Upper San Joaquin River Basin Storage Investigation

Raise Pine Flat Dam

Surface Storage Option Technical Appendix to the Phase 1 Investigation Report

A Joint Study by:

Bureau of Reclamation
Mid-Pacific Region

California Department of Water Resources

In Coordination with:

The California Bay-Delta Authority

October 2003

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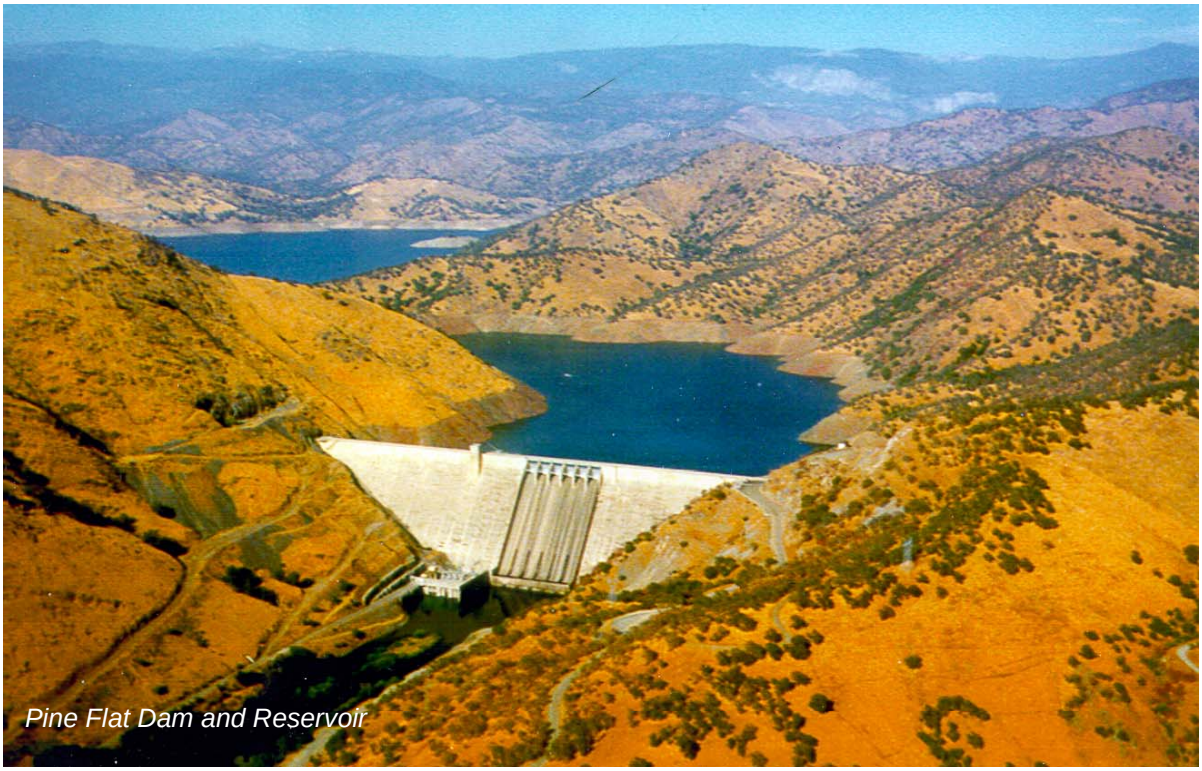

Pine Flat Dam and Reservoir

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SURFACE WATER STORAGE OPTION
TECHNICAL MEMORANDUM

RAISE PINE FLAT DAM

UPPER SAN JOAQUIN RIVER BASIN STORAGE INVESTIGATION

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Acronyms and Abbreviations List

CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	United States Army Corps of Engineers
CVP	Central Valley Project
EA	Environmental Assessment
EIS	Environmental Impact Statement
EIR	Environmental Impact Report
elevation	number of feet above mean sea level
FCRRD	Fresno County Parks and Recreation Department
HEP	Habitat Evaluation Procedure
IECO	International Engineering Company, Inc.
Investigation	Upper San Joaquin River Basin Storage Investigation
KRCD	Kings River Conservation District
MW	megawatt
NEPA	National Environmental Policy Act
PCB	polychlorinated biphenyl
PG&E	Pacific Gas and Electric
Reclamation	United States Department of the Interior, Bureau of Reclamation
ROD	Record of Decision
TAF	thousand acre-feet
TM	Technical Memorandum
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

EXECUTIVE SUMMARY

Pine Flat Dam and Reservoir are located in Fresno County near the community of Piedra, about 30 miles east of Fresno. The dam is on the Kings River at river mile 95, about 20 miles downstream of its confluence with the North Fork of the Kings River, and creates Pine Flat Reservoir, which has a storage capacity of about 1,000 thousand acre-feet (TAF).

One of the water storage options considered as part of the Upper San Joaquin River Basin Storage Investigation (Investigation) would increase the capacity of Pine Flat Reservoir by raising the height of Pine Flat Dam. This Technical Memorandum presents initial findings regarding engineering and environmental issues associated with raising Pine Flat Dam.

Pine Flat Dam is a concrete gravity structure completed by the United States Army Corps of Engineers (Corps) in 1954. A 165 megawatt (MW) power plant operated by Kings River Conservation District (KRCD) is located at the downstream base of the dam on the right side. A Pacific Gas and Electric (PG&E) power plant and penstock (Kings Power Plant) are located on the upper margin of Pine Flat Reservoir.

The storage option involves increasing the gross pool elevation of the reservoir by 20 feet, resulting in 124 TAF of additional storage. This would be accomplished by raising the dam crest 12 feet, replacing existing tainter (radial) gates, and modifying other features at the dam. This option would also require raising the PG&E Kings River Power Plant 21.5 feet and reconfiguring the Pine Flat Power Plant at the toe of dam. Additional water stored in the enlarged Pine Flat Reservoir would be released to the Kings River to supplement Central Valley Project deliveries or to offset water released from Millerton Lake. Implementation of this option would require involvement with KRCD and other water rights holders in the Kings River watershed.

Although engineering features for this option would be extensive, no technical constraints were identified that would limit their design or construction. However, KRCD indicated that potential environmental impacts to botany, fisheries, endangered species, and rafting would be significant, and KRCD would not be interested in participating in implementing this option. In addition, the Corps had previously considered this option for flood protection purposes, but dropped it on the basis of environmental issues. Therefore, this option was dropped from further consideration in the Investigation.

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CHAPTER 1. INTRODUCTION

The Bureau of Reclamation, in cooperation with the California Department of Water Resources, is completing the Upper San Joaquin River Basin Storage Investigation (Investigation), consistent with the CALFED Bay-Delta Program Record of Decision (ROD), August 2000. The Investigation will consider opportunities to develop water supplies to contribute to water quality improvements in and restoration of the San Joaquin River, and to enhance conjunctive management and exchanges to provide high-quality water to urban areas. The ROD indicated that the Investigation should consider enlarging Friant Dam or developing an equivalent storage program to meet Investigation objectives.

The Investigation identified several potential surface storage sites to be initially considered through prefeasibility-level studies of engineering and environmental issues. This document presents findings from an prefeasibility-level review of the potential enlargement of Pine Flat Dam and Reservoir.

OPTION SUMMARY

Pine Flat Dam and Reservoir are located in Fresno County, near the community of Piedra, about 30 miles east-northeast of Fresno. The dam is located on the Kings River about 20 miles downstream of its confluence with the North Fork of the Kings River (Figure 1-1).

This Technical Memorandum (TM), which was prepared as a technical appendix to the Phase I Investigation Report, considers raising the gross pool elevation of Pine Flat Reservoir by up to 20 feet to increase its storage capacity by up to 124.38 thousand acre-feet (TAF).

EXISTING FACILITIES

Pine Flat Dam is a 429-foot-high concrete gravity structure constructed on the Kings River in 1954 by the United States Army Corps of Engineers (Corps) to provide flood protection to downstream properties. The dam is owned and operated by the Corps. Its axis is oriented in a north-northwest to south-southeast direction and at a gross pool elevation of 951.5 feet above mean sea level (elevation 951.5), it impounds a reservoir with a volume of 1,000 TAF and an area of 5,970 acres (see Figure 1-2).

The dam crest at elevation 970.0 is 32 feet wide and 1,820 feet long. Pine Flat Dam has a gated spillway located in the center of the dam with an ogee crest at elevation 916.5. The spillway is 292 feet long and is divided into six 42-foot-wide bays. Each bay is equipped with a radial tainter gate 36 feet high and 42 feet wide.

In 1984, Kings River Conservation District (KRCD) constructed Pine Flat Power Plant at the downstream toe of the dam on the right abutment. Pine Flat Power Plant is owned and operated by KRCD. The powerhouse contains three Francis turbines with a total installed capacity of 165 megawatts (MW).

