FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR COTTONWOOD CREEK RESERVOIR COMPLEX

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for Cottonwood Creek Reservoir Complex* has been prepared as part of the Storage and Conveyance Component Refinement Task of the CALFED Bay-Delta Program (CALFED or Program). CALFED's mission is to develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) system.

This report summarizes the principal features, estimated costs, and environmental considerations of constructing the Cottonwood Creek Reservoir Complex. This project would include two reservoirs, Dutch Gulch and Tehama Reservoirs. This evaluation and others being performed by CALFED are intended to provide a facilities evaluation and updated cost estimates of representative storage and conveyance components. The specific objectives of the Cottonwood Creek Reservoir Complex evaluation are (1) to provide an updated cost estimate which represents a cost within the range expected if the project were to be constructed today and (2) to enable CALFED to equally compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The cost estimate for the Cottonwood Creek Reservoir Complex was determined by escalating the costs in the U.S. Army Corps of Engineers (COE) May 1983 report *Cottonwood Creek, California, Draft General Design Memorandum: Phase I Plan Formulation* (*Draft General Design Memorandum*). The cost estimates presented by the COE in that report have been reviewed and adopted for this evaluation. Modifications have been made to reflect current design and safety standards where appropriate.

A preliminary evaluation of the environmental considerations associated with this project has also been included in this report. Fish, wildlife, plant, and cultural resources that could be affected

have been described and potential impacts have been identified. The information for the evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Early studies for water development on the Sacramento River system on Cottonwood Creek were performed by the Bureau of Reclamation (Reclamation) in the mid-1940s. Reclamation identified a combination of three potential dam sites on the north fork, middle fork, and south fork of Cottonwood Creek that would capture runoff from a 425-square-mile watershed. The resulting reservoir would have a total storage capacity of 380,000 acre-feet.

In 1957, the California Department of Water Resources (DWR) released *The California Water Plan* (Bulletin No. 3), which identified a four reservoir project on Cottonwood Creek for local use and flood control. This project configuration would capture runoff from a 607-square-mile watershed and have a total storage capacity of 486,000 acre-feet. Later studies completed by DWR as part of the *Upper Sacramento River Basin Investigation* (Bulletin No. 150) indicated that only two of the four reservoirs were justifiable from an economic standpoint. This two reservoir configuration would capture runoff from a 213-square-mile watershed and have a total storage capacity of 207,000 acre-feet.

In 1965, the COE began a comprehensive study of the Cottonwood Creek Basin as part of the Northern California Streams surveys authorized by Public Law (PL) 87-874, the Flood Control Act of 1962. The COE examined the previously identified sites, but selected two new sites much lower in the basin than those considered in earlier studies. This project configuration included Dutch Gulch Reservoir on the mainstem Cottonwood Creek, with a gross storage of 1,100,000 acre-feet, and Tehama Reservoir on South Fork Cottonwood Creek, with a gross storage of 900,000 acre-feet. Combined these two projects will provide 1,450,000 acre-feet of conservation storage and almost 500,000 acre-feet of flood control storage.

In May 1983, the COE released a new report, *Cottonwood Creek, California, General Design Memorandum: Phase I Plan Formulation*, which recommended Dutch Gulch Reservoir with a total storage of 900,000 acre-feet and a Tehama Reservoir with a total storage of 700,000 acre-feet. The reservoir configuration presented in the COE May 1983 report is the basis of this analysis.

In June 1984, DWR initiated a reconnaissance study of potential water projects in the Cottonwood Creek Basin as possible alternatives to the Dutch Gulch and Tehama Reservoirs authorized by the COE. The results of this investigation were presented in DWR's May 1985 report *Cottonwood Creek Alternatives*. This report considered a new project configuration of three reservoirs not included as part of the recommended project in the 1983 COE study.

FACILITIES DESCRIPTION

This section provides an overview of the major features of the Cottonwood Creek Reservoir Complex. The principal reference used for this synopsis is the COE's *Draft General Design Memorandum*, which provides a cost estimate and facilities description for constructing the Dutch Gulch and Tehama Reservoirs as components of the Cottonwood Creek Reservoir Complex.

PROJECT LOCATION

The Cottonwood Creek Reservoir Complex would be located on the mainstem of Cottonwood Creek and on the South Fork Cottonwood Creek about 15 miles west of the confluence with the Sacramento River (Figure 1). Cottonwood Creek flows west out of the Coast Range to the Sacramento River. The mainstem of Cottonwood Creek is the boundary between Shasta and Tehama Counties. The drainage area includes about 930 square miles in Shasta and Tehama Counties, making it the largest unregulated stream system in the northern Sacramento Valley. From 1922 to 1978, the average annual runoff of Cottonwood Creek was about 543,500 acre-

feet. Elevations within the drainage area range from a few hundred feet to 8,000 feet above mean sea level (MSL). Dutch Gulch Reservoir would be located on the mainstem of Cottonwood Creek about 15 miles from the confluence with the Sacramento River. Tehama Reservoir would be located on the South Fork Cottonwood Creek about 12 miles from the confluence with the Sacramento River.

The dam sites would be located within the northern edge of the Great Valley geomorphic province. This area is covered by semiconsolidated and unconsolidated Pleistocene and Pliocene sediments. These sediments are in turn underlain by Cretaceous marine sediments of the Coast Range. This area is one of the most seismically stable in the state, with no known earthquake-generating faults located in the area.

PROJECT DESCRIPTION

The two reservoirs included as part of the Cottonwood Creek Reservoir Complex would provide on-stream storage of surplus water on Cottonwood Creek. The three primary purposes for the Cottonwood Creek Reservoir Complex are (1) to provide additional flood protection for the lower Cottonwood Creek and in the Butte Basin along the Sacramento River; (2) to increase water supply opportunities from the Cottonwood Creek watershed; and (3) to provide additional drought year water supplies for agricultural, environmental, and urban uses in the Bay-Delta. This would be accomplished by storing excess flows that would otherwise enter the Sacramento River and the Sacramento-San Joaquin Delta.

EXISTING FACILITIES

There are no existing facilities within the study area, but there are water supply facilities upstream and downstream of the project area. Rainbow Lake is located on the North Fork Cottonwood

Creek about 20 miles upstream of the Dutch Gulch dam site. Rainbow Lake has a 4,800 acre-foot capacity and is utilized by the Igo-Ono area for irrigation and related purposes.

The Anderson-Cottonwood Irrigation District, located downstream of the project area, serves about 32,000 acres in Tehama and Shasta Counties, including the communities of Anderson and Cottonwood. Approximately 12,000 acres lie in the Cottonwood Creek basin. The district diverts up to 175,000 acre-feet of water annually from the Sacramento River near Redding.

PRINCIPAL FACILITIES

This section provides an overview of the major features associated with the Cottonwood Creek Reservoir Complex. The features include the facilities at both the Dutch Gulch Reservoir and Tehama Reservoir. The features at Dutch Gulch Reservoir include the main dam, spillway, main outlet works, and generating plant. The features at Tehama Reservoir include the main dam, spillway, outlet works, eight saddle dams, and generating plant. The principal reference used for this synopsis is the COE's *Draft General Design Memorandum.* The principal facilities involved in the Cottonwood Creek Complex area listed on Table 1 and shown in Figure 2.

Dutch Gulch Reservoir

The reservoir would have a gross pool elevation of 740 feet above MSL with a corresponding storage volume of 900,000 acre-feet. The reservoir would have a surface area of 11,200 acres at the gross pool elevation. The area-capacity curves for Dutch Gulch Reservoir are shown on Figure 3a. Figure 4 shows a schematic representation of the Dutch Gulch Reservoir.

At this site, the upstream drainage area totals about 390 square miles and has an average annual runoff of 292,000 acre-feet per year. This represents 54 percent of the total runoff from Cottonwood Creek to the Sacramento River.

Main Dam

The Dutch Gulch Reservoir would be formed with a rockfill dam rising 247 feet above the existing streambed with an embankment volume of 48.9 million cubic yards. The crest length of the dam would be 20,700 feet at an elevation of 758 feet above MSL. The impervious core of the dam would be founded in a wide core trench excavated to the Tehama Formation. A 10-foot-wide vertical drain is included in the design to control minor seepage through the dam, and a horizontal drainage blanket would discharge embankment seepage at the downstream toe of the dam to minimize surface foundation pore pressure. The upstream slope of the dam would be covered by a 15-inch-thick layer of riprap to protect against wind-generated waves. The downstream slope would be covered with a 12-inch-thick layer of riprap to protect against erosion from storm runoff.

Spillway

The spillway would be located on the right reservoir rim about two miles west of the right abutment of the dam. The spillway crest would be at the gross pool elevation (740 feet MSL). The spillway would consist of an unlined trapezoidal approach channel approximately 1,275 feet long and an ungated 800-foot-wide, rectangular concrete low ogee section. The spillway capacity would be 136,000 cfs, equivalent to the Probable Maximum Flood (PMF). The spillway would lead to a stilling basin which would have a 1,800-foot-long, riprapped exit channel discharging into Moboy Gulch, a natural channel draining into Cottonwood Creek about four miles downstream of the dam.

Outlet Works

The outlet works would be located adjacent to the right abutment of the dam and would consist of an intake structure, control tower with access bridge, oblong cut-and-cover conduit, and

stilling basin. The control tower would have a multiple-level intake to control the temperature of downstream releases. The *Draft General Design Memorandum* sized the outlet works for 10,000 cfs. This has been increased to 12,760 cfs to provide the capacity needed for the DWR Division of Safety of Dam's emergency drawdown criteria (discussed further below).

Generating Plant

The generating plant at the base of the outlet works would include three turbines with a combined power generating capacity of 17.6 megawatts.

Facility Relocations

As of 1983, this part of the Sacramento Valley was sparsely populated, and the Dutch Gulch Reservoir inundation area did not include residences or businesses. Relocations of some utilities and cemeteries would be required, along with approximately 18 miles of roads.

Tehama Reservoir

Tehama Reservoir would have a gross pool elevation of 696 feet above MSL with a corresponding storage volume of 700,000 acre-feet. The reservoir would have a surface area of 10,200 acres at the gross pool elevation. The dam site would be located just downstream of the confluence of Dry Creek and South Fork Cottonwood Creek. At this site, the upstream drainage area totals about 370 square miles and has an average annual runoff of 188,000 acre-feet. This represents 34 percent of the total runoff from Cottonwood Creek to the Sacramento River. The area-capacity curves for Tehama Reservoir are shown on Figure 3b. Figure 4 shows a schematic representation of the Tehama Reservoir.

