FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR MILLERTON LAKE ENLARGEMENT

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for Millerton Lake Enlargement* report 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 consideration of enlarging the existing Friant Dam and Millerton Lake. The general location of Millerton Lake is shown on Figure 1. 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 objectives of the Millerton Lake Enlargement 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 compare this project against other projects that might be considered as part of a long-term CALFED solution strategy.

The cost estimate for the Millerton Lake Enlargement was determined by escalating the costs from the July 1982 *Friant Dam Reconnaissance Cost Estimate* compiled by the U.S. Bureau of Reclamation (Reclamation). The cost estimate performed by Reclamation in 1982 was reviewed and adapted for this evaluation. Modifications were made to Reclamation's cost estimate, where applicable, to reflect current design and safety standards.

A preliminary evaluation of the environmental considerations associated with this project has been included with this evaluation. 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.

PROJECT BACKGROUND

In the 1930s, the State recognized the need to provide supplemental surface water supplies to the southeastern San Joaquin Valley. The State of California Department of Public Works, Division of Water Resources, *Report to Legislature of 1931 on State Water Plan* (Bulletin No. 25) identified an immediate need for numerous water resources development projects in California including (1) the Friant Dam on the San Joaquin River, (2) the San Joaquin River-Kern County Canal with a diversion capacity of 3,000 cfs, and (3) the Madera Canal with a diversion capacity of 1,500 cfs. These proposed facilities were planned to be constructed as part of the State Water Project (SWP), but would later be constructed as part of the federal Central Valley Project (CVP).

The Friant Dam, Friant-Kern Canal, and Madera Canal were authorized as part of the CVP in the Rivers and Harbors Act (Act) of 1937. The primary purpose of these facilities was to protect the valley floor from floods and to provide water supply for the CVP Friant Division. Other facilities authorized by the Act included Shasta and Keswick Dams, Tracy Pumping Plant, Delta-Mendota Canal, Contra Costa Canal, Delta Cross Channel, and Coleman Fish Hatchery.

Friant Dam was completed in 1942, creating Millerton Lake which began impounding water in 1944. Friant Dam controls flows on the San Joaquin River and provide downstream releases to meet flow requirements above Mendota Pool. Conservation storage in Millerton Lake supplies the diversions into the Madera Canal and Friant-Kern Canal. Diversions began to these facilities in 1943 and 1949, respectively.

In the early 1980s, the Friant Power Users Authority developed power production as the third purpose of Friant Dam. Power production facilities at Friant Dam, Madera Canal, and Friant-Kern Canal came on line in January 1986.

FACILITIES DESCRIPTION

This section provides an overview of the major features of the Millerton Lake Enlargement project. The principal reference used for this synopsis is an unpublished Reclamation report *Friant Dam Reconnaissance Cost Estimate*, July 1982, for an enlarged Friant Dam.

PROJECT LOCATION

The Millerton Lake Enlargement would be located on the San Joaquin River about 25 miles east of Fresno at the same location as the existing Millerton Lake. Millerton Lake inundates a portion of the foothill areas of Fresno and Madera Counties. Figure 2 shows the location of the project facilities for the Millerton Lake Enlargement.

PROJECT DESCRIPTION

The Millerton Lake Enlargement would provide (1) greater flood control on the San Joaquin River; (2) additional water supplies to meet local needs; and (3) additional drought year water supplies for agricultural, environmental, and urban uses in eastern San Joaquin Valley. This would be accomplished by storing excess flows that are otherwise released or spilled to the lower San Joaquin River and the Sacramento-San Joaquin Delta.

The project operations would be coordinated with other existing and future SWP, CVP, and proposed CALFED facilities to enhance water supply opportunities. Changes in the storage

and release of water from an enlarged Millerton Lake would depend on other activities of CALFED, the Central Valley Project Improvement Act, and Bay-Delta Water Quality Standards. Because these aspects of the operation are in the formative stages, the present analysis does not provide quantitative descriptions of water supply opportunities or detailed descriptions of project operations.

EXISTING FACILITIES

The San Joaquin River is the water supply source for the CVP Friant Division. Existing facilities include Millerton Lake, Friant Dam, Madera Canal, and Friant-Kern Canal. Facilities upstream of Millerton Lake include Powerhouse No. 1 and Powerhouse No. 2 of the Pacific Gas and Electric Company's (PG&E) Kerckhoff Project. These existing facilities, as well as those facilities associated with the enlargement of Millerton Lake, are shown in detail in Figure 2.