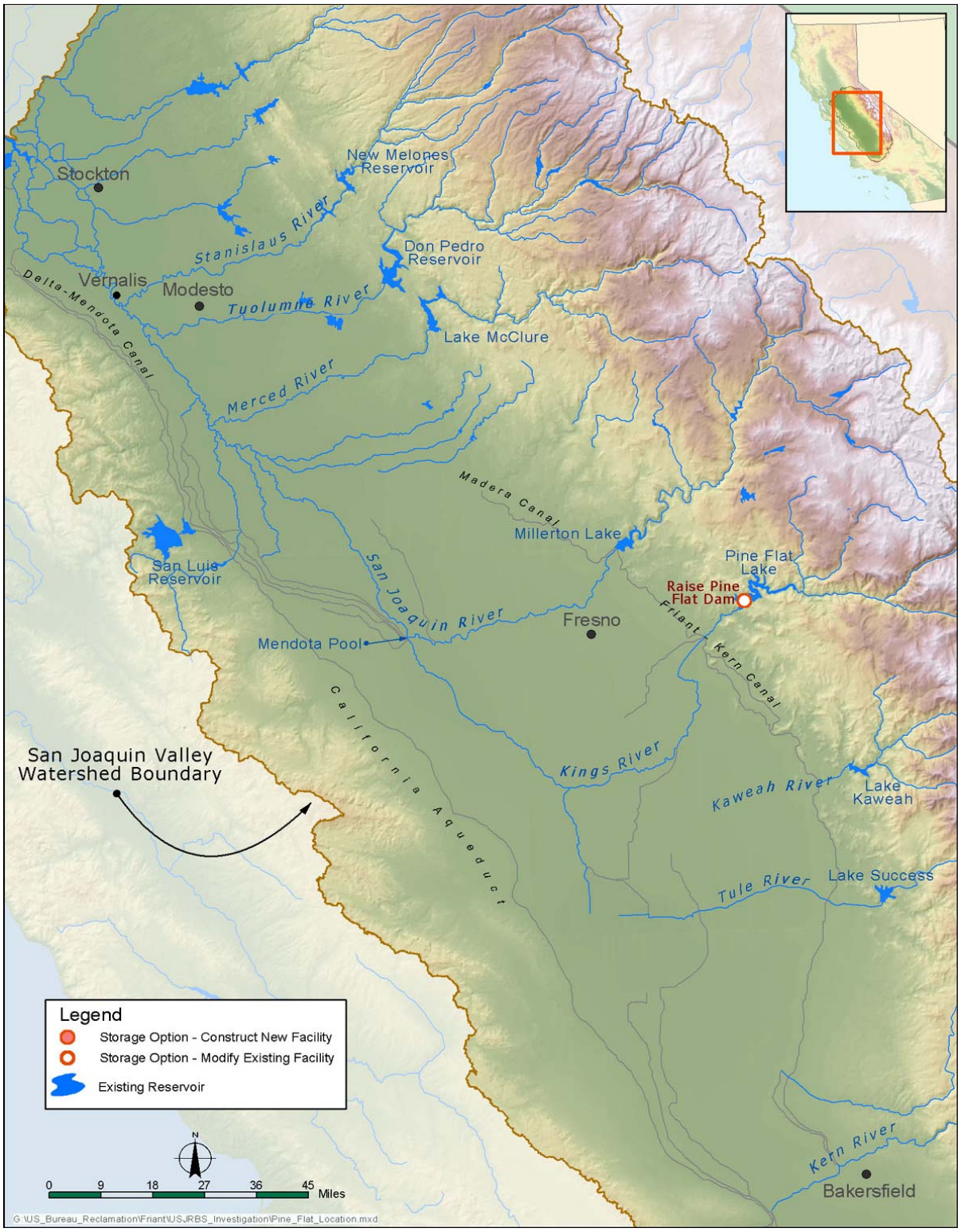

FIGURE 1-1. PINE FLAT RESERVOIR LOCATION MAP

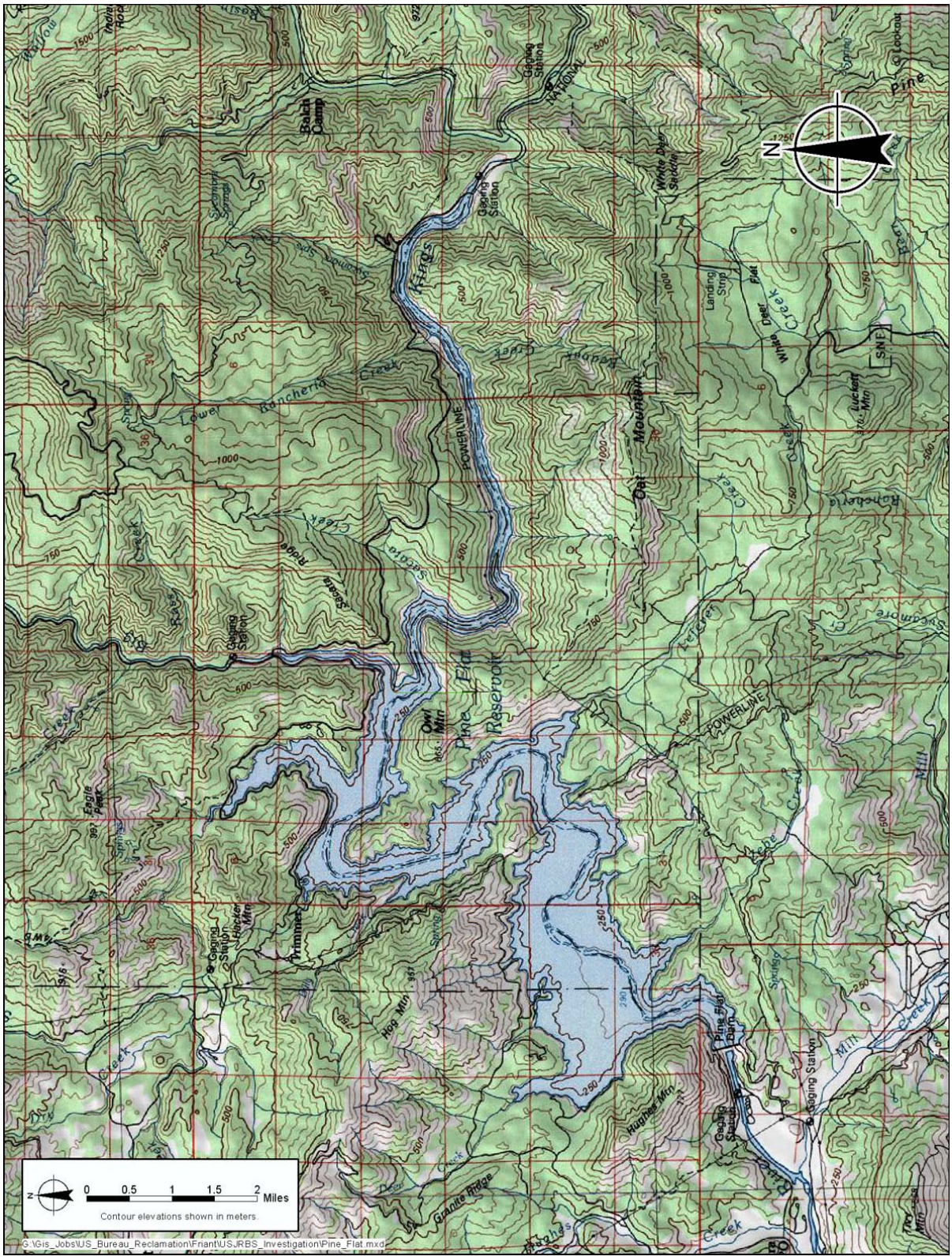

FIGURE 1-2. PINE FLAT RESERVOIR AND VICINITY

Wishon and Courtwright reservoirs are located upstream of Pine Flat Reservoir, with storage capacities of 128.6 TAF and 123.3 TAF, respectively. Due to their high elevation, these reservoirs have relatively little effect on rain floods. However, they do store snowmelt runoff that might otherwise need to be stored in Pine Flat Reservoir.

Pacific Gas and Electric Company (PG&E) operates three hydroelectric power projects in the Kings River Basin: the Kings River, Balch, and Helms Pumped Storage projects. The Kings River Project consists of the Courtwright and Wishon reservoirs and the Haas and Kings River powerhouses. The Balch Project consists of Balch Powerhouse No. 1 and Powerhouse No. 2, a small upstream diversion dam, and an afterbay. The Helms Pumped Storage Project uses Wishon Reservoir as the afterbay and Courtwright Reservoir as the forebay.

The Friant-Kern Canal, part of the Federal Central Valley Project (CVP), crosses the Kings River about 8 miles below Pine Flat Dam. There are also numerous flood control levees and irrigation distribution systems downstream of the dam.

SUMMARY OF PREVIOUS INVESTIGATIONS

In 1974, a Master Plan of the Kings River Service Area was prepared for KRCD by International Engineering Company, Inc. (IECO). The e Master Plan recommended a course of action that would: 1) prove a balanced water supply; 2) minimize flood damage; and 3) conserve and develop water and power resources. One alternative evaluated was a 20-foot raise of Pine Flat Dam and Reservoir. It was one of four economically feasible alternatives retained as viable. IECO concluded that a staged development of the four recommended alternatives be pursued.

In 1976, the Corps prepared a Master Plan, Design Memorandum No. 7 (DM No. 7) to guide resource use and development over the life of the Pine Flat project to protect and to further enhance the scenic, biologic, and recreational resources of the area. The Master Plan was intended to maximize the recreational benefits and enjoyment of Pine Flat Reservoir.

In 1989, the Corps prepared a Reconnaissance Report describing a study to investigate flood control and water-related resource opportunities associated with Pine Flat Dam. Enlarging Pine Flat Reservoir was among the measures evaluated. Both 15- and 20-foot raises of Pine Flat Reservoir were considered, which would increase storage capacity by 92.772 TAF and 124.38 TAF, respectively.

Also in 1989, the Corps prepared an Environmental Assessment (EA) - Reconnaissance Study for Flood Control to determine if raising the gross pool of Pine Flat by 20 feet would result in any significant environmental impacts. Based on the analysis and coordination with concerned agencies, organizations, and individuals, it was concluded that significant impacts would result, and that an Environmental Impact Statement (EIS) would need to be prepared during the future feasibility planning stage. The report also concluded that although local support was present, there was no Federal interest in a potential solution to local and regional water resource problems. The report recommended that no further Federal action be taken at that time.

In 1994, the Corps produced a Reconnaissance Report on potential fish and wildlife habitat restoration measures, including a 15-foot raise of Pine Flat Reservoir. Reservoir enlargement would have allowed a higher minimum reservoir elevation to be maintained, with potential benefits for a cold-water fishery. The report, a basis of design, provided information on water resources in the study area, environmental problems, and the potential environmental benefits, impacts, and costs of five restoration measures, along with reconnaissance-level details on operations, civil designs, and real estate requirements. The report made no recommendations regarding measure selection.

The Corps' December 2001 Final Feasibility Report and EIS/Environmental Impact Report (EIR) (revised in May 2002 and again in June 2002) describes in detail a recommended plan for fish and wildlife habitat restoration. The recommended plan, now awaiting Congressional authorization, involves a multilevel intake structure to manage the temperature of releases from Pine Flat Reservoir, and other habitat restoration actions at Byrd Slough, located along the Kings River immediately south of the Friant-Kern Canal siphon. The feasibility report documents how the recommended plan evolved from the five measures considered in the 1994 Basis of Design, while the EIS/EIR provides a detailed environmental analysis of the selected plan and other final alternatives considered. The 15-foot raise of Pine Flat Reservoir was not carried forward to the feasibility phase for inclusion in alternative restoration plans principally because of cost and adverse effects.

POTENTIAL IMPROVEMENTS CONSIDERED

Raising the gross pool elevation of Pine Flat Reservoir by 20 feet from the present elevation of 951.5 feet to elevation 971.5 would increase storage capacity by 124.38 TAF. This option would include raising the dam crest 12 feet and replacing the 36-foot-high spillway gates with 59-foot-high gates. The dam crest would be raised from elevation 970.0 to elevation 982.0 by adding reinforced concrete and pre-stressed tendons to the downstream face of the dam. The existing ogee spillway would be reshaped and the piers enlarged and strengthened. The hoist works for the power plant intake trash racks and stop logs would have to be raised, as well as the service elevator.

As a consequence of these modifications, the PG&E King River Power Plant, located along the upper reaches of Pine Flat Reservoir, would need to be raised 21.5 feet. The KRCD Pine Flat Powerhouse, at the toe of Pine Flat Dam, would also require reconfiguration (Figure 1-3).

APPROACH AND METHODOLOGY

This TM was prepared from a brief review of the previous reports mentioned above, an engineering field reconnaissance on 13 June 2002 (Appendix A), and an environmental field reconnaissance of the dam and reservoir area on 29 May 2002 (Appendix B).

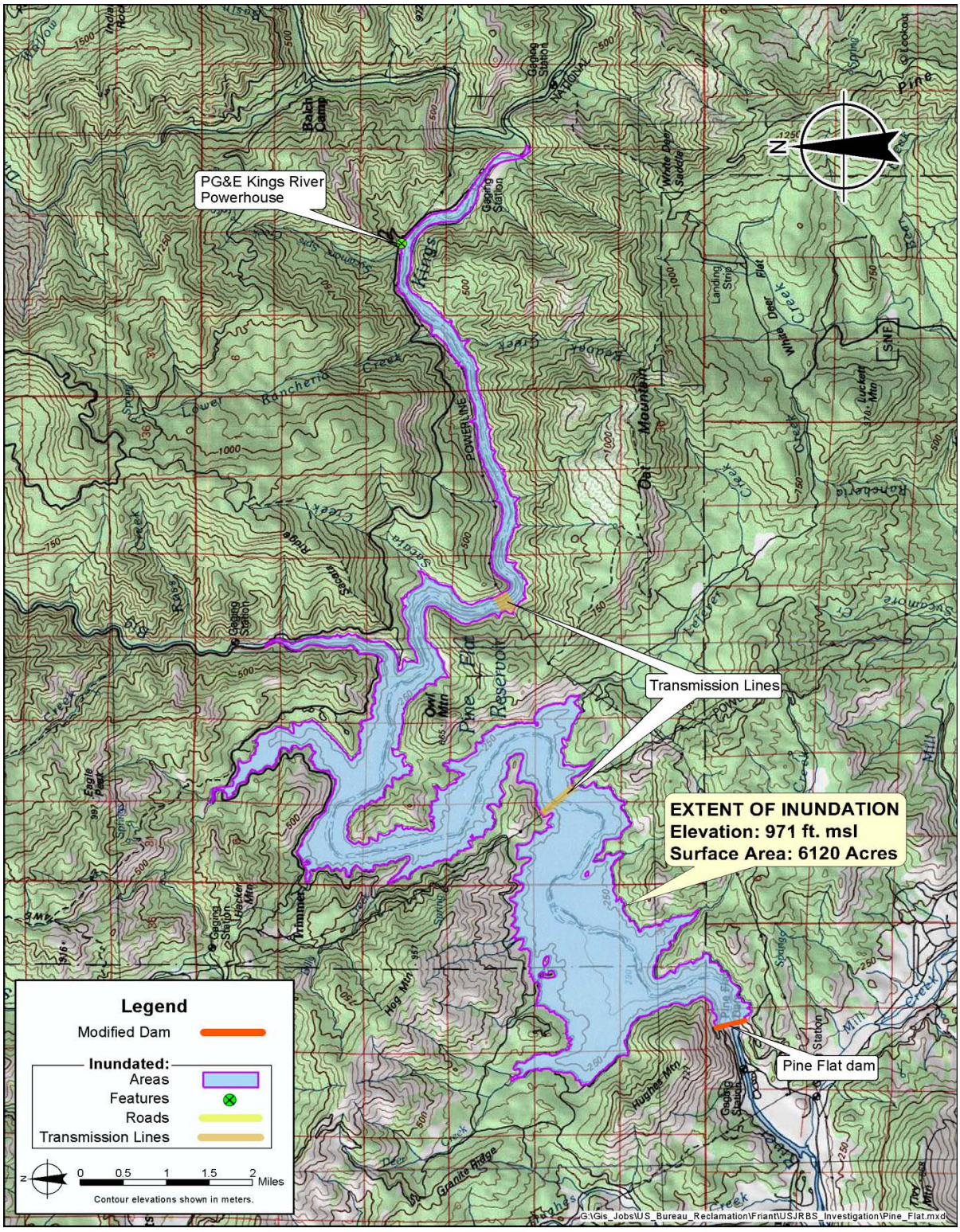

FIGURE 1-3. POTENIAL PINE FLAT RESERVOIR ENLARGEMENT INUNDATION AREA

During the June 2002 field trip, engineers and geologists examined the site under consideration. Locations of existing and potential structures were visually assessed. Topography, geology, geotechnical conditions, and utilities were noted. Access routes and possible borrow, staging, and lay-down areas were considered.