Main Dam

The Tehama Reservoir would be formed with a rockfill dam rising 215 feet above the existing streambed with an embankment volume of 31.2 million cubic yards. The crest length of the dam would be 23,000 feet at an elevation of 714 feet above MSL. The impervious core of the dam would be founded in a wide core trench excavated to the Tehama Formation. A 10-foot-wide vertical drain is included to control minor seepage through the dam and a horizontal drainage blanket would discharge embankment seepage at the downstream toe of the dam to minimize surface foundation pore pressure. The upstream slope of the dam would be covered with a 15-inch-thick layer of riprap to protect against wind-generated waves. The downstream slope would be covered with a 12-inch-thick layer of riprap to protect it against erosion from storm runoff.

Saddle Dams

A total of eight saddle dams ranging in height from 40 to 80 feet would be required for this facility. The two largest saddle dams would have the same cross section as the main dam, except that the downstream toe drain would be omitted. The central core of all the saddle dams would be founded in core trenches excavated to stiff clay or silt layers within the Tehama Formation.

Spillway

The spillway would be located on the right reservoir rim immediately upstream of the right abutment. The spillway crest would be at the gross pool elevation (696 feet MSL). The spillway would consist of an unlined trapezoidal approach channel approximately 1,400 feet long and an ungated 800-foot-wide, rectangular, concrete low ogee section with a capacity of 129,500 cfs, equivalent to the PMF. The spillway would lead to a stilling basin that would have a 1,400-foot-long, riprapped exit channel discharging into Mitchell Gulch. Mitchell Gulch is a natural channel

draining into South Fork Cottonwood Creek about two-and-one-half miles downstream of the dam.

Outlet Works

The outlet works would be located adjacent to the right abutment and would consist of an intake structure, a control tower with access bridge, an oblong cut-and-cover conduit, and a stilling basin. The control tower would have a multiple-level intake to control the temperature of downstream releases. The *Draft General Design Memorandum* sized the outlet works for 6,000 cfs. This has been increased to 10,080 cfs to provide the capacity needed for the DWR Division of Safety of Dam's emergency drawdown criteria (discussed further below).

Generating Plant

The generating plant at the base of the outlet works would include three turbines with a combined power generating capacity of 7.8 megawatts.

Facility Relocations

As of 1983, this part of the Sacramento Valley was sparsely populated, and the Tehama Reservoir inundation area did not include residences or businesses. Relocations of some utilities and cemeteries would be required. Approximately 30 miles of roads and two bridges would require relocation.

Emergency Release

In the event of potential emergency conditions, the outlet works and spillway must be capable of evacuating 10 percent of the maximum water depth within ten days as required by DWR's

Division of Safety of Dams. Dutch Gulch Reservoir would have an ungated spillway and is assumed to be unable to contribute to the emergency release. With this criterion, the emergency drawdown flow for Dutch Gulch Reservoir would be 12,760 cfs for 10 days. All of this flow would be assumed to pass through the outlet works.

Tehama Reservoir also has an ungated spillway and would be unable to contribute to the emergency release. To meet the emergency drawdown criterion, the outlet works at Tehama Reservoir would need to release 10,080 cfs.

Both of the emergency drawdown flows for the proposed reservoirs are less than historical maximum observed flows on Cottonwood Creek. The maximum recorded flow on Cottonwood Creek at Cottonwood was 86,000 cfs in March 1983.

COST ESTIMATE

The cost estimates for the facilities identified in the previous sections are based on the COE's May 1983 *Draft General Design Memorandum.* Project costs not identified in the COE report are not included in the present updated cost estimate. Some of these additional costs include environmental documentation, operation and maintenance, power, filling of the reservoir, recreational development, and interest during construction.

COST ESTIMATE METHODOLOGY

The 1983 COE cost estimates have been reviewed and adopted for the present cost estimate update. Several items in the previous cost estimates were modified to ensure that current design standards and safety factors were incorporated.

General

The cost estimates for the Dutch Gulch and Tehama Reservoirs were determined by escalating the costs provided in the 1983 COE report to October 1996 dollars using the Reclamation's Construction Cost Trends (CCT) indices. Table 2 provides a detailed breakdown of the estimated costs of Dutch Gulch and Tehama Reservoirs, respectively. These tables also include an updated cost estimate for each cost item identified in the previous cost estimates, along with the quantities of the cost item or an indication that the estimated cost has been developed through a lump sum approach. The table also includes the CCT index for the month and year in which the estimated cost was developed and for October 1996. The Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Table 2 provides the cost reference for each cost item.

Right-of-Way Costs

Right-of-way costs of $1,500 per acre were based on land use costs developed by the Reclamation, Land Resource Branch (pers. comm. February 1997). The total project lands to be acquired would include a buffer around the maximum water surface area. The ratio of total project land to maximum water surface area used in the cost estimate is 1.32 based on data from the September 1990 *Los Banos Grandes Facility Feasibility Report, Appendix A: Design and Cost Estimates* by DWR.

Outlet Capacity Adjustments

The river outlet works for Dutch Gulch and Tehama Reservoirs as sized in COE's *Draft General Design Memorandum* can release 10,000 cfs and 6,000 cfs, respectively. To comply with DWR's Division of Safety of Dams, the release capacities were resized to 12,760 cfs and 10,080 cfs for

Dutch Gulch and Tehama Reservoirs, respectively. To develop cost estimates for the resized outlet works, the cost estimates for the original outlet works were factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{Q_1^{3/4}}{Q_2^{3/4}}$$

This cost factor formula is typically valid over moderate ranges in capacity; the validity over larger ranges is undetermined. However, because the estimated cost of the outlet works is a relatively low percentage of the total project cost, the impact of any error resulting from utilizing this ratio beyond its valid range is considered to be within the range of the accuracy of the estimate.

Pumping-Generating Plant Costs

The pumping-generating plant cost estimates are based on actual construction costs for the Waddell Pumping-Generating Plant in Arizona, which was completed in 1994 and is similar in size and scope to the generating facilities. To develop a cost for the generating facilities, the actual construction cost of the Waddell Pumping-Generating Plant (escalated to October 1996 dollars) was factored by the following empirical equation:

$$\frac{(Cost)_1}{(Cost)_2} = \frac{HP_1^{6/10}}{HP_2^{6/10}}$$

This cost factor formula is typically valid over moderate ranges in horsepower; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is also expected to be within the range of the accuracy of the estimate.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by historical engineering judgment based on a similar level of cost estimation. Contingencies were chosen to be 20 percent, and engineering, construction management, and administration were chosen to be 35 percent. A cost range was developed for the project by subtracting 10 percent from the estimated capital cost for the low end cost and adding 15 percent to the estimated capital cost for the high end.

PRELIMINARY COST FINDINGS

The 900,000 acre-foot Dutch Gulch Reservoir and 700,000 acre-foot Tehama Reservoir would consist of new earthfill dams and associated facilities. The total cost of this project is estimated to range from $1,086 to $1,388 million. A detailed estimate of the cost of this facility is provided in Table 2. Table 3 provides a summary of the costs of the principal project features.

ENVIRONMENTAL CONSIDERATIONS

This portion of the report provides a summary of environmental considerations related to the Cottonwood Creek Reservoir Complex. Fish, wildlife, plant, and cultural resources that could be affected by the proposal are described and the extent of the impacts identified. For the most part, the information presented in this section was gathered from existing literature, with limited original research. No field work was conducted for this analysis.

WILDLIFE

The Cottonwood Creek Reservoir Complex would inundate approximately 21,400 acres of terrestrial wildlife habitat within the Cottonwood Creek basin. The most significant effect on

wildlife habitat associated with the Cottonwood Creek Reservoir Complex (Dutch Gulch and Tehama Reservoirs) would be the loss of approximately 1,600 acres of riparian habitat along Cottonwood Creek and its associated drainages, which is considered breeding habitat for many species of reptiles, amphibians, birds, and mammals.

Fish, Amphibians, Reptiles, and Invertebrates

The streams that run through the Cottonwood Creek watershed provide aquatic life zones for rainbow trout, California roach, Sacramento squawfish, Sacramento sucker, and hardheads. The principal game fish in the project area are chinook salmon, steelhead trout, and smallmouth bass. Other fish species that can be found in the project area include brown bullhead, green sunfish, carp, bluegill, dace, mosquitofish, and sculpin.

Approximately 130 miles of stream system within the Cottonwood Creek basin are accessible to anadromous fish. The project would adversely affect anadromous fish reproduction by blocking fish passage to the spawning areas in the basin. Without compensation measures in addition to adequate flow releases, the project could ultimately result in an average annual loss of 1,600 chinook salmon and 1,000 steelhead trout. Project operations and lack of gravel recruitment from the upstream areas could adversely affect an additional 2,700 salmon as a result of disturbance of spawning, incubation, and rearing habitat in the areas downstream of the dam. The project will also eliminate approximately 40 miles of smallmouth bass habitat and reduce productivity for sucker and squawfish.

Fish production in the Sacramento River and in the Delta could also be affected by the Cottonwood Creek Reservoir Complex. Reductions in productivity of anadromous and resident fish could occur as a result of the higher temperatures, increased turbidities, and reduced food production caused by reservoir releases and increased current velocities. Striped bass and American shad reproduction might be enhanced because of increased amounts of nutrients

transported to the lower river, which could improve the productivity of their food sources. Reproduction of Sacramento River and Delta resident fish could be enhanced when higher flows increase the size of life-supporting and food-production areas.

General Wildlife

Lands within the reservoir complex area support a moderately diverse wildlife population. Open grasslands and riparian areas along the basin's drainages provide yearling and winter deer use. The habitat value for deer is high and supports approximately 300,000 deer-use days. Other game species in the project area include Canada geese, wood ducks, mergansers, quail, turkeys, and about 15 species of furbearers. Nongame species include approximately 130 species of songbirds, birds of prey (bald eagle, osprey, and other raptors), rodents, eight species of amphibians, reptiles, and invertebrates.

Wildlife habitat losses resulting from the project would adversely affect deer, turkey, quail, waterfowl, and other wildlife populations using the area. Additional habitat losses could be expected in areas such as Deer Creek,where construction materials could be obtained.

