known as the Byrd Slough area, was historically part of the Kings River/Byrd Slough flood plain and was primarily riparian in nature prior to construction of Pine Flat Dam. The site would be acquired to restore the lost riparian and SRA vegetation and seasonal and permanent wetlands that historically occurred in this area. The restoration of this site would provide a linkage of the Kings River to the historical flood plain. Restoration would create conductivity of the riparian and SRA system to the ground water and other small ponds, and provide an improved ecosystem for fish and wildlife in the lower Kings River watershed.

MULTI-LEVEL INTAKE STRUCTURE: Pine Flat Dam is owned and operated by the U.S. Army Corps of Engineers. No land is required for the multilevel intake structure since it will be attached to the upstream face of Pine Flat Dam which is a federal facility located on federal property. A staging area of 2.07 acres will be located on federal property near the left abutment of the dam.

The project real estate requirements detailing estates and areas are described below as fee simple ownership. The value is based on a Gross Appraisal Report prepared by the Appraisal Branch of the Sacramento District Real Estate Division.

Table 2.1

Estate	Ownerships	Acres	Value
Fee Simple Title	1	143.5	$ 294,000

3. **Federal Lands**.

Pine Flat Dam and Lake are situated on Federal lands. Other than Pine Flat Dam and a staging area to be located near the left abutment of the dam, no other Federal lands are being used.

4. **Sponsor Owned Lands**.

The non-Federal sponsor, Kings River Conservation District (KCRD), does not own the project land.

5. **Navigational Servitude**.

There are no lands within the project area that are subject to the applications of navigational servitude.

6. **Public Law 91-646 Relocations And Benefits**.

Relocation of persons and personal property is not required.

7. **Sponsor's Ability To Acquire**.

The non-Federal sponsor for the project is the Kings River Conservation District (KRCD). The District has the ability to acquire the necessary rights in real estate for the project and has an experienced staff to manage the real estate required by the project. KRCD has submitted their acquisition schedule which is presented below.

8. **Baseline Cost Estimate For Real Estate**.

Land cost estimates were based on a Gross Appraisal Report prepared by the Appraisal Branch of the Sacramento District Real Estate Division. Costs are estimated at October 1998 price levels. All lands, regardless of ownerships, have been estimated at fair market value. Contingencies take into account severance damage, unknown property splits, undetected improvements, minor project design changes, and any additional costs involved in the application of PL 91-646. The difference between State and Federal appraisal rules have been considered and are not expected to have any appreciable impact on the estimated real property costs. HQ South Pacific Division approved the appraisal on 18 September 1998.

The Federal costs for PED, review of the PCA, monitoring the acquisitions, certifying for construction and crediting the partner were estimated by the Sacramento District Real Estate Division, taking into consideration that its involvement with the project will continue for several years.

A summary of the Real Estate Baseline Cost Estimate is shown below.

Table 8.1

Project	Federal	Non-Federal	Lands	Total* LERRDs
Restoration Site	$12,700	$12,000	$294,000	**$318,700**

***Includes Administrative Costs**

9. **Map**.

See Exhibit A.

10. **Minerals**.

There is no mineral impact associated with the project.

11. **Proposed Estates**.

The estate required for the project is Fee Simple Title, subject to existing easements, to construct and maintain project restoration measures.

12. **Facility/Utility Relocations**.

The project will not impact any facilities or utilities.

13. **Hazardous Toxic And Radioactive Waste (HTRW).**

Reference HTRW Section of Feasibility Report.

14. **Attitude Of Land Owners And Community**.

Public meetings have been held and continue to take place. The project has received local support in the past. Future public workshops will provide opportunities for additional comments.

15. **Other.**

Date of value of the report is September 18, 1998. Field examinations of the subject properties were conducted in June 1998 and again in September 1998 for the restoration lands.

16. **Acquisition Schedule**.