During the environmental field visit, specialists in botany, wildlife, aquatic biology, recreational resources, and cultural resources visually assessed existing environmental resources. Additional research was conducted, making use of prior studies and available literature, the California Natural Diversity Database (CNDDB), topographic maps, and aerial photographs. This information was used to determine the extent to which potential environmental impacts might constrain storage options under consideration. Where evident, opportunities for improving environmental resources or mitigating adverse effects were also noted. Surveys were not conducted and consultations with external resource management or environmental agencies were not held.

The seismotectonic evaluation conducted by Reclamation (2002) for this study was based on readily available information and is considered appropriate for prefeasibility-level designs only. Detailed, site-specific seismotectonic investigations were not conducted, nor were aerial photographs or other remotely sensed imagery evaluated. More detailed, site-specific studies would be required for higher-level designs.

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CHAPTER 2. TOPOGRAPHIC SETTING

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. Elevations in the immediate vicinity of Pine Flat Dam and Reservoir range from about elevation 600 to nearly elevation 2,400.

Farther east, the terrain steepens and the canyons become more incised. The canyons have been cut by southwest- to west-flowing rivers and associated large tributaries. The Kings River is the main river in the area. The topography of the Kings River basin is the most rugged in the entire Sierra Nevada, rising to over elevation 14,000 in the upper watershed.

The existing dam is located in a section of river that passes through a narrow, west-southwest-trending bedrock canyon. The right abutment slope rises steeply (1.5:1 horizontal to vertical ratio) to the crest of Hughes Mountain. The left abutment slope rises at a similar inclination, with a 1.7:1 horizontal to vertical ratio.

AVAILABLE TOPOGRAPHIC MAPPING

Publicly available topographic mapping of the study area is from the United States Geological Survey (USGS). It is likely that additional, and potentially more detailed, topographic maps of the reservoir and dam site are held by the Corps and KRCD.

AVAILABLE AERIAL PHOTOGRAPHY

Aerial photography of various scales and imagery is available from the archive files of the USGS. Additional aerial imagery may also be available from the United States Department of Agriculture, Reclamation, and the Corps. A specific search of the available photography was not conducted for this TM nor was any aerial photography reviewed.

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CHAPTER 3. GEOLOGIC AND SEISMIC SETTING

The Pine Flat Dam and Reservoir area is located near the boundary of the Sierra Nevada Geomorphic Province and the San Joaquin Valley portion of the Great Valley Geomorphic Province. The Great Valley basin is filled with thick accumulations of marine (at depth) and non-marine sediments shed largely from the Sierra Nevada mountain range. Recent alluvium of lake and river origin blankets most of the present-day surface, while dissected remnants of Pleistocene alluvial fans rim the valley margin.

The Kings River basin is located within a complex geologic area containing pre-Cretaceous meta-sedimentary and meta-volcanic rocks that have been folded, faulted, and intruded by granitic rocks of three different ages. Volcanism, followed by glaciation and recent stream down-cutting, have modified the topography to essentially the present day landscape. Major geologic structures trend to the northwest. Bedding and foliation of the rock units typically strike northerly and dip steeply west. The degree of weathering and jointing varies by rock type.

Overall, seismic hazard potential at the site is low. Preliminary earthquake loading analysis for this prefeasibility-level evaluation considered two types of potential earthquake sources: fault sources and areal/background sources (Reclamation, 2002).

Twenty-two potential fault sources were identified, including those associated with the San Andreas fault, seven western Great Valley faults, seven eastern Sierra Nevada faults, the White Wolf fault of the southern San Joaquin Valley, and six faults of the Sierra Nevada foothills system. No major through-going or shear zones have been identified in this area of the Sierra Nevada and historic seismicity rates are low.

The areal/background seismic source considered was the South Sierran Source Block, the region surrounding the site. This region possesses relatively uniform seismotectonic characteristics.

Probabilistic seismic hazard analysis shows that the peak horizontal accelerations to be expected at the site are 0.13g with a 2,500-year return period, 0.17g with a 5,000-year return period, and 0.23g with a 10,000-year return period.

SITE GEOLOGY

Pine Flat Dam and Reservoir are located near the boundary of the Sierra Nevada foothills and the Great Valley. The state geologic map (CDMG, 1966) shows that the area to the north of the lower part of the reservoir is a complex of geologic units comprising pre-Cenozoic meta-volcanic and meta-sedimentary rocks, and Mesozoic granitic, basic intrusive, and ultrabasic rocks. The south side of the lower end of the reservoir is composed of pre-Cenozoic granitics, and the upper reaches of the reservoir are made up of Mesozoic granitics.

Pine Flat Dam is situated on hard metamorphic (meta-volcanic) rock consisting primarily of jointed amphibolite with scattered seams of calcite, quartz, and lesser occurrences of gypsum.

No significant through-going fault zones are known to exist within the area.

SITE GEOTECHNICAL CONDITIONS

Typically, rock at the dam site is hard, dark gray, fine-grained, and brittle. Thin seams of gypsum and deeply weathered joints were encountered on the right abutment during construction of Pine Flat Dam. These seams are not expected to present a significant foundation problem for raising the dam.

Several landslides were observed downstream of the dam. These landslides appeared to be wedge failures occurring along weak remnant bedding planes in the metamorphic rock mass in conjunction with sub-vertical joint sets.

CHAPTER 4. HYDROLOGIC SETTING

The Kings River watershed upstream of Pine Flat Dam covers approximately 1,700 square miles, ranging from about elevation 600 at Pine Flat Dam to elevation 14,000. The Kings River has three primary branches: the North, Middle, and South forks.

RAINFALL

Rainfall in this Mediterranean climate region varies from about 8 or 9 inches per year in the valley to about 60 inches per year in the Sierra Nevada. About 90 percent of runoff-producing precipitation occurs from November through April.

Precipitation usually occurs as rain below elevation 4,000 and as snow at higher elevations. However, snow has occurred in the San Joaquin Valley and rain sometimes occurs above elevation 10,000. The snow pack accumulates during the winter and early spring and generally starts melting in April. The April to July runoff at the Piedra stream gaging station, just downstream of Pine Flat Dam, accounts for an average of about 75 percent of total annual runoff.

EROSION, RUNOFF, AND RECHARGE

Specific information on soils and erosion potential at the site was not identified. It is expected that the soils in the Kings River basin could be broadly classified into two types. The first type consists of shallow, well-drained, slightly acidic, rocky, medium-textured soils, developed on slates, schists, volcanic debris, and serpentine bedrock. Soils of this type are reasonably stable with adequate vegetation.

The other soil type is moderately deep, moderately coarse-textured, well-drained, slightly acidic, and granitic. Soils of this type are subject to severe erosion. Farther southwest along the Kings River, the flood plain area would consist of moderately deep, nearly level to gently rolling well-drained loams underlain with hardpan.

Steamflow data have been collected at gaging stations in the Kings River basin by the USGS, the Corps, and local agencies for a varying number of years. The stream gage at Piedra has been in operation since 1895, providing the longest continuous set of flow data available. The average annual volume for the Kings River at Pine Flat Dam is 1,587.9 TAF.

AVAILABLE FLOOD DATA

Detailed flood data were not identified in the documents reviewed. Two types of flood flows occur on the Kings River: winter rain floods and spring snowmelt floods. Winter rain floods, which occur from November through March, are caused by heavy rains and are characterized by sharp, high peaks of short duration and comparatively small volumes.

Snowmelt floods occur from March through June. While not producing the high peak flows of winter-type floods, snowmelt floods have a much larger runoff volume.

The history of flooding in the Kings River basin extends back to 1895. Flood years were 1966, 1969, and 1978. Snowmelt in 1966 was 290 percent of normal. The snowmelt in 1969 exceeded all previous recorded years; flood control releases to the San Joaquin River in 1969 totaled 1,017 TAF. Pine Flat Dam was operated to control outflow to a maximum of 17,100 cubic feet per second (cfs) (Corps, 1989a).

Over the past 48 years, Pine Flat Dam has not provided the high degree of flood protection that was originally intended. This is due to the unanticipated precipitation and runoff in the Kings River Basin, which included the largest 30-day inflow of record (1986) and the largest snowmelt of record (April through July 1969).

Based on recent trends toward greater precipitation and runoff in the Kings River Basin, investigations show that flood-producing storms greater than those of the past are expected to occur in the future. Three of the most severe rainfloods during the 85-year period of 1895 to 1980 have occurred since Pine Flat Dam was completed, and water-year runoff has exceeded the 85-year mean 11 times. Due to increased development over the years, more recent floods have caused substantial damage to roads and bridges, homes, businesses, public utilities, recreational facilities, and highly developed agricultural land.

CHAPTER 5. STORAGE STRUCTURES AND APPURTENANT FEATURES

This chapter describes the recommended storage structure and appurtenant features for the Pine Flat site, and the constructibility, cost, and systems operations for this option.

STORAGE STRUCTURE

In 1989, the Corps evaluated options for increasing Pine Flat Reservoir's gross pool elevation by 15 and 20 feet. The Corps determined that the 15-foot raise would result in 92.772 TAF of additional storage. Work to raise the gross pool by 15 feet would include the following:

- Raising dam crest 7.0 feet to elevation 977.0
- Reshaping the spillway ogee
- Enlarging the spillway piers
- Installing new 42-foot-wide by 54-foot-high tainter gates
- Raising the upstream PG&E Kings Power Plant 16.5 feet, from elevation 958.0 to elevation 974.5
- Relocating 3.5 miles of Trimmer Springs Road, including three bridges
- Raising hoist works for the power plant intake trash racks and stop logs and elevator at Pine Flat Dam
- Relocating inundated recreation facilities where possible
- Mitigating impacts to fish and wildlife

A 20-foot raise in the gross pool elevation of Pine Flat Reservoir would result in 124,380 TAF of additional storage. Raising the gross pool by 20 feet would include the following:

- Raising dam crest 12 feet to elevation 982.0
- Reshaping spillway ogee
- Enlarging spillway piers
- Installing new 42-foot by 59-foot tainter gates
- Raising upstream PG&E Kings Power Plant 21.5 feet from elevation 958.0 to elevation 979.5
- Adding reinforced concrete with pre-stressed tendon to the downstream face of the dam
- Relocating 3.5 miles of Trimmer Springs Road, including three bridges
- Raising hoist works for the power plant intake trash racks and stop logs, and elevator at Pine Flat Dam

- Relocating inundated recreation facilities where possible
- Mitigating fish and wildlife impacts

A typical cross section of the potential dam raise was not provided in the 1989 Corps report.

RESERVOIR ELEVATION VS CAPACITY

A reservoir elevation versus storage volume curve is shown in Figure 5-1.