Sensitive and Listed Fish and Wildlife Species

The winter-run-chinook salmon (federal endangered) and its critical habitat could be directly affected by the Cottonwood Creek Reservoir Complex. The downstream effects of the project may have an adverse effect on the Delta smelt (federal threatened) and the Sacramento splittail (proposed federal threatened).

The California red-legged frog (federal threatened) has been known to occur within the Cottonwood Creek Reservoir Complex area and could be impacted by the project.

Vernal pool habitats, if present, have the potential to support fairy shrimp, listed as federal threatened. It may also be possible that the valley elderberry longhorn beetle (federal threatened) could occur at this site.

Several federally listed bird species have the potential to occur within the project area; these include American peregrine falcon, Aleutian Canada goose, and northern spotted owl (all federal threatened). It is also possible that the area may receive sporadic use by wintering bald eagles, which is also listed as federal threatened.

Wildlife species that are candidates for federal listing that could be affected directly or indirectly by the project include foothill yellow-legged frog, western spadefoot toad, northwestern pond turtle, green sturgeon, river lamprey, longfin smelt, Antioch Dunes anthicid beetle, Sacramento anthicid beetle, spotted bat, small-footed myotis bat, long-eared myotis bat, fringed myotis bat, Yuma myotis bat, San Joaquin pocket mouse, pale Townsend's big-eared bat, Pacific western big-eared bat, Bell's sage sparrow, western burrowing owl, ferruginous hawk, little willow flycatcher, and white-faced ibis.

VEGETATION

Vegetation at the Cottonwood Creek Reservoir complex consists primarily of foothill woodland. Other plant associations found here include chaparral, valley grassland, yellow-pine forest, and red-pine forest. Some valley needlegrass grassland communities may be found in the area. Approximately 1,600 acres of riparian vegetation ~~are found~~ would be within the area directly affected by the project, the majority consisting of sycamore, willow, and cottonwood.

Sensitive and Listed Plant Species

While no listed plant species have been recorded in the Cottonwood Creek Reservoir Complex area to date, further surveys would be needed to make a final determination.

Two plants, Red Bluff dwarf rush and dimorphic snapdragon, considered by the California Native Plant Society to be either rare, threatened, or endangered in California and elsewhere, may occur with the Cottonwood Creek Reservoir Complex.

Additional sensitive plants that would be impacted should they be found to occur with the area of the project are silky cryptantha (federal candidate), and Ahart's whitlow-wort (federal candidate).

Wetlands

Within the reservoir sites, there are approximately 53 miles of intermittent streambed, 27 miles of upper perennial stream, one mile of saturated forested semipermanent wetland (deep marsh), 28 acres of forested temporary flooded wetlands (wet meadow), seven acres of temporarily flooded wetlands (wet meadow), and four acres of open water, saturated wetland (deep marsh).

CULTURAL RESOURCES

Cultural resources within the project area consist of 33 nonsignificant and 173 significant prehistoric sites, 160 nonsignificant and 73 significant historic sites, and 19 ethnographic sites.

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Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
COTTONWOOD CREEK RESERVOIR COMPLEX

	Dutch Gulch Reservoir	Tehama Reservoir
Reservoir		
Gross Pool Elevation (feet MSL)	740	696
Capacity at Gross Pool Elevation (acre-feet)	900,000	700,000
Inundation Area (acres)	11,200	10,200
Main Dam		
Type	Rockfill	Rockfill
Height above Streambed (feet)	247	215
Top of Dam (feet MSL)	758	714
Embankment Volume (million cubic yards)	48.9	31.2
Freeboard (feet)	4.2	3.8
Downstream Face Slope (horizontal on vertical)	3:1	3:1
Upstream Face Slope (horizontal on vertical)	3.5:1	3.25:1
Minimum Pool (acre-feet)	30,900	29,100
Saddle Dams		
Number Required	-	8
Outlet Works		
Capacity (cfs)	12,760	10,080
Power Generation		
Capacity (MW)	17.6	7.8
Spillway		
Width (feet)	800	800
Capacity (cfs)	136,000	129,500
Invert Elevation (feet MSL)	740	696
Stilling Basin		
Capacity (cfs)	12,760	10,080
Invert Elevation (feet MSL)	490	479

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
DUTCH GULCH RESERVOIR (900 TAF)								
I. LAND AND DAMAGES								
Reservoir Lands (11,200 x 1.32)	14,780	AC				$1,500	$22,170,000	1
Lands Downstream of Spillway	2,490	AC				$1,500	$3,735,000	1
Lands for Borrow								
Dredger Tailing (Dry Creek)	830	AC	148	217	$600	$880	$730,176	2, D-101
Quarry	35	AC	148	217	$400	$586	$20,527	2, D-101
Improvements	29	EA	148	217	$60,000	$87,973	$2,551,216	2, D-101
Severance Damages	Jpb	LS	148	217	$1,770,000	$2,595,203	$2,595,203	2, D-101
Relocation Costs:								
Houses and Related Structures	29	EA	148	217	$15,000	$21,993	$637,804	2, D-101
Farms and Ranches	29	EA	148	217	$10,000	$14,662	$425,203	2, D-101
Acquisition Cost	102	EA	148	217	$3,500	$5,132	$523,439	2, D-101
SUBTOTAL LANDS AND DAMAGES							$33,389,000	
II. RELOCATIONS								
Roads:								
Relocate Gas Point Road (paved 2-lane)	8.3	MI	154	219	$700,000	$995,455	$8,262,273	2, D-102
Relocate Road for Ranchers (gravel 2-lane)	6	MI	162	237	$140,000	$204,815	$1,228,889	2, D-102
Utilities and Cemeteries:								
Relocate Powerline (115 kV on Double Wood Poles)	13	MI	141	234	$85,000	$141,064	$1,833,830	2, D-102
Relocate Power Distribution Line (Single Wood Pole)	6.6	MI	141	234	$55,000	$91,277	$602,426	2, D-102
along Gas Point Road								
Relocate Telephone Line (Underground)	6.6	MI	141	234	$40,000	$66,383	$438,128	2, D-102
Relocate Gas Point Cemetery	110	EA	148	217	$900	$1,320	$145,155	2, D-102
Relocate Tuttle Gulch Cemetery	50	EA	148	217	$900	$1,320	$65,980	2, D-102
Remove Powerline, Wood Pole (Gas Point Road)	8	MI	141	234	$17,500	$29,043	$232,340	2, D-102
Remove Powerline, Wood Pole (Along Shasta and								
Tehama County Line)	6	MI	141	234	$17,500	$29,043	$174,255	2, D-102
Remove Powerline (115 kV on Double Wood Poles)	8.5	MI	141	234	$27,500	$45,638	$387,926	2, D-102
SUBTOTAL RELOCATIONS							$13,371,000	
III. RESERVOIRS								
Clearing, Moderate to Heavy (includes Fences, Culverts,								
Bridges, etc.	11,200	AC				$1,097	$12,286,400	3, IV-a
Boundary Fencing	69	MI	142	176	$10,000	$12,394	$855,211	2, D-102
Boundary Surveys and Markers	Job	LS	142	176	$825,000	$1,022,535	$1,022,535	2, D-103
SUBTOTAL RESERVOIRS							$14,164,000	

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
DUTCH GULCH RESERVOIR (900 TAF)								
IV. DAMS								
Main Dam (Crest Elevation 758.6)								
Diversion and Care of Water	Job	LS	135	159	$675,000	$795,000	$795,000	2, D-103
Dewatering for Foundation Excavation								
Drilling 4" Holes	25,000	LF	135	159	$5.00	$5.89	$147,222	2, D-103
Well Points (1,240 ea. (Pumps and Power Complete)	Job	LS	135	159	$930,000	$1,095,333	$1,095,333	2, D-103
Excavation								
Stripping	2,472,400	CY	135	159	$1.30	$1.53	$3,785,519	2, D-103
Core Trench	2,130,500	CY				$3.23	$6,881,515	3, I-d
Right Abutment Slope Flattening	401,000	CY	135	159	$1.25	$1.47	$590,361	2, D-103
Slurry Trench (6'W x 30"D)	69,000	SY	135	159	$80.00	$94.22	$6,501,333	2, D-103
Borrow Area Upstream								
Tehama Formation (2.4 Mile)	19,561,300	CY	135	159	$1.45	$1.71	$33,406,353	2, D-103
Terrace Gravels (2.5 Mile)	19,776,000	CY	135	159	$1.40	$1.65	$32,608,427	2, D-103
Alluvium & Floodplain Deposits (2.6 Mile)	3,869,900	CY	135	159	$1.45	$1.71	$6,608,929	2, D-103
Borrow Area Upstream and Downstream								
Plant Set Up No. 1	1,576,000	CY	135	159	$6.05	$7.13	$11,229,876	2, D-104
Plant Set Up No. 2	4,068,400	CY	135	159	$3.55	$4.18	$17,010,432	2, D-104
Borrow Rock Quarry								
Develop Quarry	JOB	LS	135	159	$350,000	$412,222	$412,222	2, D-104
Plant Set-Up No. 3	530,100	CY	135	159	$12.00	$14.13	$7,492,080	2, D-104
Embankment								
Impervious Material	7,753,700	CY	135	159	$1.55	$1.83	$14,154,810	2, D-104
Random I	18,122,200	CY	135	159	$0.85	$1.00	$18,142,336	2, D-104
Random II	15,465,300	CY	135	159	$1.25	$1.47	$22,768,358	2, D-104
Transition	1,109,500	CY	135	159	$0.85	$1.00	$1,110,733	2, D-104
Filter	48,400	CY	135	159	$1.75	$2.06	$99,758	2, D-104
Drainage Fill	1,276,600	CY	135	159	$0.70	$0.82	$1,052,486	2, D-104
Select	3,423,600	CY	135	159	$0.75	$0.88	$3,024,180	2, D-105
D/S Rock Slope Protection	248,600	CY	135	159	$1.30	$1.53	$380,634	2, D-105
Riprap	381,700	CY	135	159	$0.75	$0.88	$337,168	2, D-105
D/S Toe Fill	1,063,000	CY	135	159	$0.80	$0.94	$1,001,582	2, D-105
Relief Wells								
Drilling 14" Dia. Drain Holes	103,000	LF	135	159	$10.00	$11.78	$1,213,111	2, D-105
Set-Ups and Development of Wells	1,054	EA	135	159	$2,000	$2,356	$2,482,756	2, D-105
8" Dia. PVC Pipe and Miscellaneous Items	103,000	LF	135	159	$20.00	$23.56	$2,426,222	2, D-105
3" Thick Annular Gravel Filter	4,400	TON	135	159	$40.00	$47.11	$207,289	2, D-105
Collector Ditch	21,000	LF	135	159	$15.00	$17.67	$371,000	2, D-105
Feeder Pipe	JOB	LS	135	159	$50,000	$58,889	$58,889	2, D-105