A detailed acquisition schedule is shown on the Table below. The non-Federal sponsor has reviewed and co-developed this schedule. The non-Federal sponsor will be directed to begin real property aquisition for the project only after the PCA is fully executed. The non-Federal sponsor is aware of the risks of initiating the acquisition process in advance of the PCA being executed.

REAL ESTATE ACQUISITION SCHEDULE				
Project Name: Pine Flat Dam Wildlife Habitat Restoration Study (Restoration Site)	COE Start	COE Finish	NFS Start	NFS Finish
Receipt of preliminary drawings from Engineering/PM				
Receipt of final drawings from Engineering/PM	10/00/01	10/00/01		
Execution of PCA	November 2001			
Formal transmittal of final drawings & instruction to acquire LERRDS				
Conduct landowner meetings			12/00/01	01/00/02
Prepare/review mapping & legal descriptions			12/00/01	12/00/01
Obtain/review title evidence			12/00/01	12/00/01
Obtain/review tract appraisals			01/00/02	02/00/02
Conduct negotiations			02/00/02	03/00/02
Perform closing			05/00/02	05/00/02
Prepare/review condemnations			N/A	N/A
Perform condemnations			N/A	N/A
Obtain Fee Simple Title			06/00/02	06/00/02
Complete/review PL 91-646 benefit assistance			-	-
Conduct/review facility and utility relocations			12/00/01	02/00/02
Certify all necessary LERRDS are available for construction	03/00/02	04/00/02		
Prepare and submit credit requests				
Review/approve or deny credit requests				
Establish value for creditable LERRDS in F&A cost accounting system				

NFS - Non-Federal Sponsor
COE - Corps of Engineers

17.

.ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

THE PINE FLAT DAM FISH AND WILDLIFE HABITAT RESTORATION STUDY

SPONSOR: The King's River Conservation District (KRCD)

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES**

b. Does the sponsor have the power of eminent domain for this project? **YES**

c. Does the sponsor have "quick-take" authority for this project? **YES**

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **YES**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? **YES** (Fresno County)

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? **NO**

b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? **N/A**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **NO**

d. Is the sponsor's project in-house staffing level sufficient considering its other work load, if any, and the project schedule? **YES**

e. Can the sponsor obtain contractor support, if required, in a timely fashion? **YES**

f. Will the sponsor likely request USACE assistance in acquiring real estate?
NO (possibly at a later date)

II. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site?
YES

b. Has the sponsor approved the project real estate schedule/milestones?
YES

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **N/A**

b. With regard to this project, the sponsor is anticipated to be:
Kings River Conservation District (KRCD)

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **YES**

b. Does the sponsor concur with this assessment? **YES**

Prepared by:

____
Dee La Sala
Realty Specialist
Acquisition Branch

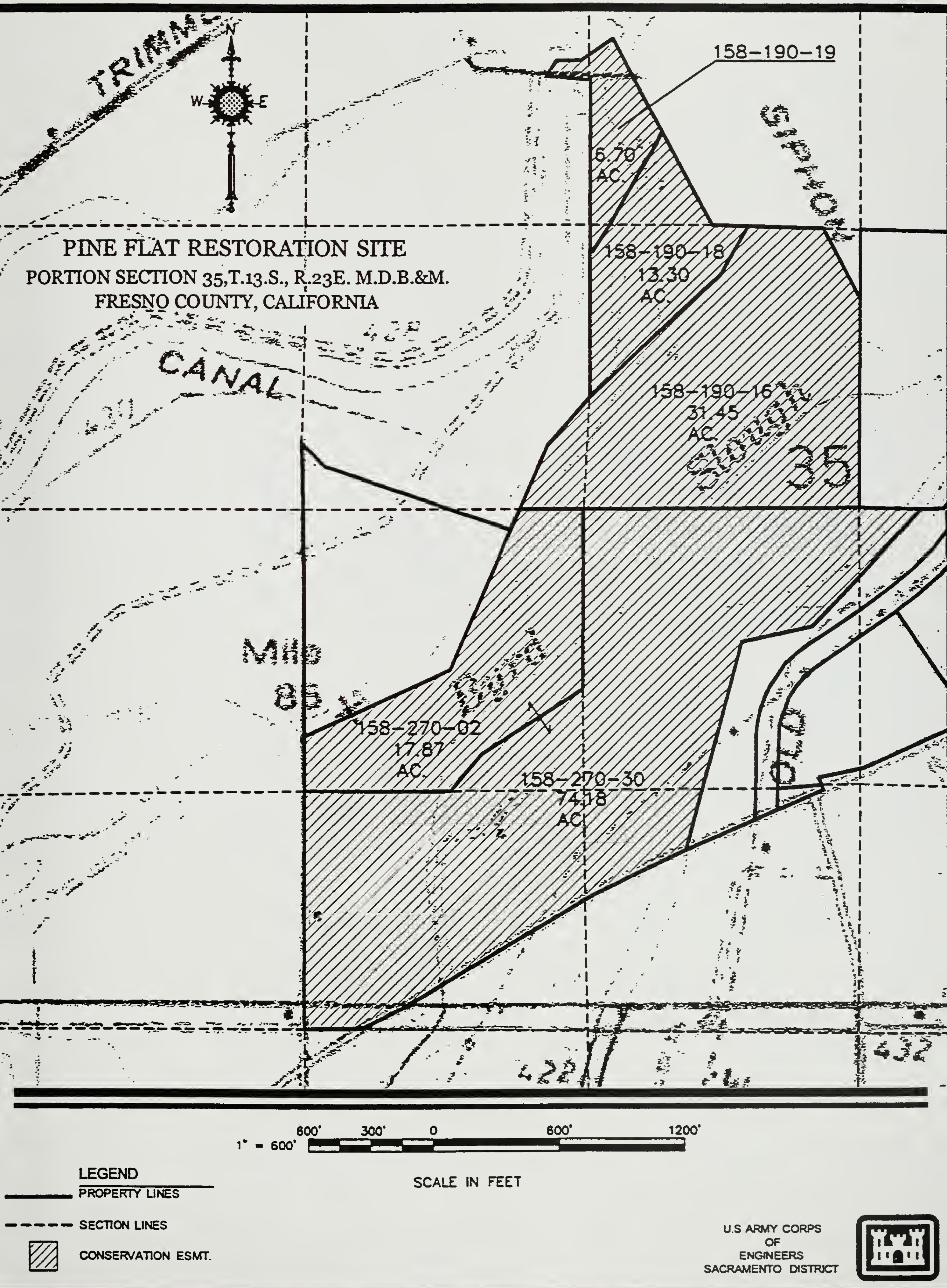
Date _____________

Reviewed and Approved by:

____
Marvin D. Fisher
Chief, Real Estate Division

Date _____________

EXHIBIT A


PINE FLAT RESTORATION SITE
PORTION SECTION 35,T.13.S., R.23E. M.D.B.&M.
FRESNO COUNTY, CALIFORNIA
N
W
E
CANAL
158-190-19
6.70 AC.
158-190-18
13.30 AC.
158-190-16
31.45 AC.
Slough
35
Mill
158-270-02
17.87 AC.
158-270-30
74.18 AC.
600' 300' 0 600' 1200'
1" = 600'
SCALE IN FEET
LEGEND
PROPERTY LINES
SECTION LINES
CONSERVATION ESMT.
U.S ARMY CORPS
OF
ENGINEERS
SACRAMENTO DISTRICT

Appendix F

Correspondence

See Environmental Impact Statement/ Environmental Impact Report for pertinent correspondence appendices:

Appendix A. Coordination Act Report
Appendix B. Letter from FWS Regarding Threatened and Endangered Species
Appendix C. Biological Assessment and Biological Data Report
Appendix D. Correspondence with the Natural Resources Conservation Service
Appendix E. Correspondence with the State Historic Preservation Officer