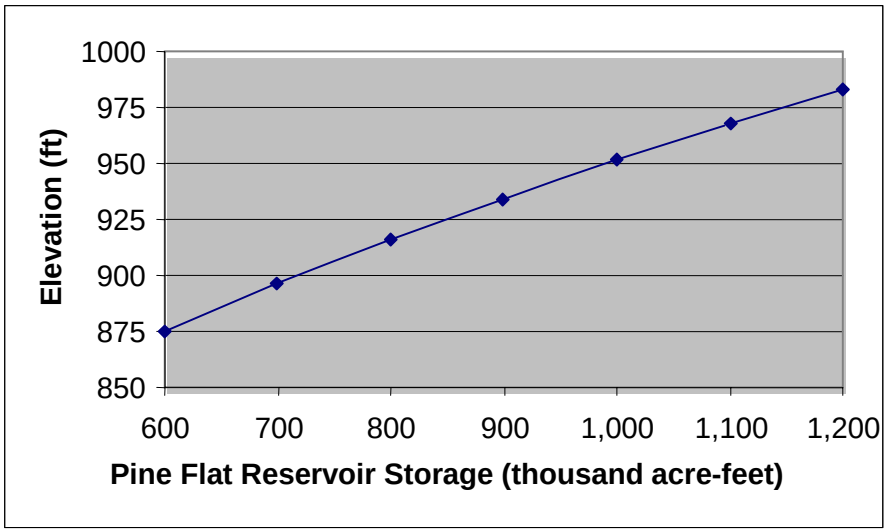

FIGURE 5-1. RESERVOIR ELEVATION VS. CAPACITY CURVE

APPURTENANT FEATURES

No new conveyance, outlet or spillway facilities would be required for raising Pine Flat Reservoir.

CONSTRUCTIBILITY

This section discusses issues of concern related to raising the dam.

Land, Rights-of-Way, Access, and Easements

Public roads lead to the Pine Flat Dam and Reservoir area. Overhead and underground utilities lead to and service the dam and the area below the dam. A number of high voltage transmission lines traverse the area. One line traverses the ridge south of the dam and reservoir; others cross the Kings River just downstream of the dam and downstream of Piedra; another crosses the central portion of the reservoir; and one exits southward from the KRCD power plant and the PG&E power plant.

Borrow Sources/Materials

Alluvial river gravel suitable for processing into concrete aggregate is available along the banks of the Kings River and lower Mill Creek Valley immediately downstream of Pine Flat Dam. Reportedly, these river deposits were previously investigated by Reclamation and the Corps, and a sufficient quantity exists to meet the needs of any potential scheme for raising the dam (IECO, 1974). Furthermore, Corps staff have reported that plans are being made for developing a quarry in the granitic rock of nearby Jesse Mountain.

Foundations

The foundation of the raised portion of Pine Flat Dam would be in hard, sound amphibolite. Care must be taken during foundation excavation of the abutments to ensure stability of the cut slopes above the dam on each abutment.

Power Sources

Nearby electrical power is available from the Pine Flat generating unit.

Staging and Lay-Down Area

Potential staging and lay-down areas are available within the parking area on the downstream side of the left abutment and at the bottom of the dam crest access road, near the Corps office.

Contractor Availability and Resources

There are several local general contractors capable of performing the rock excavation and concrete work necessary to raise the dam. Installation of post-tension tendons, fabrication and installation of gates, and raising the intake gate frames and elevator would probably have to be contracted to specialty firms outside the immediate region.

Construction Schedule and Seasonal Constraints

It is anticipated that all construction activity necessary to raise the dam could be carried out over a period of 1 year. Seasonal constraints include the winter rainy season between late October and May, and spring floods can occur between April and June due to snowmelt. The reservoir level during construction would have to be maintained at a suitably low elevation to avoid damage to construction activities by potential floods.

Flood Routing During Construction

Floods would be stored in the drawn-down reservoir during construction, and flows routed through the powerhouse.

Environmental Impacts During Construction

Environmental impacts during construction could be mitigated with proper planning and implementation of best management practices. The work site is remote from urban development. Visual impacts would thus be minimal and noise would affect few humans. Air quality issues can be mitigated by dust control measures for quarrying, material processing, and construction on the dam. Any blasting that might be required on the abutments will require both noise and vibration monitoring of the dam. A cultural survey would have to be conducted to identify any ancestral American Indian or historic artifacts and construction activities would be restricted in those areas. Bald eagles have been sighted within the reservoir area. Importing concrete aggregate from distant plants may cause traffic impacts but with proper planning and coordination with Caltrans, major impacts could be mitigated. All construction equipment should have spark arresters and fire control equipment would need to be kept readily accessible during construction. Construction water would have to be controlled and provisions made for runoff and erosion control. A spill control plan would be needed to control any construction-related fuels, lubricants, and other materials.

Permits

Federal and non-Federal sponsors would be proposing the dam raise. This joint sponsorship could complicate the permitting process as Federal projects are not subjected to the same level of permitting required for non-Federal projects.

Given the probable duality of sponsorship, and potential environmental and cultural impacts identified, at a minimum, certain permits could be required from the permitting agencies listed in Table 5-1.

TABLE 5-1. POSSIBLE PERMITS REQUIRED

Permit	Permitting Agency
Permit to Construct	DSOD, Fresno County
Encroachment	Caltrans, Fresno County
Air Quality	CARB, Fresno County
Low/No Threat NPDES	RWQCB
Waste Discharge	RWQCB
401 Certification	SWRCB
Blasting	Fresno County
Streambed Alteration	CDFG
Fire/Burn	CDF, Fresno County

Key:

CARB	California Air Resources Board
CDF	California Department of Forestry
CDFG	California Department of Fish and Game
DSOD	Department of Safety of Dams
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resource Control Board

In addition, the following agencies could be involved in reviewing permit conditions:

- Bureau of Indian Affairs
- Bureau of Land Management
- State Historic Preservation Office
- Advisory Council on Historic Preservation
- United States Fish and Wildlife Service (USFWS)

In obtaining these various permits, several plans would have to be prepared and submitted to the responsible agencies for review and approval:

- Construction Plan and Summary Documents
- Quality Control Inspection Plan
- Highway Notification Plan
- Blasting Plan
- Noise Monitoring Plan
- Water Quality Monitoring Plan
- Noxious Weed Control Plan
- Bat Protection Plan
- Management Plan for Avoidance and Protection of Historic and Cultural Properties
- Storm Water Pollution Prevention Plan
- Spill Prevention/Containment Plan
- Visual Quality Control Plan
- Dust Control and Air Quality Plan

Another important regulatory requirement involves compensation/mitigation for habitat loss. In October 1998, the USFWS issued its draft Coordination Act Report and Habitat Evaluation Procedure (HEP Analysis). The HEP Analysis delineates how compensation for adversely affected baseline habitat and wildlife conditions is to be determined.

In addition, if power generation is included in a project or is modified for an existing project, the Federal Energy Regulatory Commission may become involved in the permitting process.

COSTS

Based on the 1974 IECO study, a cost estimate for the potential Pine Flat Dam raise was updated to April 2002 price levels using Reclamation Construction Cost Trends. Costs were also modified to reflect current component costs and standards of practice, especially with respect to seismic requirements.

Initial Construction Costs

The estimated total first cost for the potential 20-foot raise of Pine Flat Reservoir is $44 million. Estimated cost components are presented below in Table 5-2 and in Appendix C. Field costs represent the estimated cost to construct identified features and provisions for unlisted items (15 percent), contingencies (25 percent), and mitigation (5 percent). Land costs are excluded from this prefeasibility-level estimate, as are costs for relocating or modifying affected power plants. Additional study of these requirements would be needed to determine their costs. Total costs include field costs and estimated costs for future analyses and planning documentation, development of designs, and construction management (15 percent).

TABLE 5-2.
SUMMARY OF FIRST COSTS

Component	20-Foot Pool Raise ($Million)
Dam, Spillway, Gates	24
Permanent Operating Equipment	1
Unlisted Items	4
Contingency	7
Mitigation	2
Total Field Cost	**38**
Invest/Design/CM	6
Total First Cost	**44**

Operations and Maintenance Costs

Operations, maintenance, and replacement costs have not yet been estimated for the Pine Flat raise. These will be estimated by applying representative figures based on a review by Reclamation of other similar projects and agency guidance. However, it is expected that operations and maintenance costs would be only slightly higher than presently expended for Pine Flat Reservoir.

SYSTEMS OPERATIONS

Preliminary Corps operations studies of the enlarged Pine Flat Reservoir with a storage volume of about 1,124 TAF proposed that all new space be devoted to flood control.

To benefit the San Joaquin River or CVP water users, water from Millerton Lake would be exchanged with an equivalent amount of water captured by the expanded Pine Flat Reservoir.

CHAPTER 6. HYDROELECTRIC POWER OPTIONS

Various hydroelectric power options were considered for each surface storage site, including Pine Flat.

PUMPED STORAGE CONSIDERATIONS

The potential raise of Pine Flat Reservoir does not involve pumped storage.

ADDED HYDROELECTRIC POWER TO EXISTING STRUCTURES

In general, the Pine Flat Power Plant would be operated at higher heads for longer periods of time and would therefore generate more power. However, the Kings River Power Plant would be inoperable at certain times of the year when the reservoir level was too high, unless the facility were moved to a higher elevation.

NEW HYDROELECTRIC POWER

This storage option would not develop any new hydroelectric power sources.

TRANSMISSION AND DISTRIBUTION

No information is available on transmission and distribution of potential additional power developed from the hydroelectric projects associated with raising Pine Flat Reservoir.

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CHAPTER 7. ENVIRONMENTAL CONSIDERATIONS

This chapter describes existing environmental resources at the site and qualitatively describes potential effects of reservoir enlargement, indicating the extent to which expected or potential environmental effects might pose a constraint to the development of surface storage. Where evident, opportunities for improving environmental resources or mitigating adverse effects have been noted. Analysis focused on botany, terrestrial wildlife, aquatic biology, water quality, recreational resources, cultural resources, and existing land uses. Mining and other known past activities that might affect site conditions are also briefly discussed, along with the potential presence of hazardous or toxic materials. Temporary construction-related disruptions and impacts are discussed in Chapter 5.

Identification of constraints was conducted at a preliminary, prefeasibility-level of planning, consistent with the current phase of the Investigation. Criteria considered were based, in part, on criteria commonly used to evaluate environmental impacts of projects under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The application of criteria that may be used for NEPA or CEQA evaluation does not imply that the analysis is at a level that would be needed for an EIS or EIR. Considerations included presence of special status species (e.g. Federally listed endangered species), species of concern, or sensitive habitats; relative amounts of affected riparian or wetland habitat; effects on native or game fish; conflict with established recreational uses or land uses; presence of nationally registered historic places, sacred Native American sites, or Traditional Cultural Properties; permanent disruption or division of established communities; and loss of energy production facilities.

BOTANY

Annual grassland, foothill woodland, and chaparral habitats are found in the area around Pine Flat Dam and Reservoir. Some riparian vegetation is found along the shores of the reservoir, but occurrences that are more extensive are found upstream on the Kings River and in some tributaries, particularly Big Creek and Deer Creek. Seeps and other seasonal wetlands are likely to be present as well.

Only five special-status botanic species were reported in the CNDDB in areas surrounding Pine Flat Reservoir: orange lupine, tree anemone, American mannagrass, Madera linanthus, and Kings River buckwheat. Of these, only the tree anemone is listed by the State or Federal government as threatened or endangered, and three have California Native Plant Society (CNPS) List 1B status. The closest known location of the tree anemone, which is listed by the State of California as a threatened species, occurs in the upper reaches of Big Creek east of Barnes Mountain. However, habitat for the tree anemone occurs elsewhere in the watershed, and surveys may be required to determine its presence or absence. Suitable habitat for the three CNPS List 1B species probably occurs in the watershed, possibly outside the potential new pool elevation.

Portions of the affected area are on serpentine soil. Although the CNDDB does not indicate the presence of serpentine-dependent species in this area, surveys would be necessary to confirm their presence or absence.

Constraints

The primary botany-related potential constraint to enlarging Pine Flat Reservoir would be the loss of riparian and wetland habitat. The exact amount of habitat loss associated with a 20-foot raise in the reservoir's maximum water surface elevation is unknown. However, a 15-foot raise would flood riparian and shaded riverine aquatic habitat for ¾ of a mile up the Kings River, for approximately 1 month in 20 percent of the years. It would also periodically inundate nearly 300 acres of oak woodland, oak savannah, and non-native valley grassland (Corps, 2001). An incremental amount of additional habitat would be periodically inundated by a 20-foot raise. It is possible that special-status species could pose a constraint, but it is unlikely.