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
DUTCH GULCH RESERVOIR (900 TAF)								
D/S Drainage Blanket								
Clearing and Grubbing	131,400	SY	135	159	$1.75	$2.06	$270,830	2, D-105
Filter Gravel	35,200	TON	135	159	$8.50	$10.01	$352,391	2, D-105
Drain Rock Course Aggregate	256,000	TON	135	159	$8.00	$9.42	$2,412,089	2, D-105
Road Surfacing, Stabilized Aggregate Base	10,100	TON				$19.15	$193,415	3, V-d
Instrumentation	JOB	LS	135	159	$1,180,000	$1,389,778	$1,389,778	2, D-105
Construction Facilities	JOB	LS	135	159	$675,000	$795,000	$795,000	2, D-105
SUBTOTAL DAMS							$202,809,000	
V. SPILLWAY - 800' OGEE								
Excavation Unclassified	5,199,800	CY				$4.03	$20,955,194	3, Avg. II-a & III-a
Backfill	4,400	CY				$8.17	$35,948	3, III-f
Derrick Stone	53,300	CY	147	186	$11.00	$13.92	$741,849	2, D-106
Riprap	222,300	CY				$31.64	$7,033,572	3, I-n
Drainage Filter Material								
Behind Wall	310	CY				$8.54	$2,647	3, Avg. I-i & I-j
Under Floor Slabs	4,200	CY				$8.54	$35,868	3, Avg. I-i & I-j
Concrete								
Wing Walls	460	CY				$365	$168,010	3, Avg. II-h, III-c, III-d
Ogee Section								
Mass Concrete	23,280	CY				$293	$6,823,135	3, III-d
Walls	360	CY				$365	$131,486	3, Avg. II-h, III-c, III-d
Chute and Stilling Basin	5,150	CY				$365	$1,880,986	3, Avg. II-h, III-c, III-d
6" Dia. Perforated Drain Pipe	140	LF	147	186	$10.00	$12.65	$1,771	2, D-106
Handrail	380	LF	147	186	$20.00	$25.31	$9,616	2, D-106
SUBTOTAL SPILLWAY							$37,820,000	
VI. OUTLET WORKS, POWER INTAKE WORKS, POWERHOUSE, AND WATER QUALITY OUTLET WORKS								
Excavation Unclassified	218,700	CY				$6.76	$1,478,412	3, VI-i
Riprap	16,100	TON				$14.09	$226,849	3, III-g
Control Tower and Intake Structure								
Concrete								
Intake Structure								
Below Invert	320	CY				$270	$86,544	3,VI-j
Above Invert	990	CY				$340	$336,105	3, VI-k
Log Rack	40	CY				$340	$13,580	3, VI-k
Control Tower								

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
DUTCH GULCH RESERVOIR (900 TAF)								
Below Invert	11,900	CY				$270	$3,218,355	3,VI-j
Below Chamber Floor	6,100	CY				$340	$2,070,950	3, VI-k
Above Chamber Floor	10,800	CY				$340	$3,666,600	3, VI-k
Miscellaneous Metal	38,000	LBS				$3.63	$137,940	3, VI-ii
Control House	JOB	LS	151	206	$110,000	$150,066	$150,066	2, D-107
Slide Gates (6.5' x 14.0')	2	EA	151	206	$1,250,000	$1,705,298	$3,410,596	2, D-107
Water Quality Slide Gates (4.5' x 9.0')	5	EA	151	206	$160,000	$218,278	$1,091,391	2, D-107
Bulkhead Gate (8.0' x 14.0')	1	EA	151	206	$320,000	$436,556	$436,556	2, D-107
Bulkhead Gate (6.0' x 11.0')	1	EA	151	206	$160,000	$218,278	$218,278	2, D-107
Slide Gates for Bypass (3.5' x 3.5')	2	EA	151	206	$80,000	$109,139	$218,278	2, D-107
Slide Gate Operating Equipment	JOB	LS	151	206	$650,000	$886,755	$886,755	2, D-107
Bulkhead Guides and Frames	JOB	LS	151	206	$600,000	$818,543	$818,543	2, D-107
Truck Crane - 50 Ton	JOB	LS	151	206	$350,000	$477,483	$477,483	2, D-107
Compressed Air System	JOB	LS	151	206	$65,000	$88,675	$88,675	2, D-107
Water Supply System	JOB	LS	151	206	$75,000	$102,318	$102,318	2, D-107
Sewerage System and Plumbing	JOB	LS	151	206	$65,000	$88,675	$88,675	2, D-107
Electrical System	JOB	LS	151	206	$355,000	$484,305	$484,305	2, D-107
Emergency Generator	JOB	LS	151	206	$100,000	$136,424	$136,424	2, D-107
Chain Hose System	JOB	LS	151	206	$100,000	$136,424	$136,424	2, D-107
Bubbler System	JOB	LS	151	206	$15,000	$20,464	$20,464	2, D-107
Air Intake Piping	JOB	LS	151	206	$130,000	$177,351	$177,351	2, D-107
Bypass System for Gates	JOB	LS	151	206	$115,000	$156,887	$156,887	2, D-107
Water Quality Slide Gates (6.0' x 12.0')	5	EA	151	206	$240,000	$327,417	$1,637,086	2, D-107
Elevator	JOB	LS	151	206	$300,000	$409,272	$409,272	2, D-107
Ventilating System	JOB	LS	151	206	$85,000	$115,960	$115,960	2, D-107
Drainage System	JOB	LS	151	206	$45,000	$61,391	$61,391	2, D-107
Painting, Tests, Quality Control, Misc.	JOB	LS	151	206	$400,000	$545,695	$545,695	2, D-107
Water Quality Trashrack Bars	11,000	LBS				$3.63	$39,930	3, VI-q
Metal Bridge Railing	350	LF	151	206	$20.00	$27.28	$9,550	2, D-107
Penstock A-537 Steel	6,000	LBS				$1.65	$9,900	3, VII-c
Exterior Electricity	JOB	LS	151	206	$80,000	$109,139	$109,139	2, D-107
Bulkhead Gate (11.0' x 18.0')	1	EA	151	206	$500,000	$682,119	$682,119	2, D-107
Tower Jib Cranes	JOB	LS	151	206	$200,000	$272,848	$272,848	2, D-107
Access Bridge								
Excavation, Pier and Abutment (Dam Embankment)	5,900	CY				$181	$1,069,434	3, VI-dd
Concrete								
Bridge Deck	420	CY				$424	$177,874	3, VI-gg
Pier								
Footing	700	CY				$288	$201,397	3, VI-ee

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
DUTCH GULCH RESERVOIR (900 TAF)								
Column and Cap	950	CY				$363	$344,385	3, VI-ff
Abutment								
Footing	90	CY				$363	$32,626	3, VI-ff
Stem	90	CY				$363	$32,626	3, VI-ff
Bridge Railing	1,650	LF	151	206	$20.00	$27.28	$45,020	2, D-108
Structural Steel	447,000	LBS				$2.42	$1,081,740	3, VI-hh
Structural Metal	6,500	LBS				$3.63	$23,595	3, VI-ii
Upstream Transition (Expanded Conduit Section)								
Concrete	370	CY	151	206		$340	$125,615	3, VI-k
Conduit-Oblong								
Concrete	11,900	CY				$340	$4,040,050	3, VI-k
Foundation Preparation	JOB	LS					$500,000	2, D-108
Downstream Transition								
Concrete	80	CY				$340	$27,160	3, VI-k
Exit Structure								
Concrete								
Formed	1,860	CY				$340	$631,470	3, VI-k
Unformed	2,270	CY				$270	$613,922	3, VI-j
Handrail	540	LF	151	206	$20.00	$27.28	$14,734	2, D-108
Backfill	10,800	CY	151	206	$5.50	$7.50	$81,036	2, D-108
Drainage System	JOB	LS	151	206	$4,000	$5,457	$5,457	2, D-108
Outlet Works Cost							$33,276,000	
Upsize Outlet Works for Emergency Evacuation								
Increase Outlet Works Capacity from 10,300 cfs to 12,760 cfs								
Cost Factor = $(12,760/10,300)^{3/8} = 1.084$	1.084							
SUBTOTAL OUTLET WORKS							$36,071,000	
VII. ROADS								
Project Access Roads (Paved, 2-Lane)	4	MI	162	237	$400,000	$585,185	$2,340,741	2, D-109
SUBTOTAL ROADS							$2,341,000	
VIII. RECREATION FACILITIES (MINIMUM FACILITIES)								
Ridge Road (Includes Portable Chemical Toilets,								
Turnarounds, Unpaved Safety Zone (25-Car), Unpaved								
Barrier (Post w/chain), Signs and Markers)	JOB	LS	162	237	$40,000	$58,519	$58,519	2, D-109
SUBTOTAL RECREATION FACILITIES							$59,000	

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
DUTCH GULCH RESERVOIR (900 TAF)								
IX. BUILDINGS, GROUNDS, AND UTILITIES								
Buildings								
Residence	2	EA	148	217	$50,000	$73,311	$146,622	2, D-109
Office	4,000	SF	148	217	$65.00	$95.30	$381,216	2, D-109
Shop	6,000	SF	148	217	$50.00	$73.31	$439,865	2, D-109
Vehicle Storage	3,000	SF	148	217	$25.00	$36.66	$109,966	2, D-109
Warehouse	3,000	SF	148	217	$50.00	$73.31	$219,932	2, D-109
Overlook	2,000	SF	148	217	$75.00	$110	$219,932	2, D-109
Grounds								
Landscaping	JOB	LS	148	217	$125,000	$183,277	$183,277	2, D-109
Utilities								
Water and Sewer Systems	JOB	LS	152	198	$400,000	$521,053	$521,053	2, D-109
Power (120/208v, 3 Phase)	1	MI	141	234	$25,000	$41,489	$41,489	2, D-109
Telephone	1	MI	141	234	$20,000	$33,191	$33,191	2, D-109
SUBTOTAL BUILDINGS, GROUNDS, AND UTILITIES							$2,297,000	
X. PERMANENT OPERATING EQUIPMENT								
Hydrologic and Communications Facilities	JOB	LS	148	217	$750,000	$1,099,662	$1,099,662	2, D-110
Project Tools and Equipment	JOB	LS	162	225	$500,000	$694,444	$694,444	2, D-110
SUBTOTAL PERMANENT OPERATING EQUIPMENT							$1,794,000	
XI. DUTCH GULCH POWERPLANT (17.6 MW)	JOB	LS				$75,041,000.00	$75,041,000	
SUBTOTAL FOR DUTCH GULCH RESERVOIR							$419,156,000	
CONTINGENCIES 20%							$83,831,200	
ESTIMATED CONSTRUCTION COST FOR DUTCH GULCH RESERVOIR							$502,987,200	
ENGR, LEGAL, AND ADMIN @ 35%							$176,046,000	
ESTIMATED CAPITAL COST FOR DUTCH GULCH RESERVOIR							$679,033,000	
ESTIMATED CAPITAL COST RANGE FOR DUTCH GULCH RESERVOIR								
LOW (-10%)							$611,000,000	
HIGH (+15%)							$781,000,000	

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
I. LAND AND DAMAGES								
Reservoir Lands (10,200 x 1.32)	13,460	AC				$1,500	$20,190,000	1
Lands Downstream of Spillway	890	AC				$1,500	$1,335,000	1
Lands for Borrow								
Dredger Tailing (Dry Creek)	1,000	AC	148	217	$600	$880	$879,730	2, D-111
Quarry	25	AC	148	217	$400	$586	$14,662	2, D-111
Improvements	34	EA	148	217	$60,000	$87,973	$2,991,081	2, D-111
Severance Damages	JOB	LS	148	217	$1,612,700	$2,364,567	$2,364,567	2, D-111
Relocation Costs:								
Houses and Public Building	34	EA	148	217	$15,000	$21,993	$747,770	2, D-111
Farms and Ranches	18	EA	148	217	$10,000	$14,662	$263,919	2, D-111
Acquisition Cost	154	EA	148	217	$3,500	$5,132	$790,291	2, D-111
SUBTOTAL LANDS AND DAMAGES							$29,577,000	
II. RELOCATIONS								
Roads:								
Relocated Highway 36 (paved 2-lane)	21	MI	154	219	$247,500	$351,964	$7,391,250	2, D-112
Relocate Bowman Road (paved 2-lane)	9	MI	154	219	$225,000	$319,968	$2,879,708	2, D-112
Bridge Across Cottonwood Creek								
(120' long x 30' wide x 40' high)	3,600	SF				$100	$360,000	4
Bridge Across Highway 36 (50' long x 30' wide x 30' high)	1,500	SF				$100	$150,000	4
Utilities and Cemeteries:								
Relocate Powerline (Hwy 36, 115 kV on Wood Poles)	5	MI	141	234	$55,000	$91,277	$456,383	2, D-112
Relocate PG&E Underground Gas Line								
(12" Dia. High Pressure)	11	MI	152	198	$125,000	$162,829	$1,791,118	2, D-112
Relocate Grave (Near Bowman Road and South Fork								
of Cottonwood Creek)	1	EA	148	217	$1,000	$1,466	$1,466	2, D-112
Remove Broken Telephone Line (Hwy 36)	3	MI	141	234	$11,000	$18,255	$54,766	2, D-112
Remove Powerline, Wood Pole (Hwy 36)	9	MI	141	234	$17,500	$29,043	$261,383	2, D-112
Remove Powerline, Wood Pole (Bowman Road)	2	MI	141	234	$17,500	$29,043	$58,085	2, D-112
Remove Powerline, Wood Pole (Bowman Road)	4	MI	141	234	$12,500	$20,745	$82,979	2, D-112
SUBTOTAL RELOCATIONS							$13,487,000	
III. RESERVOIRS								
Clearing, Moderate to Heavy (includes Fences, Culverts,								
Bridges, etc.	10,200	AC				$1,097	$11,189,400	3, IV-a
Boundary Fencing	63	MI	142	176	$10,000	$12,394	$780,845	2, D-112

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
Boundary Surveys and Markers	JOB	LS	142	176	$730,000	$904,789	$904,789	2, D-113
SUBTOTAL RESERVOIRS							$12,875,000	
IV. DAMS								
Main Dam (Crest Elevation 714.0)								
Diversion and Care of Water	JOB	LS	135	159	$550,000	$647,778	$647,778	2, D-113
Dewatering for Foundation Excavation								
Drilling 4" Holes	25,000	LF	135	159	$5.00	$5.89	$147,222	2, D-113
Well Points (1,240 ea. (Pumps and Power Complete)	JOB	LS	135	159	$930,000	$1,095,333	$1,095,333	2, D-113
Excavation								
Stripping	1,834,300	CY	135	159	$1.30	$1.53	$2,808,517	2, D-113
Core Trench	1,307,400	CY				$3.23	$4,222,902	3, I-d
Left Abutment Slope Flattening	100,000	CY	135	159	$1.25	$1.47	$147,222	2, D-113
Slurry Trench (6'W x 30"D)	76,800	SY	135	159	$80.00	$94.22	$7,236,267	2, D-113
Borrow Area Upstream								
Tehama Formation (2.8 Mile)	9,377,900	CY	135	159	$1.55	$1.83	$17,119,877	2, D-113
Terrace Gravels (2.9 Mile)	8,925,800	CY	135	159	$1.50	$1.77	$15,768,913	2, D-113
Alluvium & Floodplain Deposits (3.9 Mile)	6,723,800	CY	135	159	$1.80	$2.12	$14,254,456	2, D-114
Borrow Area Upstream and Downstream								
Plant Set Up No. 1	1,379,500	CY	135	159	$6.15	$7.24	$9,992,178	2, D-114
Plant Set Up No. 2	3,272,400	CY	135	159	$4.20	$4.95	$16,187,472	2, D-114
Borrow Rock Quarry								
Develop Quarry	JOB	LS	135	159	$150,000	$176,667	$176,667	2, D-114
Plant Set-Up No. 3	442,300	CY	135	159	$13.05	$15.37	$6,798,151	2, D-114
Embankment								
Impervious Material	4,943,500	CY	135	159	$1.65	$1.94	$9,606,868	2, D-115
Random I	9,639,600	CY	135	159	$0.85	$1.00	$9,650,311	2, D-115
Random II	8,593,800	CY	135	159	$1.35	$1.59	$13,664,142	2, D-115
Unclassified Fill	2,185,000	CY	135	159	$0.85	$1.00	$2,187,428	2, D-115
Transition	788,900	CY	135	159	$0.90	$1.06	$836,234	2, D-115
Filter	51,400	CY	135	159	$2.05	$2.41	$124,102	2, D-115
Drainage Fill	1,117,400	CY	135	159	$1.05	$1.24	$1,381,851	2, D-115
Select	2,753,700	CY	135	159	$1.10	$1.30	$3,567,571	2, D-116
D/S Rock Slope Protection	191,800	CY	135	159	$2.45	$2.89	$553,450	2, D-116
Riprap	318,500	CY	135	159	$0.75	$0.88	$281,342	2, D-116
D/S Toe Fill	608,000	CY	135	159	$0.70	$0.82	$501,262	2, D-116
Relief Wells								
Drilling 14" Dia. Drain Holes	93,000	LF	135	159	$10.00	$11.78	$1,095,333	2, D-116

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
Set-Ups and Development of Wells	958	EA	135	159	$2,000	$2,356	$2,256,622	2, D-116
8" Dia. PVC Pipe and Miscellaneous Items	93,000	LF	135	159	$20.00	$23.56	$2,190,667	2, D-116
3" Thick Annular Gravel Filter	4,000	TON	135	159	$40.00	$47.11	$188,444	2, D-116
Collector Ditch	19,000	LF	135	159	$15.00	$17.67	$335,667	2, D-116
Feeder Pipe	JOB	LS	135	159	$45,000	$53,000	$53,000	2, D-116
D/S Drainage Blanket								
Clearing and Grubbing	164,000	SY	135	159	$1.75	$2.06	$338,022	2, D-116
Filter Gravel	43,800	TON	135	159	$8.50	$10.01	$438,487	2, D-116
Drain Rock Course Aggregate	295,400	TON	135	159	$8.00	$9.42	$2,783,324	2, D-116
Road Surfacing, Stabilized Aggregate Base	11,200	TON				$19.15	$214,480	3, V-d
Instrumentation	JOB	LS	135	159	$625,000	$736,111	$736,111	2, D-117
Construction Facilities	JOB	LS	135	159	$750,000	$883,333	$883,333	2, D-117
SUBTOTAL DAMS							$150,471,000	
V. SPILLWAY - 800' OGEE								
Excavation Unclassified	4,706,000	CY				$4.03	$18,965,180	3, Avg. II-a & III-a
Backfill	4,000	CY				$8.17	$32,680	3, III-f
Derrick Stone	54,400	CY	147	186	$11.00	$13.92	$757,159	2, D-117
Riprap	231,800	CY				$31.64	$7,334,152	3, I-n
Drainage Filter Material								
Behind Wall	280	CY				$8.54	$2,391	3, Avg. I-i & I-j
Under Floor Slabs	4,200	CY				$8.54	$35,868	3, Avg. I-i & I-j
Concrete								
Wing Walls	290	CY				$365	$105,920	3, Avg. II-h, III-c, III-d
Ogee Section								
Mass Concrete	21,070	CY				$293	$6,175,406	3, III-d
Walls	280	CY				$365	$102,267	3, Avg. II-h, III-c, III-d
Chute and Stilling Basin	1,980	CY				$365	$723,175	3, Avg. II-h, III-c, III-d
6" Dia. Perforated Drain Pipe	140	LF	147	186	$10.00	$12.65	$1,771	2, D-118
Handrail	250	LF	147	186	$20.00	$25.31	$6,327	2, D-118
SUBTOTAL SPILLWAY							$34,242,000	
VI. OUTLET WORKS, POWER INTAKE WORKS, POWERHOUSE, AND WATER QUALITY OUTLET WORKS								
Excavation Unclassified	598,500	CY				$6.76	$4,045,860	3, VI-i
Riprap	11,700	TON				$14.09	$164,853	3, III-g
Control Tower and Intake Structure								
Concrete								