Opportunities

Opportunities to improve vegetation at the site or mitigate for habitat loss are uncertain. Habitat losses are likely to be small and there may be some possibility of on-site mitigation.

WILDLIFE

An increase in the Pine Flat Reservoir pool would result in loss of upland foothill woodland habitats and inundation of the terminal points of tributary streams. The foothill woodland habitat hosts a diverse wildlife community, including a small deer population. Golden eagles are known to occur in the Pine Flat area, as are spotted bats. Foothill yellow-legged frogs and western pond turtles inhabit some tributary streams (four streams are reported to have populations of pond turtles). Valley elderberry longhorn beetles, a Federally listed threatened species, are also present throughout the area.

Constraints

The area surrounding the Pine Flat Reservoir is remarkably devoid of special status wildlife species for such a large area. The loss of tributary stream habitats for foothill yellow-legged frogs and western pond turtles would require further investigation to determine the extent of potential constraints. The loss of valley elderberry longhorn beetle habitat would require mitigation.

Opportunities

Since Pine Flat Reservoir has potentially fewer constraints posed by special status wildlife species, this site would offer a less encumbered opportunity for development than other sites of similar size.

AQUATIC BIOLOGY/WATER QUALITY

The Pine Flat Reservoir basin is steep-sided and the reservoir has limited shallow, vegetated shoreline habitat for fish. Large annual water level fluctuations presumably contribute to the degradation of the habitat value of the shoreline.

Pine Flat Reservoir was thermally stratified in the summer of 1976 and dissolved oxygen concentrations approached zero near the bottom in the previous fall and winter (KRCD, 1977). Since the reservoir is deep and relatively narrow with cold-water inflows from the Kings River, it probably stratifies every summer.

Rainbow trout and white catfish are the principal fishery species in Pine Flat Reservoir. Threadfin shad and golden shiner (*Notemigonus crysoleucas*) provide the prey base for these fisheries. White bass (*Morone chrysops*) was recently illegally introduced to the reservoir and is now considered a nuisance species by the California Department of Fish and Game (CDFG). The principal concern is that white bass could enter the San Joaquin River during flood flows and these fish could make their way to the Sacramento-San Joaquin Delta, where they would compete with or prey on native species. Kern brook lamprey are found in the Kings River upstream of the reservoir, as are wild rainbow trout (Corps, 1994).

Constraints

This measure would entail raising the maximum pool elevation of Pine Flat Reservoir by 20 feet. Such a small raise would have little effect on aquatic biological resources or water quality, particularly given the large size and depth of the existing reservoir. The increase in water level would result in upstream inundation of the Kings River and a loss of valuable fish habitat, especially for wild rainbow trout and Kern brook lamprey. Although the exact amount of habitat loss associated with a 20-foot raise is unknown, a 15-foot raise would flood riparian and shaded riverine aquatic habitat for ¾ of a mile up the Kings River, for approximately 1 month in 20 percent of the years (Corps, 2001).

Opportunities

If inundation of upstream shaded riverine aquatic habitat created adverse effects on the Kings River fishery that needed to be mitigated, mitigation could be difficult. Conversely, however, an increase in water level elevation would also produce a modest increase in reservoir fish habitat, probably leading to minor increases in fish production. In addition, warm water species could benefit from the inundation of terrestrial vegetation, and increased reservoir volume could improve temperature conditions for cold-water fish such as trout (Corps, 1994).

RECREATION

Pine Flat Reservoir is a major low-elevation recreation destination that provides a variety of water-oriented recreation opportunities, including pleasure boating, water skiing, fishing and swimming. Lands surrounding Pine Flat Reservoir are used for camping, picnicking, and hunting. An average of over 4 million visitor hours are recorded annually. Fishing and boating are the primary activities during spring. Hunting and fishing predominate during fall and winter (Corps, 1989b).

Pine Flat Reservoir covers 5,950 surface acres and has 67 miles of shoreline, most of which are steep-sided (KRCD, 1977). The south side of the reservoir is undeveloped and accessible only by boat. Trimmer Springs Road, a paved county road, provides access to the north shoreline. A number of developed recreation facilities are present along the north shore and the river just upstream of the reservoir, as shown in Table 7-1.

TABLE 7-1.
RECREATION FACILITIES IN THE VICINITY OF PINE FLAT RESERVOIR

Facility	Description
Lake Ridge Marina	Boat launching and mooring
Deer Creek Recreation Area	Boat launching, day use, camping
Island Park Recreation Area	Boat launching, day use, camping
Lakeview Recreation Area	Boat launching, day use
Trimmer Marina	Boat launching and mooring
Trimmer Recreation Area	Boat launching, day use, camping
Sycamore Flat 1 Campground	Day use, camping (no lake access)
Sycamore Flat 2 Campground	Day use, camping (no lake access)
Lakeview Recreation Area	Day use, camping (no lake access)
Kirch Flat Campground	Camping, day use, whitewater boating take out

Lodging and other services are available at various locations around the reservoir, including near Island Park and Lakeview.

In addition to the facilities described above, several developed recreation facilities are present downstream of Pine Flat Dam on the Kings River. These include Pine Flat Recreation Area, Choinumni Park, Winton Park, and Avocado Lake Park. These developed areas offer overnight camping, picnicking, and fishing access.

Pine Flat Recreation Area is located one-half mile downstream of the dam, accessible by Pine Flat Road via Trimmer Springs Road (KRCD, 1977). Fresno County Parks and Recreation Department (FCPRD), under license to the Corps, operates this 174-acre area. This area is divided into two parts: one west of Piedra Road, designed for overnight and day use, and the other, east of Piedra Road and closer to Pine Flat Dam, designated as day use only. The eastern part receives heavy use by picnickers (KRCD, 1977).

Choinumni Park is located on the north side of the Kings River, about 2½ miles downstream of Pine Flat Dam. This 170-acre park, with day use and overnight facilities, is owned and operated by FCPRD. Winton Park and Avocado Lake Park, further downstream, would probably not be affected.

The North Fork and main stem of the Kings River, just upstream of Pine Flat Reservoir, provide various day use and overnight opportunities such as hiking, fishing, picnicking, swimming, wading, and dispersed and developed camping. In addition, both the North Fork and the main stem Kings River are popular whitewater boating destinations, and support both private and commercial use. Boaters typically put in at Garnet Dike Campground and take out at Kirch Flat Campground. This run, referred to as Garnet Dike Run or Banzai Run, is 10 miles long and ranges in difficulty from Class III to Class IV, depending on flow. Commercial outfitters have set up base camps along this reach of the river to accommodate their boating operations.

Constraints

Raising the water surface elevation 20 feet would inundate all or portions of existing developed recreation facilities. Exceptions are Sycamore Flat 1 and 2 campgrounds and the Lakeview Recreation Area. These sites are situated upslope, away from the shoreline. It may be difficult to move some of the other facilities further upslope owing to relatively steep terrain surrounding the reservoir.

Raising the water surface 20 feet would also inundate the Kings River upstream of Pine Flat Reservoir. According to the 1989 Corps report, this measure would flood base camps for several commercial rafting outfitters (Corps, 1989b). In addition, it would inundate Karch Flat Campground, the preferred take-out for private boaters. Raising the water surface elevation 20 feet would inundate about 1 mile of rapids, impacting rafting and trout fishing opportunities.

Opportunities

According to the Corps, raising the gross pool elevation 20 feet would increase the reservoir surface by approximately 355 acres. The additional surface area would create new water-oriented opportunities and create demand for new facilities. Appropriate facilities would include additional boat launch areas, campsites, and day use areas.

Any facilities that were inundated should be replaced in kind, or with improvements to other recreation facilities in the area to accommodate increased use.

CULTURAL RESOURCES

The territory of the Choynimni Foothill Yokuts extended up the Kings River to the vicinity of Pine Flat Dam. The majority of Southern Valley and Foothill Yokuts people now live on the Tule River Indian Reservation, near Porterville. The upper reaches of present-day Pine Flat Reservoir, from Trimmer upstream, are within the traditional territory of the Wobonuch people, Numic-speaking relatives of the Northfork Mono along the San Joaquin River. Like the Northfork Mono, the Wobonuch lived in small settlements along larger watercourses. Wobonuch descendants live primarily in Dunlap, southeast of Pine Flat Reservoir (Spier 1978). The Holkoma Mono people, not discussed by Spier, presently live at Cold Springs Rancheria about 10 miles north of Trimmer.

Pine Flat Reservoir was surveyed as part of a Smithsonian Institution River Basin Surveys program, begun in 1947 (Drucker, 1948). Details of this work are presently unavailable, as is information regarding subsequent studies.

Pine Flat Dam was constructed in 1951 through 1954. Specific information is presently unavailable regarding other aspects of Pine Flat area history. A variety of sites are likely to be present associated with mining, logging, reservoir development, recreation, residential development, and other activities.

Constraints

Numerous cultural resources are known to be present, and there may be additional resources not yet recorded. Inundation of archaeological sites (prehistoric or historic) can result in loss of important scientific data. A potential reservoir raise of 20 feet might affect additional properties. No properties eligible for the National Register of Historical Places are known to be present, but future study may identify such properties. No Native American sacred sites or Traditional Cultural Places are known to occur, but Wobonuch and Holkoma Mono concerns are expected.

Opportunities

Inundation damage to archaeological sites can be mitigated with scientific data recovery programs. Reservoir projects also provide an opportunity for public interpretation of the past. Ancillary facilities, such as roads, power lines, or other structures, may provide opportunity for avoidance of impact to archaeological sites through design or facility placement.

LAND USE

The only facilities that may be affected by this measure would be the PG&E Kings River Power Plant, penstock, and the associated transmission line at the eastern end of the reservoir.

Constraints

The PG&E power plant, located in the upper reaches of Pine Flat Reservoir, would need to be raised 21.5 feet. No other constraints were identified.

Opportunities

Because the 20-foot raise would not disrupt an existing community, this measure is considered an opportunity for making land use improvements.

MINING AND OTHER PAST ACTIVITIES

Beyond the activities referred to above under cultural resources and recreation, no evidence of mining or other past human activities that could affect the site were identified.

Constraints

No constraints related to past uses that could affect the site have been identified, except those previously discussed above.

HAZARDOUS AND TOXIC MATERIALS

Recreational properties in the reservoir area may possess, or may have once possessed underground or aboveground storage tanks for petroleum hydrocarbon fuels or lubricants. Depending on the type of operation, electrical transformers containing polychlorinated biphenyls (PCBs) may also be or have been present in the area.

Constraints

Potential impacts to the site requiring remediation include impacts from fuel and lubricant hydrocarbons, and from electrical transformers that may exist within the area.

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CHAPTER 8. FINDINGS AND CONCLUSIONS

This TM describes a water storage option that would increase the capacity of Pine Flat Lake by raising the height of Pine Flat Dam. The storage option involves increasing the gross pool elevation of the reservoir by 20 feet, resulting in 124 TAF of additional storage. This would be accomplished by raising the dam crest 12 feet, replacing existing tainter (radial) gates, and modifying other features at the dam. This option would also require raising the PG&E Kings River Power Plant 21.5 feet and reconfiguring the Pine Flat Power Plant at the toe of dam.

Additional water stored in the enlarged Pine Flat Reservoir would be released to the Kings River to supplement CVP deliveries or to offset water released from Millerton Lake. Implementation of this option would require involvement with KCRD and other water rights holders in the Kings River watershed.

Although engineering features for this option would be extensive, no technical constraints were identified that would limit their design or construction. However, KCRD indicated that potential environmental impacts to botany, fisheries, endangered species and rafting would be significant and KCRD would not be interested in participating in implementing this option. In addition, the Corps had previously considered this option for flood protection purposes, but dropped it on the basis of environmental issues. Therefore, this option was dropped from further consideration in the Investigation.