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
Intake Structure								
Below Invert	300	CY				$270	$81,135	3,VI-j
Above Invert	790	CY				$340	$268,205	3, VI-k
Log Rack	50	CY				$340	$16,975	3, VI-k
Control Tower								
Below Invert	10,000	CY				$270	$2,704,500	3,VI-j
Below Chamber Floor	4,100	CY				$340	$1,391,950	3, VI-k
Above Chamber Floor	9,500	CY				$340	$3,225,250	3, VI-k
Miscellaneous Metal	38,000	LB				$3.63	$137,940	3, VI-ii
Control House	JOB	LS	151	206	$100,000	$136,424	$136,424	2, D-118
Slide Gates (5.5' x 11.25')	2	EA	151	206	$812,000	$1,107,762	$2,215,523	2, D-118
Water Quality Slide Gates (4.5' x 9.0')	5	EA	151	206	$160,000	$218,278	$1,091,391	2, D-118
Bulkhead Gate (7.0' x 11.0')	1	EA	151	206	$205,000	$279,669	$279,669	2, D-118
Bulkhead Gate (7.0' x 7.0')	1	EA	151	206	$130,000	$177,351	$177,351	2, D-119
Slide Gates for Bypass (3.5' x 3.5')	2	EA	151	206	$70,000	$95,497	$190,993	2, D-119
Slide Gate Operating Equipment	JOB	LS	151	206	$500,000	$682,119	$682,119	2, D-119
Bulkhead Guides and Frames	JOB	LS	151	206	$450,000	$613,907	$613,907	2, D-119
Truck Crane - 40 Ton	JOB	LS	151	206	$280,000	$381,987	$381,987	2, D-119
Compressed Air System	JOB	LS	151	206	$65,000	$88,675	$88,675	2, D-119
Water Supply System	JOB	LS	151	206	$75,000	$102,318	$102,318	2, D-119
Sewerage System and Plumbing	JOB	LS	151	206	$65,000	$88,675	$88,675	2, D-119
Electrical System	JOB	LS	151	206	$355,000	$484,305	$484,305	2, D-119
Emergency Generator	JOB	LS	151	206	$100,000	$136,424	$136,424	2, D-119
Chain Hose System	JOB	LS	151	206	$100,000	$136,424	$136,424	2, D-119
Bubbler System	JOB	LS	151	206	$10,000	$13,642	$13,642	2, D-119
Air Intake Piping	JOB	LS	151	206	$120,000	$163,709	$163,709	2, D-119
Bypass System for Gates	JOB	LS	151	206	$85,000	$115,960	$115,960	2, D-119
Elevator	JOB	LS	151	206	$300,000	$409,272	$409,272	2, D-119
Ventilating System	JOB	LS	151	206	$85,000	$115,960	$115,960	2, D-119
Drainage System	JOB	LS	151	206	$45,000	$61,391	$61,391	2, D-119
Painting, Tests, Quality Control, Misc.	JOB	LS	151	206	$175,000	$238,742	$238,742	2, D-119
Water Quality Trashrack Bars	7,200	LB				$3.63	$26,136	3, VI-q
Metal Bridge Railing	280	LF	151	206	$20.00	$27.28	$7,640	2, D-119
Water Quality Slide Gates (4.5' x 4.5')	5	EA	151	206	$80,000	$109,139	$545,695	2, D-119
Penstock A-537 Steel	4,400	LB				$1.65	$7,260	3, VII-c
Exterior Electricity	JOB	LS	151	206	$90,000	$122,781	$122,781	2, D-119
Bulkhead Gate (9.0' x 15.0')	1	EA	151	206	$350,000	$477,483	$477,483	2, D-119
Tower Jib Cranes	JOB	LS	151	206	$185,000	$252,384	$252,384	2, D-119
Access Bridge								

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
Excavation, Pier and Abutment (Dam Embankment)	4,800	CY				$181	$870,048	3, VI-dd
Concrete								
Bridge Deck	350	CY				$424	$148,229	3, VI-gg
Pier								
Footing	470	CY				$288	$135,224	3, VI-ee
Column and Cap	580	CY				$363	$210,256	3, VI-ff
Abutment								
Footing	90	CY				$363	$32,626	3, VI-ff
Stem	90	CY				$363	$32,626	3, VI-ff
Bridge Railing	1,400	LF	151	206	$20.00	$27.28	$38,199	2, D-119
Structural Steel	373,000	LB				$2.42	$902,660	3, VI-hh
Structural Metal	5,400	LB				$3.63	$19,602	3, VI-ii
Upstream Transition								
(Expanded Conduit Section)								
Concrete	340	CY				$340	$115,430	3, VI-k
Conduit-Oblong								
Concrete	6,600	CY				$340	$2,240,700	3, VI-k
Foundation Preparation	JOB	LS	151	206	$400,000	$545,695	$545,695	2, D-120
Downstream Transition								
Concrete	50	CY				$340	$16,975	3, VI-k
Exit Structure								
Concrete								
Formed	1,020	CY				$340	$346,290	3, VI-k
Unformed	1,500	CY				$270	$405,675	3, VI-j
Handrail	450	LF	151	206	$20.00	$27.28	$12,278	2, D-120
Backfill	6,700	CY	151	206	$5.50	$7.50	$50,272	2, D-120
Drainage System	JOB	LS	151	206	$4,000	$5,457	$5,457	2, D-120
Outlet Works Cost							$27,529,150	
Upsize Outlet Works for Emergency Evacuation								
Increase Outlet Works Capacity from 6,700 cfs to 10,080 cfs								
Cost Factor = $(10,080/6,700)^{3/4} = 1.166$	1.166							
SUBTOTAL OUTLET WORKS							$32,099,000	
VII. ROADS								
Project Access Roads (Paved, 2-Lane)	5	MI	162	237	$400,000	$585,185	$2,925,926	2, D-121
SUBTOTAL ROADS							$2,926,000	

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
VIII. RECREATION FACILITIES (MINIMUM FACILITIES)								
Beegum (Includes Portable Chemical Toilets,								
Turnarounds, Unpaved Safety Zone (25-Car), Unpaved								
Barrier (Post w/chain), Signs and Markers)	JOB	LS	162	237	$40,000	$58,519	$58,519	2, D-121
SUBTOTAL RECREATION FACILITIES							$59,000	
IX. BUILDINGS, GROUNDS, AND UTILITIES								
Buildings								
Residence	2	EA	148	217	$50,000	$73,311	$146,622	2, D-121
Office	4,000	SF	148	217	$65.00	$95.30	$381,216	2, D-121
Shop	6,000	SF	148	217	$50.00	$73.31	$439,865	2, D-121
Vehicle Storage	3,000	SF	148	217	$25.00	$36.66	$109,966	2, D-121
Warehouse	3,000	SF	148	217	$50.00	$73.31	$219,932	2, D-121
Overlook	2,000	SF	148	217	$75.00	$109.97	$219,932	2, D-121
Grounds								
Landscaping	JOB	LS	148	217	$125,000	$183,277	$183,277	2, D-121
Utilities								
Water and Sewer Systems	JOB	LS	152	198	$400,000	$521,053	$521,053	2, D-121
Power (120/208v, 3 Phase)	1	MI	141	234	$25,000	$41,489	$41,489	2, D-121
Telephone	1	MI	141	234	$20,000	$33,191	$33,191	2, D-121
SUBTOTAL BUILDINGS, GROUNDS, AND UTILITIES							$2,297,000	
X. PERMANENT OPERATING EQUIPMENT								
Hydrologic and Communications Facilities	JOB	LS	148	217	$750,000	$1,099,662	$1,099,662	2, D-122
Project Tools and Equipment	JOB	LS	162	225	$500,000	$694,444	$694,444	2, D-122
SUBTOTAL PERMANENT OPERATING EQUIPMENT							$1,794,000	
XI. TEHAMA POWERPLANT (7.8 MW)	JOB	LS				$46,027,000	$46,027,000	
SUBTOTAL FOR TEHAMA RESERVOIR							$325,854,000	
CONTINGENCIES 20%							$65,170,800	
ESTIMATED CONSTRUCTION COST FOR TEHAMA RESERVOIR							$391,024,800	
ENGR, LEGAL, AND ADMIN @ 35%							$136,858,680	
ESTIMATED CAPITAL COST FOR TEHAMA RESERVOIR							$527,883,000	

Table 2
ESTIMATED COSTS
COTTONWOOD CREEK COMPLEX

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 82	USBR INDEX OCT. 96	UNIT COST OCT. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
TEHAMA RESERVOIR (700 TAF)								
ESTIMATED CAPITAL COST RANGE FOR TEHAMA RESERVOIR								
LOW (-10%)							$475,000,000	
HIGH (+15%)							$607,000,000	
SUBTOTAL FOR COTTONWOOD CREEK COMPLEX							$745,010,000	
CONTINGENCIES @ 20%							$149,002,000	
ESTIMATED CONSTRUCTION COST FOR COTTONWOOD CREEK COMPLEX							$894,012,000	
ENGR, LEGAL, AND ADMIN @ 35%							$312,904,000	
ESTIMATED CAPITAL COST FOR COTTONWOOD CREEK COMPLEX							$1,206,916,000	
ESTIMATED CAPITAL COST RANGE FOR COTTONWOOD CREEK COMPLEX								
LOW (-10%)							$1,086,000,000	
HIGH (+15%)							$1,388,000,000	

Footnote:

[a]AC=acre; LS=lump sum; MI=mile; CY=cubic yard; LF=linear Foot; SY=square yard; LB=pound; EA=each

Cost References:

1. U.S. Bureau of Reclamation, Land Resources Branch, Personal Communication with Graham McMullen, February 1997.
2. U.S. Corps of Engineers, Sacramento District, *Cottonwood Creek Draft General Design Memorandum Appendixes*, May 1983.
3. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, Table 4, December 1990.
4. Cost developed by Bookman-Edmonston Engineering.