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CHAPTER 9. LIST OF PREPARERS

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APPENDIX A

Engineering Field Trip Report

Raise Pine Flat Dam

Field Trip Log			
Trip Log Number:	12	**Project No.:**	1003032.01180502
Dates:	6/13/02	**Times:**	0900-1130
Site Name:	Pine Flat Dam & Reservoir	**Location:**	Piedra
Prepared By:	DKR/JMH/WAM	**Reviewed By:**	
Date:	6/13/02	**Date:**	

Attendees/Visitors Name	**Organization/Phone/Email**
DKR	MWH, 925.685.6275 x125, david.k.rogers@mwhglobal.com
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WAM	MWH, 425.602.4025 x1060, william.a.moler@mwhglobal.com
Frank Fonseca	USCOE, Pine Flat
Roy Proffit	USCOE, Pine Flat

Weather Conditions:

Clear, slight haze, warm (mid 70s), light breeze

Access Route (attach map):

Highway 99, Ventura Av / State highway 180 (E) through Fresno to Centerville, to Trimmer Springs Rd (N), to Pine Flat Rd (E)

Attachments:	**Yes**	**No**
Photo Log	✔	
Photos	✔	
Video Log (available)	✔	
Dictation Log (available)	✔	
Topographic Map	✔	

Purpose:

Review potential raise of existing dam.

Field Observations:

Existing Structures/Cultural Features:

Pine Flat Dam is a concrete gravity structure completed in 1954. The existing dam crest is 429 feet high (el. 970), 32 feet wide and 1,820 feet long. The gated spillway has a gross length of 292 feet, a net length of 252 ft, and a crest elevation of 916.5 ft. There are six spillway tainter gates that each measure 42 ft by 36 ft. Pine Flat Reservoir covers 5,970 acres at a gross pool elevation of 951.5 and has a maximum storage capacity of 1,000 TAF. The Pine Flat Dam drainage area covers ~1,545 square miles (USCOE, 1976).

A 165 MW power plant (URS, 2000) operated by Kings River Conservation District (KRCD) is located at the right side, downstream base of the dam. A PG&E power plant and penstock (Kings Power Plant) is located on the upper margin of Pine Flat Reservoir.

What little development that has occurred on the reservoir has taken place on the north shore. Two marinas, Trimmer and Lakeridge, and four campgrounds, Island Park, Kirch Flat, a group site, and unnamed site are all along the north shore. Campgrounds are also found a short distance downstream of Pine Flat Dam. The land within the embankments is used for agriculture. A citrus grove was observed in the southeast portion of the reservoir and the rest appeared to be used as grazeland.

Right of Way/Access Restrictions:

Public roads lead to the Pine Flat Dam and Reservoir area.

Overhead/Buried Utilities:

Overhead / underground utilities lead to and service the dam and the area below the dam. A number of high voltage transmission lines traverse the area. One line traverses the ridge south of the dam and reservoir, others cross the Kings River just downstream of the dam and downstream of Piedra, and another crosses the central portion of the reservoir, and one exits southward from the KRCD power plant and the PG&E power plant.

Description of Potential Structures (attached a field sketch or sketch on a topo map):

URS indicated that 45 TAF of reservoir capacity would be obtained by adding a 7 ft. parapet to the existing dam crest. URS assumed that the 7-ft parapet option was the maximum amount the current dam could be raised by adding solely to the dam crest. Any further raise would dramatically increase construction cost (URS, 2000).

Alternatives evaluated previously included 15- and 20-ft increases in the gross pool elevation. A 15-ft gross pool raise, could be accomplished by a 7-ft dam raise, and would result in an additional 92.772 TAF of storage capacity. This option could be accomplished without incurring major cost of additional concrete on the downstream dam face (USCOE, 1989).

A 20-ft gross pool raise, could be accomplished through a 12-ft dam raise, but would require extensive concrete on the downstream dam face, flood protecting of the upstream PG&E power plant. This option would result in an additional 124,380 acre-feet (USCOE, 1989).

Description of Appurtenant Features (spillways, tunnels, pumping plants, flood routing/coffer dams/dewatering during construction, outlet works, switch yards, transformer yards, transmission lines, conveyance pipelines/canals, access roads, security, operation/maintenance):

In the 15-ft gross pool raise, the ogee spillway would need reshaping, piers would be enlarged, new (42 ft by 54 ft) tainter gates would be installed, PG&E power plant would be raised (16.5 ft), 3½-miles of Trimmer Springs Rd and 3 bridges would require relocation, and recreation facilities would require relocation (USCOE, 1989).

The 20-ft gross pool raise would require similar modifications as the 15-ft raise. However, the tainter gates would be larger (42 ft by 59 ft), the PG&E power plant would be raised higher (21.5 ft total), reinforced concrete with pre-stressed tendons would be added to the downstream dam face, and the power intake frame at Pine Flat Dam would need to be raised (USCOE, 1989).

Briefly Describe Geologic/Geotechnical Site Conditions:

Pine Flat Reservoir is located near the boundary of the Sierra Nevada foothills and the Great Valley. The state geologic map shows that the southern perimeter of the lower main portion of the reservoir is bordered by pre-Cenozoic granitics, while Mesozoic granitic borders the upper reaches of the reservoir. The northern perimeter exposes a more complex set of geologic units. The lower portion of the reservoir is bordered by pre-Cenozoic meta-volcanic rocks, Mesozoic granitics, Mesozoic basic intrusive and ultrabasic rocks, and pre-Cretaceous meta-sedimentary rocks (CDMG, 1965).

At Pine Flat Dam, the right abutment is founded in the pre-Cenozoic meta-volcanic rocks, while the left abutment is founded in the pre-Cenozoic granitics (CDMG, 1965). In the power plant area, the bedrock consists of hard metamorphic (meta-volcanic) rock of jointed amphibotlite with scattered thin seams of calcite, quartz, and lesser gypsum and weathered bedrock (USCOE, 1989).

As with most sites in the region, studies indicate that there are no faults in the area capable of producing ground motions greater than those generated by four known regional sources that include the San Andreas fault system, the Sierra Frontal fault system, the White Wolf fault, and the Garlock fault (USCOE, 1990).

Location/Description of Nearest Borrow Areas (attach map or show on topo map):

Previous investigations by the USBR and USCOE identified suitable concrete aggregate along Kings River and lower valley of Mill Creek (IECO, 1974). According to Mr. Fonseca of the Pine Flat USCOE office, there are plans for a possible new granite quarry at Jesse Mountain.

Location/Description of Equipment/Material Staging and Lay Down Areas (attach map or show on topo map):

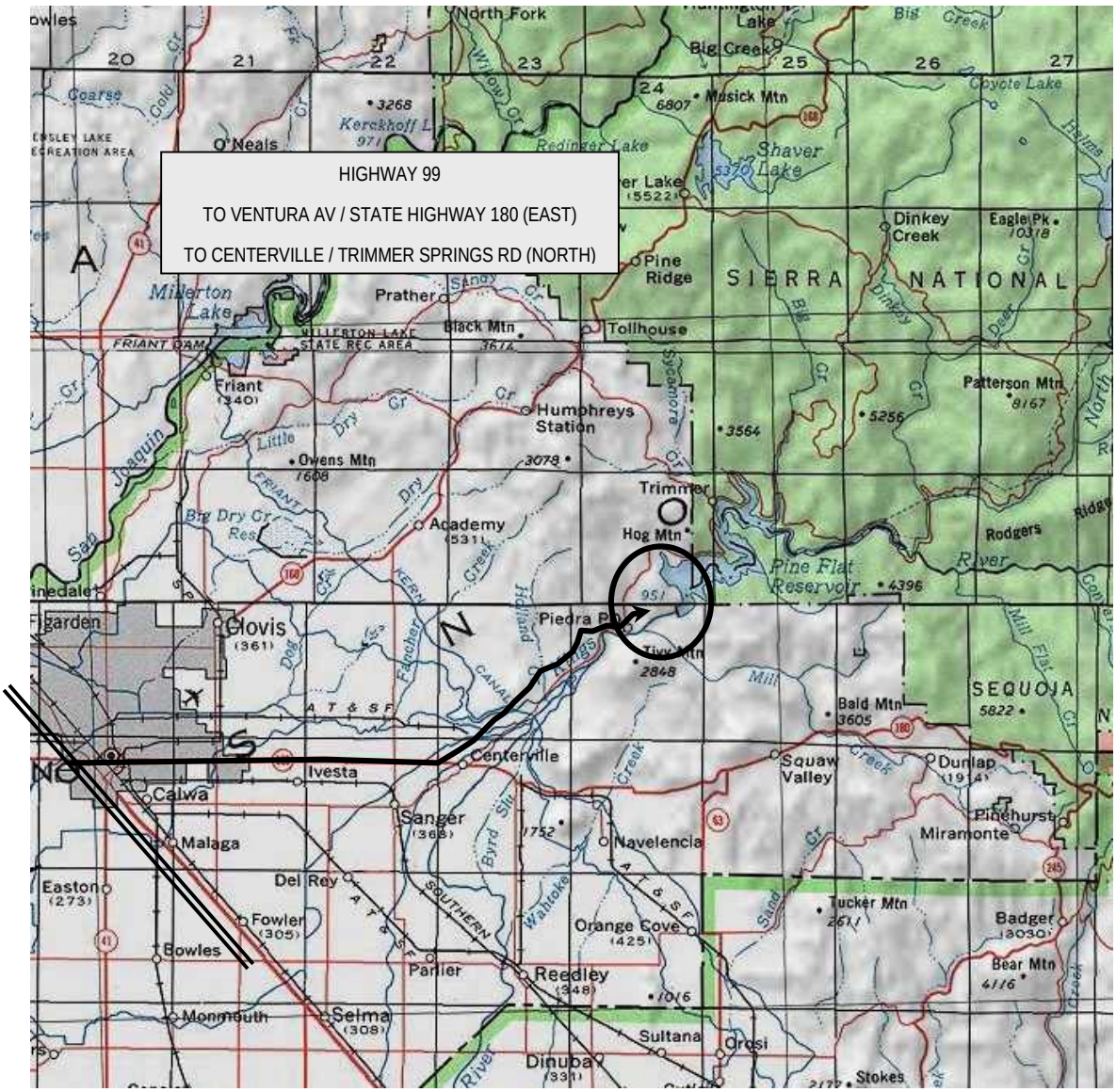
Potential staging and laydown areas are present within the parking area on the downstream side of the left abutment and at the bottom of the dam crest access road, near the USCOE office.

Identification of Environmental Sensitive Areas (wetlands, springs, rivers, streams, endangered/threatened species habitats, etc.):

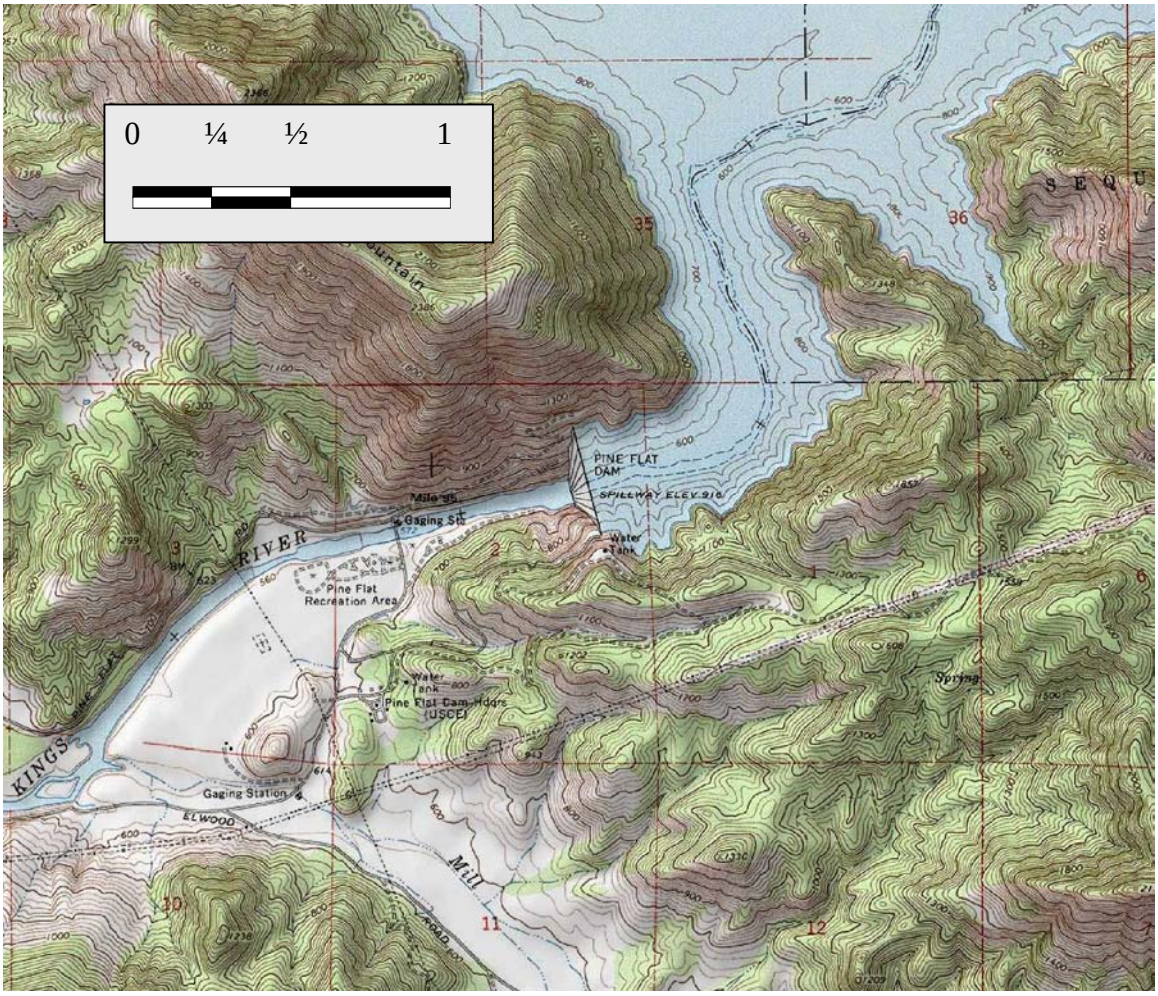
A riparian habitat upstream of the upper end of the reservoir would be affected with a dam raise, as would slight amounts of oak woodland on the left abutment. The right abutment is primarily cattle grazeland grass.

Description of Mining or Other Anthropologic Activities:

None were noted.



VICINITY MAP



LOCATION OF POTENTIAL DAM

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APPENDIX B

Environmental Trip Report

Raise Pine Flat Dam

ENVIRONMENTAL TRIP REPORT - PINE FLAT RESERVOIR

A team of environmental specialists completed an initial field trip to Pine Flat Dam and Reservoir on May 29, 2002. The field trip was the first task in the environmental study of several potential surface storage options identified for initial review during the Upper San Joaquin River Basin Storage Investigation. For initial consideration, the environmental review focused mainly on construction and potential upstream impacts associated with surface storage sites. The site visit provided an opportunity to conduct preliminary reconnaissance of existing resources at the various locations for the following resource areas: terrestrial biology; aquatic biology and water quality; recreation; cultural resources; and land use. Some sites were viewed by air because of their remoteness or due to schedule limitations. Observations for those sites are concomitant with this viewing limitation.

This appendix includes a brief overview of the resource specialists' observations, trip logs prepared by team members, photographs taken during the field trip, and maps used to identify and review existing resources.

SUMMARY OF FIELD OBSERVATIONS

This option would involve increasing the height of Pine Flat Dam, thereby enlarging Pine Flat Reservoir. Existing facilities include: Pine Flat Dam, a hydroelectric power plant and ancillary facilities, Pine Flat Reservoir, PG&E's Kings River Powerhouse and ancillary facilities, transmission towers and lines, paved and unpaved access roads, a bridge at the upper end of the reservoir, and developed recreation facilities.

Botany

- This area consists of foothill pine blue oak woodlands, grassland, oak savannah, and chaparral. There are existing collateral streams.
- Little loss of riparian and wetland habitats expected.
- Small losses of other habitats.
- Impacts to special status species are probably low.

Wildlife

- The area shows effects of heavy cattle grazing.

Aquatic Biology/Water Quality

- Slopes of Pine Flat Reservoir are steep-sided with little good shoreline fish habitat apparent.
- Fish habitat in the Kings River upstream of the reservoir would be lost.
- An enlarged reservoir would probably enhance fisheries of the reservoir.

- An enlarged reservoir and/or reservoir re-operation could affect downstream water temperatures in the Kings River.
- Inundation of abandoned mines, if any are present, could result in water quality degradation.

Recreation

- Pine Flat Reservoir is a major low elevation recreation destination and provides a variety of recreation opportunities including fishing, swimming, boating and water skiing.
- Several developed recreation facilities are present along the reservoir margins, including campgrounds, day use areas and boat launches.
- In addition, dispersed use occurs along the shoreline and along Kings River, upstream of Pine Flat Reservoir.
- Enlarging Pine Flat Reservoir would likely submerge most of the developed recreation areas.
- Enlarging Pine Flat reservoir would also inundate a portion of the Kings River which supports dispersed activities such as fishing and whitewater boating.

Cultural Resources

- A permanent stream (Kings River) along with riparian woodland, and Blue Oak on adjacent slopes would have provided diverse natural resources.
- There is a high probability of prehistoric archaeological sites including BRM stations, hunting and fishing camps, and seasonal village sites.
- Historic sites are likely, associated with mining, logging, hydroelectric development, recreation and other activities.

Land Use

- A mobile home park is located in the vicinity of the reservoir.
- It is unknown how many other residences exist on the south side of the reservoir, which is privately owned.
- Any homes in that area may be affected by inundation.

Field Trip Log - Botany		
Trip Log Number:	S6	**Project No.:** 8004094
Dates:	May 29, 2002	
Site Name:	Pine Flat Dam	
Location:	Pine Flat Reservoir, Kings River	
Prepared By:	Jeff Glazner/Barry Anderson/David Stevens	
Date:	June 5, 2002	

Weather Conditions:	Hot and dry
Areas Covered (attach map with notations	
Attachments	
Photo Log	yes
Photos	Yes
Topographic Map(s)	No

Field Observations:

Existing Facilities:

Existing dam and reservoir. Boat ramps and campgrounds.

Existing Environmental Features as Appropriate to Discipline (hydrology; aquatic-water quality; terrestrial—plants; wildlife; recreation; cultural resources; land use; aesthetic)

Shoreline is mostly barren. Surrounding area consists of grassland, chaparral, and

foothill pine blue oak woodland, grassland, oak savannah, and chaparral. Seeps, springs, and other wetlands could be present. There are existing collateral streams. The area show effects of heavy cattle grazing.

Need for additional (engineering/hydrological, or other) information on measures

Geology or soils information

Spillway elevation and limits of inundation

Location of work pads, access roads, and other construction areas

Additional data needs (within each specific discipline)

CNDDB report

CNPS report

Ceres report

Field surveys for wetlands and special status species and habitats

Field Trip Log - Wildlife		
Trip Log Number:	S6	**Project No.:** 8004094
Dates:	May 29, 2002	
Site Name:	Pine Flat Dam	
Location:	Pine Flat Reservoir, Kings River	
Prepared By:	Dave Stevens, Stephanie Murphy	
Date:	June 5, 2002	

Weather Conditions:	Hot and dry
Areas Covered (attach map with notations	
Attachments	
Photo Log	
Photos	
Topographic Map(s)	

Field Observations:

Existing Facilities:

Existing reservoir and other facilities.

Existing Environmental Features as Appropriate to Discipline (hydrology; aquatic-water quality; terrestrial—plants; wildlife; recreation; cultural resources; land use; aesthetic)

This area consists of foothill pine blue oak woodlands, grassland, oak savannah, and chaparral. There are existing collateral streams. The area show effects of heavy cattle grazing.

Need for additional (engineering/hydrological, or other) information on measures

Need inundation levels, seasonal storage regimes, etc.

Additional data needs (within each specific discipline)

Need to coordinate with resource agency biologists and agency files on known distribution of sensitive species for this area.

Field Trip Log – Fish and Water Quality		
Trip Log Number:	S6	**Project No.:** 8004094
Dates:	May 29, 2002	
Site Name:	Pine Flat Dam	
Location:	Pine Flat Reservoir, Kings River	
Prepared By:	Philip Unger	
Date:	June 10, 2002	

Weather Conditions:	Hot and dry
Areas Covered (attach map with notations	Pine Flat Reservoir from dam to North Fork Kings confluence
Attachments	
Photo Log	No
Photos	No
Topographic Map(s)	Yes

Field Observations:

Existing Facilities:

Existing facilities include: Pine Flat Dam, a hydroelectric power plant and ancillary facilities, Pine Flat Reservoir, PG&E's Kings River Powerhouse and ancillary facilities, transmission towers and lines, paved and unpaved access roads, and a bridge at the upper end of the reservoir.

Existing Environmental Features as Appropriate to Discipline (hydrology; aquatic-water quality; terrestrial—plants; wildlife; recreation; cultural resources; land use; aesthetic)

Pine Flat Reservoir is a large reservoir set in the lower foothills of the Sierras. Water level was low at the time of the field trip and the shoreline was mostly barren. Slopes were steep-sided with little good fish habitat apparent. Surrounding areas consist of grassland, chaparral, and foothill woodland.

Need for additional (engineering/hydrological, or other) information on measures

Need information on exact area that would be submerged by an enlarged Pine Flat Reservoir.

Need the following estimates for reservoir with potential higher level dam:

Mean depth for each month, April – October.

Mean surface area of shallow water habitat (less than 15 feet deep) in each month, April – October.

Mean rate of water level fluctuation for each month, April – October.

Would enlarged reservoir affect how upstream reservoirs are operated (e.g. Wishon and Courtright)?

Would flow regime in Kings River upstream or downstream of Pine Flat Reservoir be altered?

Additional data needs (within each specific discipline)

Need the following information:

Principal fish species of Pine Flat Reservoir.

Water temperature, dissolved oxygen profiles and any other existing water quality data from Pine Flat Reservoir.

Information on fish species in the Kings River upstream of Pine Flat Reservoir (in reach that would be inundated by raising reservoir level).

Information on the location and types of active and abandoned mines in the inundation zone of the potential reservoir.

Field Trip Log – Recreation		
Trip Log Number:	S6	**Project No.:** 8004094
Dates:	May 29, 2002	
Site Name:	Pine Flat Dam	
Location:	Pine Flat Reservoir, Kings River	
Prepared By:	Sandra Perry	
Date:	June 3, 2002	

Weather Conditions:	Hot and dry
Areas Covered (attach map with notations	Pine Flat Reservoir from dam to North Fork Kings confluence
Attachments	
Photo Log	No
Photos	No
Topographic Map(s)	Yes

Field Observations:

Existing Facilities:

This option would involve increasing the size of Pine Flat Dam, thereby enlarging Pine Flat Reservoir. Existing facilities include: Pine Flat Dam, a hydroelectric power plant and ancillary facilities, Pine Flat Reservoir, PG&E's Kings River Powerhouse and ancillary facilities, transmission towers and lines, paved and unpaved access roads, a bridge at the upper end of the reservoir, and developed recreation facilities.

Existing Environmental Features as Appropriate to Discipline (hydrology; aquatic-water quality; terrestrial—plants; wildlife; recreation; cultural resources; land use; aesthetic)

This reservoir is owned and by the Army Corps of Engineers (COE) and KRCD. The north side of the reservoir is bound mainly by land managed by the COE and to a lesser extent, public lands managed by the Sierra National Forest. The south side of the reservoir is bound by private land, and public lands managed by the Sequoia National Forest and the BLM. Several developed recreation facilities are located adjacent to the reservoir. The reservoir supports a variety of activities including fishing, flat water boating, power boating, nature viewing, swimming and wading. The surrounding lands support both developed and dispersed recreation including camping, picnicking and hiking.

The North Fork of the Kings and the Main Kings, just upstream of Pine Flat Reservoir provide various day use and overnight opportunities such as hiking, fishing, picnicking, swimming, wading and dispersed and developed camping. In addition, both the north fork and the main Kings are popular whitewater boating destinations, and support both private and commercial use. These runs and several developed and dispersed recreation areas would likely be inundated if Pine Flat Reservoir were enlarged.

Need for additional (engineering/hydrological, or other) information on measures

Need information on exact area that would be submerged by an enlarged Pine Flat Reservoir.

Need information on how reservoir operations would change including magnitude and timing of water level fluctuations.

Would enlarged reservoir affect how upstream reservoirs are operated (e.g. Wishon and Courtright)?