Table 3

SUMMARY OF ESTIMATED COSTS

COTTONWOOD CREEK COMPLEX

Cost Item	Estimated Cost ($Million) Dutch Gulch Reservoir	Tehama Reservoir
Lands and Damages	33.4	29.6
Relocations	13.4	13.5
Reservoirs	14.2	12.9
Dams	202.8	150.5
Spillway	37.8	34.2
Outlet Works	36.1	32.1
Roads	2.3	2.9
Recreation Facilities	0.1	0.1
Buildings, Grounds, Utilities	2.3	2.3
Permanent Equipment	1.8	1.8
Power Plant	75.0	46.0
SUBTOTAL	419.2	325.9
Contingencies (20%)	83.8	65.2
ESTIMATED CONSTRUCTION COST	503.0	391.0
Engineering, Legal, and Project Administration (35%)	176.0	137.0
ESTIMATED TOTAL CAPITAL COST	679.0	528.0
Capital Cost Range (minus 10% - plus 15%)	$611 - $ 781	$475 - $607

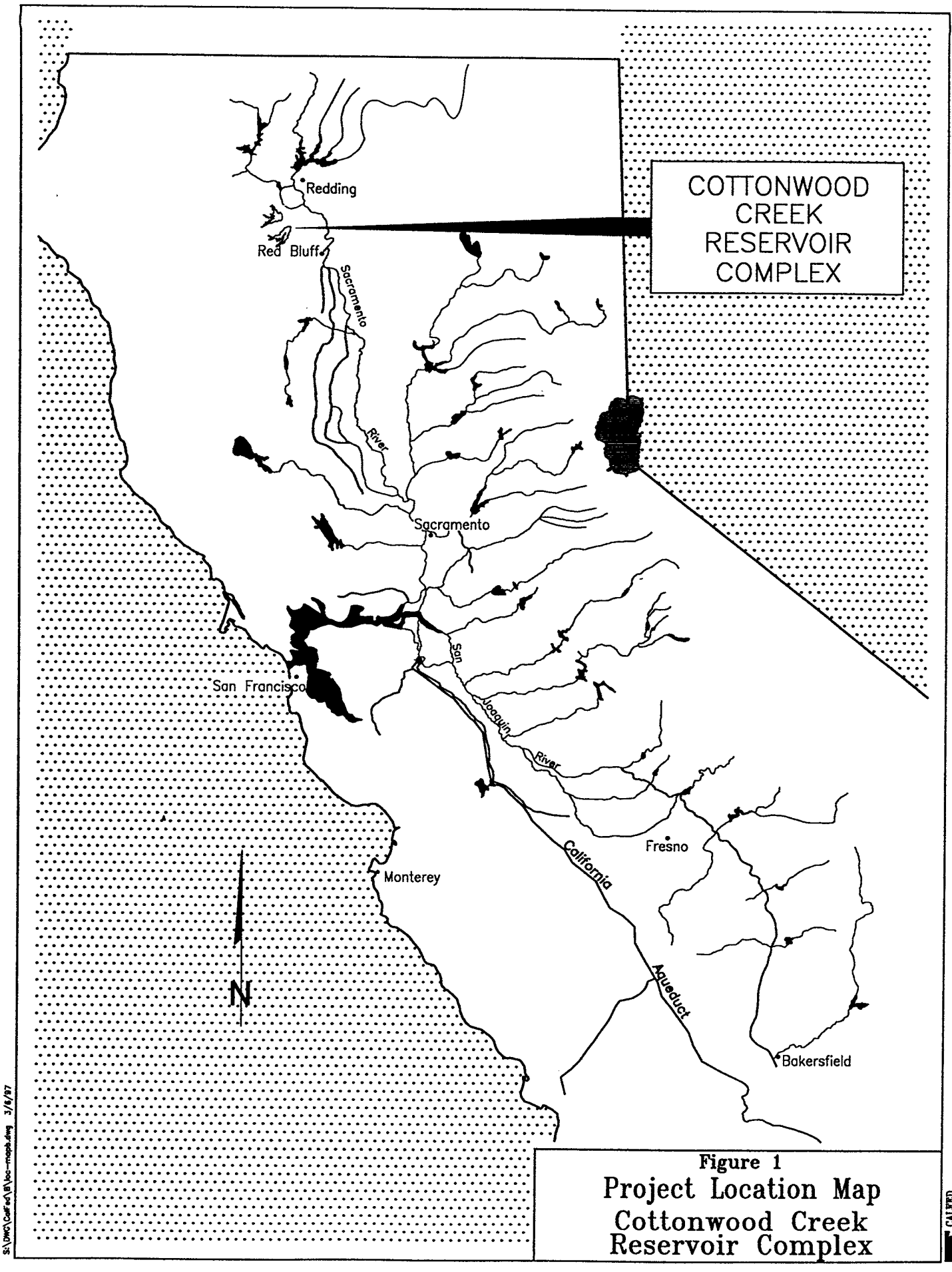

Figure 1
Project Location Map
Cottonwood Creek Reservoir Complex

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CALFED BAY-DELTA PROGRAM

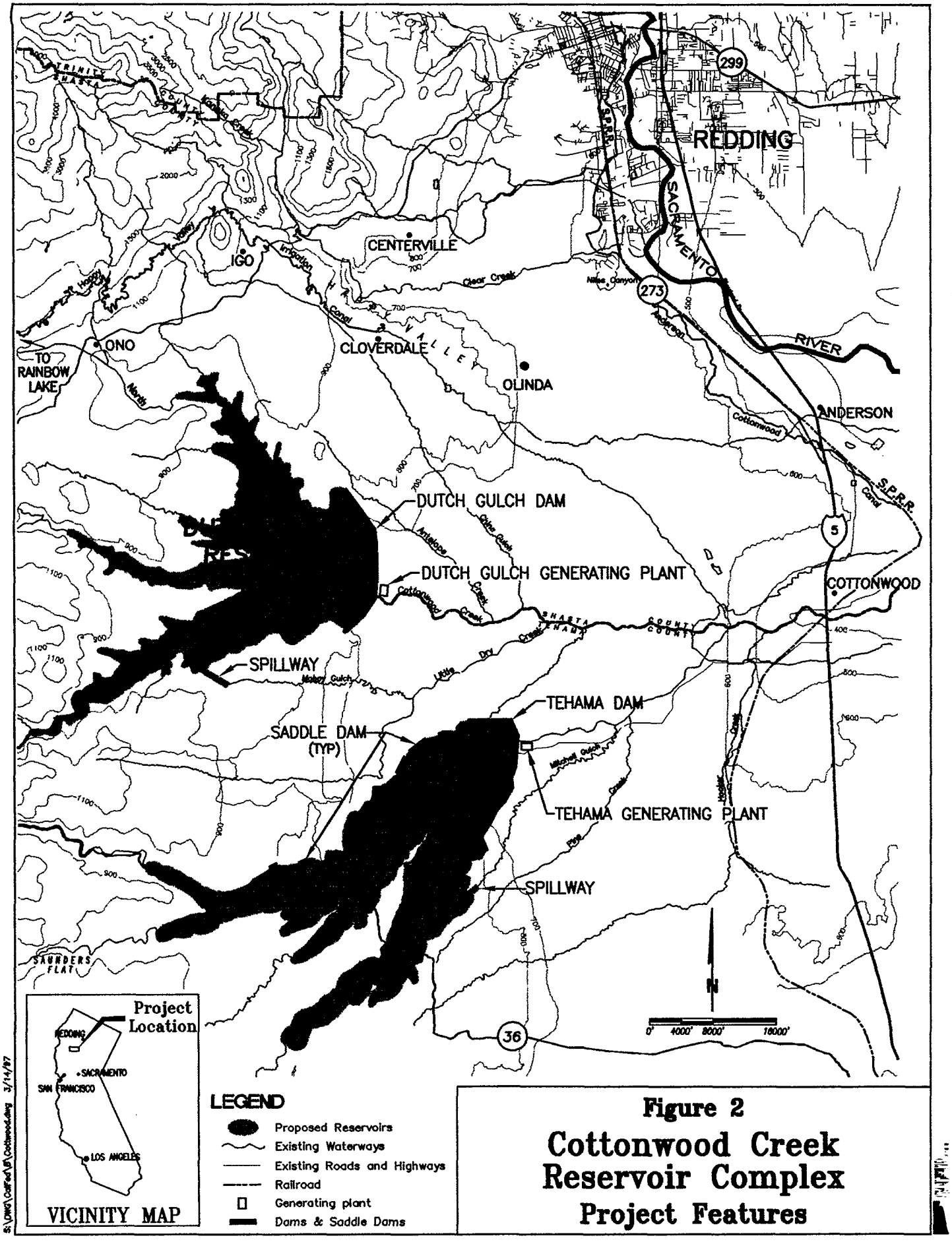

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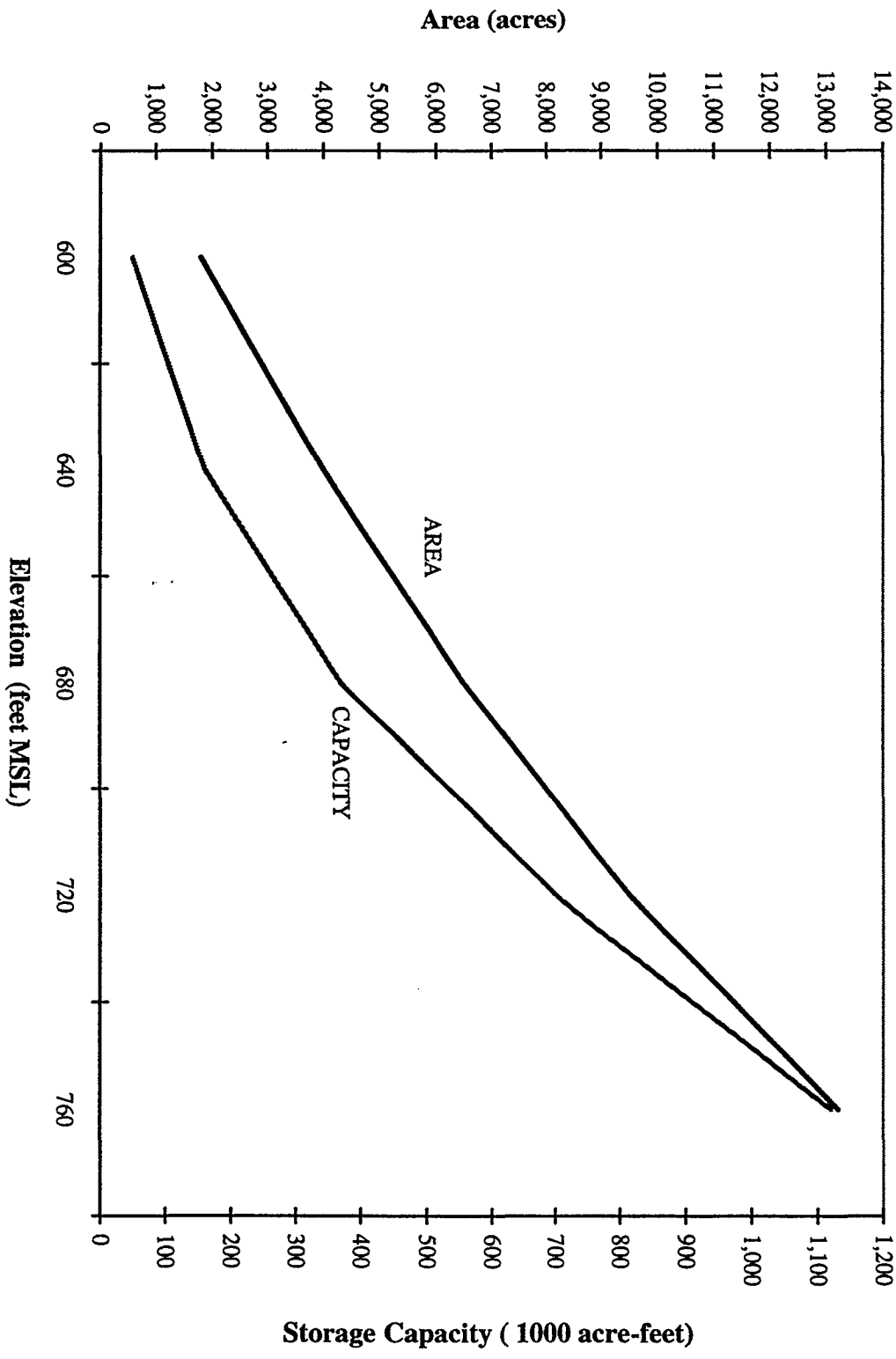
Figure 2

Cottonwood Creek Reservoir Complex

Project Features

Figure 3a
AREA-CAPACITY CURVES
DUTCH GULCH RESERVOIR



AREA-CAPACITY Tehama Lake 3/14/97

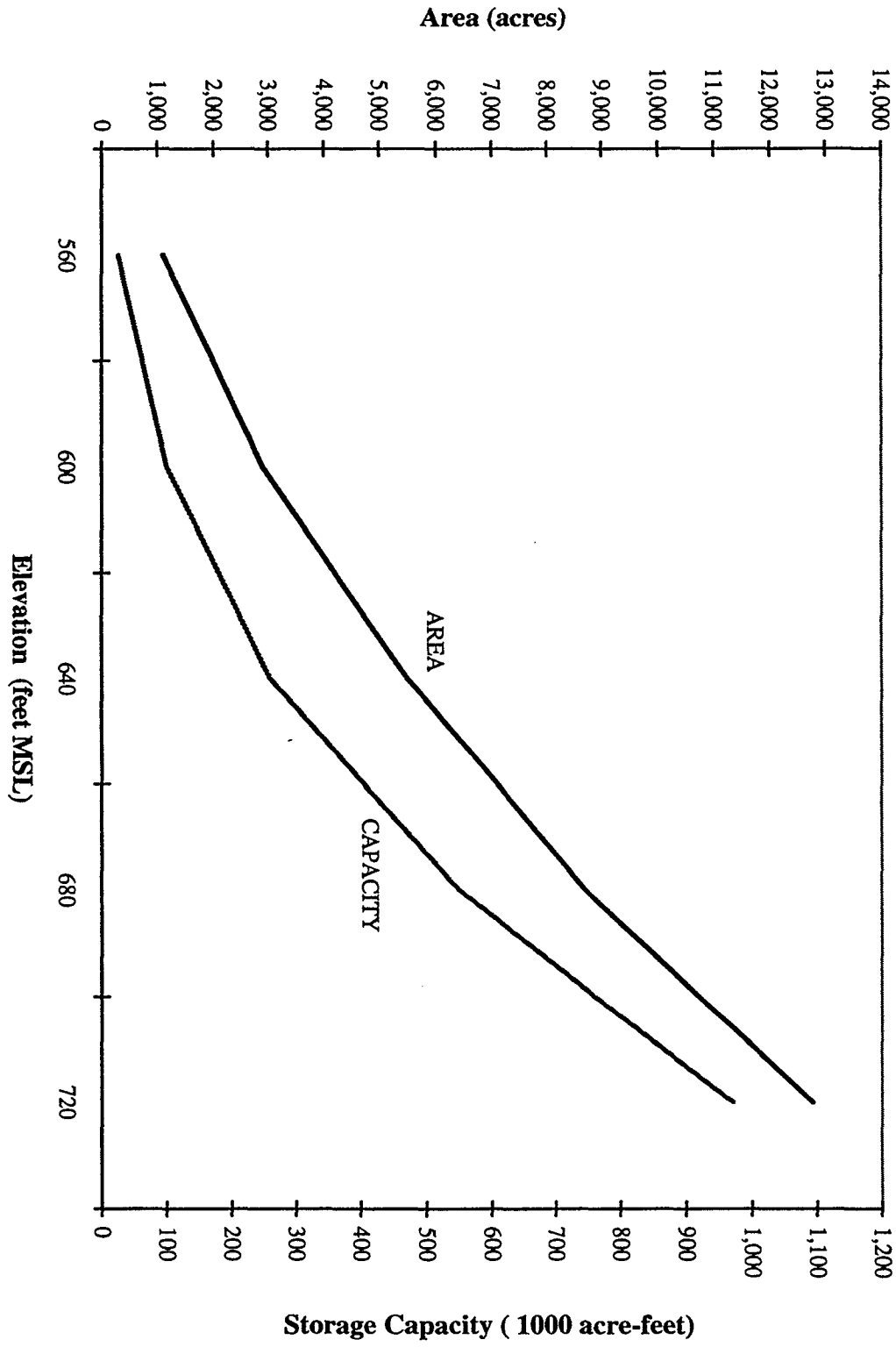


Figure 3b
AREA-CAPACITY CURVES
TEHAMA RESERVOIR

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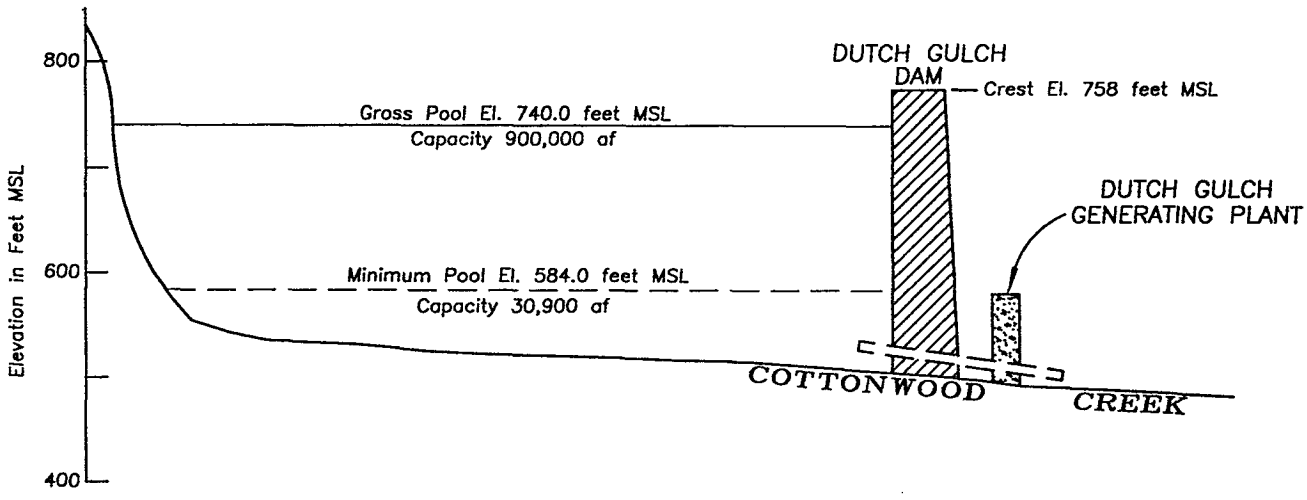
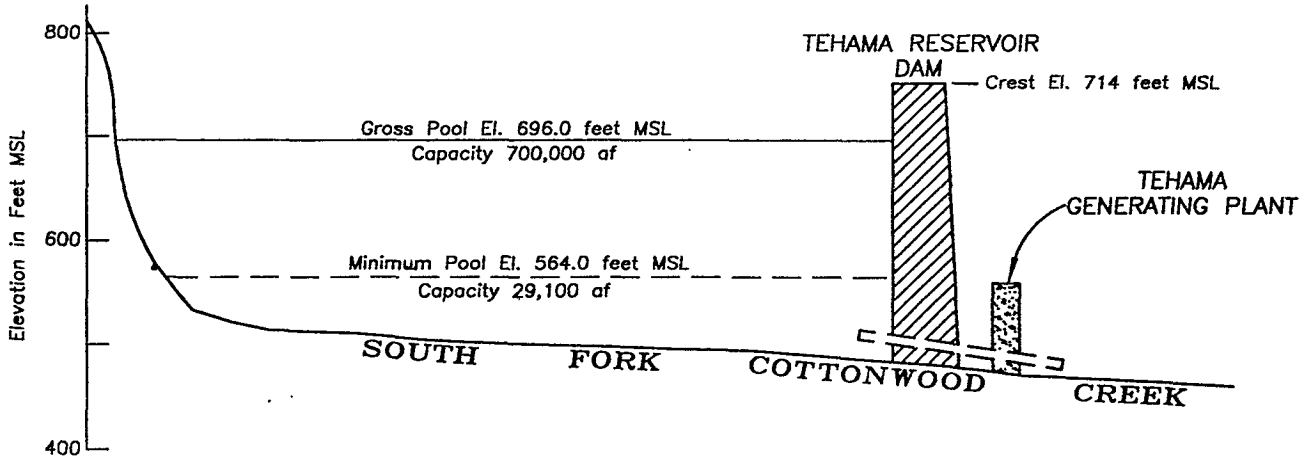


DUTCH GULCH RESERVOIR



TEHAMA RESERVOIR

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Figure 4
Cottonwood Creek Reservoir Complex
Schematic Profile