Additional data needs (within each specific discipline)

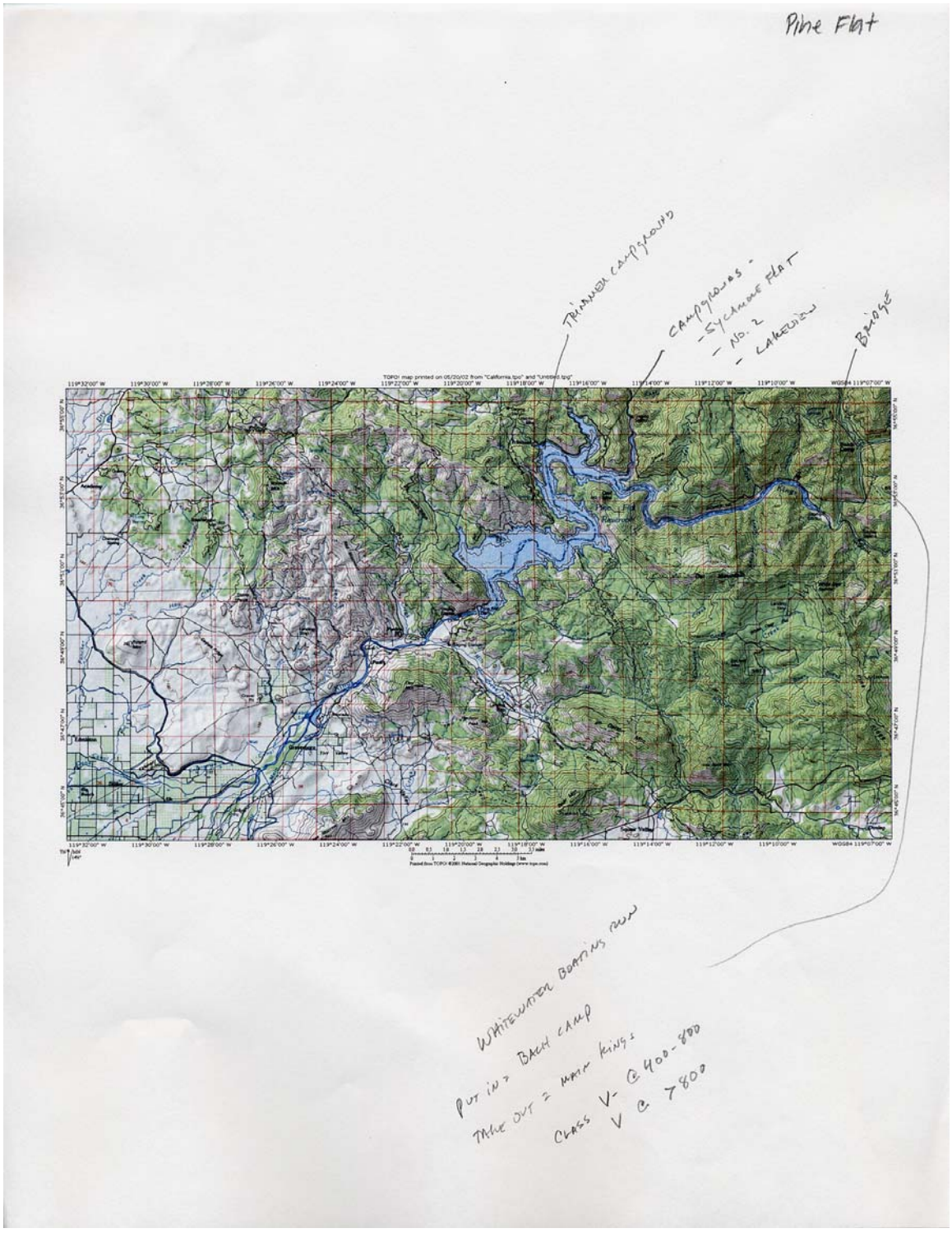
Need the following recreation-related information:

Exact location of existing recreation facilities along Pine Flat Reservoir, the North Fork of the Kings, and the main Kings with respect to new inundation area

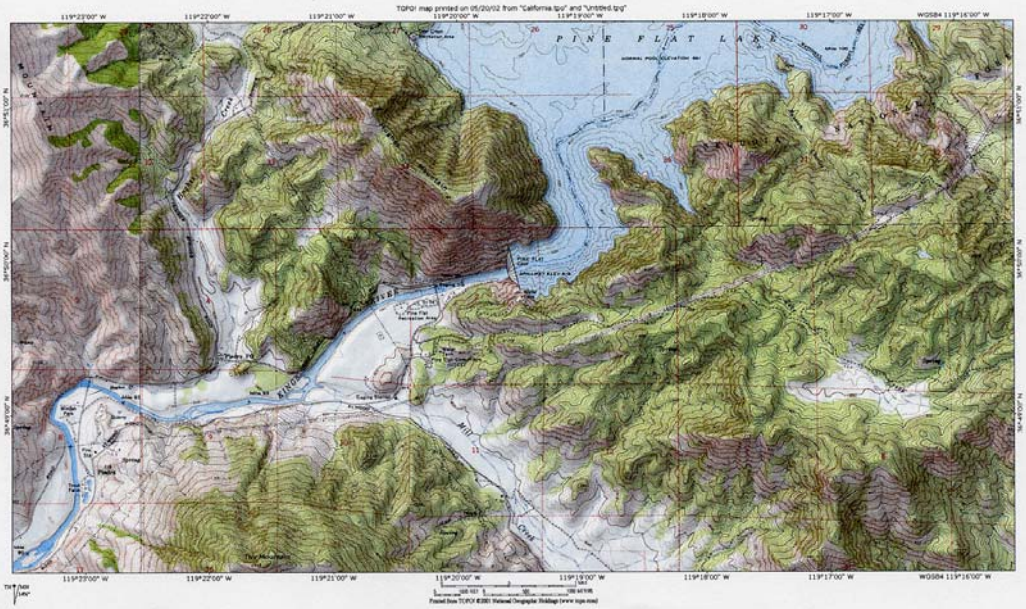
Use levels by activity for developed recreation facilities around lake and along North Fork of the Kings and the main Kings.

Use estimates for dispersed activities including whitewater boating and angling.

Commercial boating records, including use levels and season of use


Pine Flat
TRIANNON CAMPGROUND
CAMPGROUNDS -
- SYCAMORE FLAT
- NO. 2
- LAKEVIEW
BRIDGE
WHITEWATER BOATING RUN
PUT IN = BACH CAMP
TAKE OUT = MAMA KING'S
CLASS V- @ 400-800
V @ 7800

Pine Flat 7.5



Field Trip Log – Land Use		
Trip Log Number:	S6	**Project No.:** 8004094
Dates:	May 29, 2002	
Site Name:	Pine Flat Dam	
Location:	Pine Flat Reservoir, Kings River	
Prepared By:	Irina Torrey	
Date:	June 12, 2002	

Weather Conditions:	Hot and dry
Areas Covered (attach map with notations	Pine Flat Reservoir from dam to North Fork Kings confluence
Attachments	
Photo Log	No
Photos	No
Topographic Map(s)	No

Field Observations:

Existing Facilities:

This measure would involve increasing the size of Pine Flat Dam, thereby enlarging Pine Flat Reservoir. Existing facilities include: Pine Flat Dam, a hydroelectric power plant and ancillary facilities, Pine Flat Reservoir, PG&E's Kings River Powerhouse and ancillary facilities, transmission towers and lines, paved and unpaved access roads, a bridge at the upper end of the reservoir, and developed recreation facilities.

Existing Environmental Features as Appropriate to Discipline (hydrology; aquatic-water quality; terrestrial—plants; wildlife; recreation; cultural resources; land use; aesthetic)

This reservoir is owned and by the Army Corps of Engineers (COE) and the Kings River Conservation District (KRCD). The north side of the reservoir is bordered mainly by land managed by the COE and to a lesser extent, public lands managed by the Sierra National Forest. The south side of the reservoir is bordered by private land, and public lands managed by the Sequoia National Forest and the BLM. A mobile home park is located close to the Reservoir. It is unkown how many other private residences are on the south side of the reservoir.

Need for additional (engineering/hydrological, or other) information on measures

Need information on inundation area

Additional data needs (within each specific discipline)

Need information on the existence and the number of houses and any other private uses on the south side of the reservoir.

Field Trip Log – Cultural Resources		
Trip Log Number:	S6	**Project No.:** 8004094
Dates:	May 29, 2002	
Site Name:	Pine Flat Dam	
Location:	Pine Flat Reservoir, Kings River	
Prepared By:	David White	
Date:	May 29 2002	

Weather Conditions:	Hot & dry
Areas Covered (attach map with notations)	Aerial reconnaissance May 29
Attachments	
Photo Log	Yes – MWH 0205
Photos	Yes – nos. 31-35
Topographic Map(s)	Pine Flat Dam, Trimmer, Sacate Ridge, Luckett Mountain quads

Field Observations:

Existing Facilities:

Existing Pine Flat Dam; roads, residences, recreational facilities around the lake.

Existing Environmental Features as Appropriate to Discipline (hydrology; aquatic-water quality; terrestrial—plants; wildlife; recreation; cultural resources; land use; aesthetic)

Cultural resources:

Prehistoric: Permanent stream (Kings River) along with riparian woodland, Blue Oak on adjacent slopes, would have provided diverse natural resources. High probability of prehistoric archaeological sites including BRM stations, hunting & fishing camps, seasonal village sites.

Historic: Various sites likely, associated with mining, logging, hydroelectric development, recreation and other activities.

Need for additional (engineering/hydrological, or other) information on measures

Need precisely mapped footprint of reservoir, with various potential dam levels; also need footprint of all associated ground disturbance areas, to include but not be limited to offices and maintenance buildings, construction set-up and lay-down areas, access roads, electric transmission lines, water conveyance structures, and all other facilities.

Additional data needs (within each specific discipline)

Need archaeological records search with California Historic Resources Inventory System (CHRIS) information center. Clearinghouse: Southern San Joaquin Valley Info Center, CSU-Bakersfield.

Need consultation with USFS cultural resource specialists (Sierra and Sequoia National Forests) regarding sites that may not be recorded with the CHRIS information center.

Also need brief review of archaeological and ethnographic literature pertaining to the area. Minimal level of effort: (1) to identify types of archaeological remains expected, time periods represented; and (2) to identify Native American tribes historically occupying the area, along with published information on major named villages or other ethnographic sites.

Picture: P5290044 Pine Flat Reservoir, May 29, 2002, afternoon

Picture: P5290045 Pine Flat Reservoir, May 29, 2002, afternoon

Picture: P5290046 Pine Flat Reservoir, May 29, 2002, afternoon

Picture: P5290048 Air photo of Pine Flat looking northeast

Pine Flat Reservoir, view SW, 5/29/02

Pine Flat Reservoir, view SE, with marina, 5/29/02

Pine Flat Dam, view NE, 5/29/02

Pine Flat Dam, view N, 5/29/02

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APPENDIX C

Cost Estimate Summary

Raise Pine Flat Dam

Upper San Joaquin River Basin Storage Investigation	
Cost Estimate	
RAISE PINE FLAT SURFACE STORAGE OPTION	
20 foot raise in maximum gross pool elevation Based on 1974 IECO study. Costs updated to 2002.	
FIRST COST ITEMS	**ESTIMATED COST**
DAMS	
Raise Dam, Replace Gates, Reshape Spillway	$ 24,150,000
SUBTOTAL	**$ 24,150,000**
PERMANENT OPERATING EQUIPMENT	
Powerplants, generators & turbines	$ 1,000,000
SUBTOTAL	**$ 1,000,000**
TOTAL ITEMIZED COSTS (rounded)	**$ 25,200,000**
UNLISTED ITEMS (estimated at 15%; rounded)	**$ 3,800,000**
SUBTOTAL (rounded)	**$ 29,000,000**
CONTINGENCIES ON CONSTRUCTION (estimated at 25%; rounded)	**$ 7,000,000**
SUBTOTAL	**$ 36,000,000**
MITIGATION (estimated at 5%; rounded)	**$ 2,000,000**
TOTAL FIELD COSTS (excluding lands, damages, relocations)	**$ 38,000,000**
INVESTIGATION, DESIGN, & CONSTRUCTION MGMT (est. 15%; rounded)	**$ 6,000,000**
TOTAL FIRST COST	**$ 44,000,000**

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