The Friant Division provides water to agricultural and urban water users in the San Joaquin Valley by way of the Friant-Kern Canal Unit, Cross Valley Canal Unit, Madera Canal Unit, and Millerton Lake Unit. The Friant Division provides two types of water to its users, Class I and Class II. Class I water demands total about 924,600 acre-feet per year (869,400 acre-feet per year for agriculture and 64,200 acre-feet per year for municipal and industrial water users). Class II water is available only after all Class I demands have been met. Class II water demands total about 1,401,500 acre-feet per year for agricultural water users.

Friant Dam

The existing Friant Dam consists of a concrete gravity dam rising 319 feet above the streambed. The crest length is 3,488 feet at an elevation of 581 feet above mean sea level

(MSL). Friant Dam is founded in the quartz mica schist and granodiorite of the Sierra Nevada Batholith.

Spillway

The spillway consists of three 100-foot-wide ogee-shaped overflow sections located at the center of the dam, which are each controlled by 18-foot drum gates. The top of the overflow section is at an elevation of 560 feet above MSL, and the top of the gates is at 578 feet above MSL. The spillway has a capacity of 90,000 cfs. There are three separate outlet works at the dam which release water into the San Joaquin River, Madera Canal, and Friant Kern Canal.

Outlet Works

There are three outlet facilities on the existing Friant Dam: the Friant-Kern Canal outlet works, the Madera Canal outlet works, and the river outlet works. The outlet works have a combined release capacity of 23,975 cfs.

The Friant-Kern Canal outlet works are comprised of four 110-inch diameter steel pipes controlled by four 96-inch hollow jet valves at the downstream end. The capacity of the outlet works is 5,300 cfs. The Madera Canal outlet works are comprised of two 91-inch diameter steel pipes that traverse the dam structure, and are controlled by two 86-inch valves. The capacity of the Madera outlet works is 1,275 cfs. The outlet works for the San Joaquin River consist of four 110-inch diameter steel pipes through the dam, which are controlled by four 96-inch hollow jet valves at the downstream end. The total release capacity of the river outlet is 17,000 cfs.

Millerton Lake

The existing Millerton Lake has a normal water surface elevation of 578 feet above MSL with a corresponding storage volume of 520,000 acre-feet. At the normal water surface elevation Millerton Lake has a water surface area of about 4,900 acres. The area-capacity curves for Millerton Lake are shown in Figure 3. At Friant Dam, the upstream drainage area totals about 1,630 square miles and has an average annual runoff of about 1.8 million acre-feet (maf) per year.

Power Plants

The existing facilities include three power plants, one at each of the outlet works mentioned above. The river outlet has a power generating capacity of 2.0 MW. The Friant-Kern Canal outlet has a power generating capacity of 15.0 MW. The Madera Canal outlet has a power generating capacity of 8.0 MW.

Madera Canal

The Madera Canal conveys water north for 35.9 miles from Millerton Lake, delivering water throughout Madera County. The capacity of the canal is initially 1,275 cfs and decreases to 750 cfs at its terminus at the Chowchilla River.

Friant-Kern Canal

The Friant-Kern Canal conveys water south from Millerton Lake about 150 miles through Fresno, Tulare, and Kern Counties. The capacity of the canal is initially 5,300 cfs and decreases to 2,500 cfs at its terminus near Bakersfield.

Kerckhoff Project

Kerckhoff Reservoir is located about 20 miles upstream of Friant Dam. It is owned and operated by PG&E to produce hydroelectric power. Water is diverted from Kerckhoff Reservoir into tunnels to Kerckhoff Powerhouse No. 1 and No. 2 (see Figure 2) before being returned to the San Joaquin River just above Millerton Lake.

PRINCIPAL FACILITIES

The Millerton Lake Enlargement would consist of raising the height of the existing Friant Dam to create a larger storage reservoir. Existing facilities such as the Madera and Friant-Kern Canals would continue to operate as before, but would require some modification at their intake facilities. The enlargement of Millerton Lake would impact the Kerckhoff Project.

Enlarged Friant Dam

The existing Friant Dam would be enlarged by adding concrete to the crest and downstream face of the existing concrete structure. The crest height would be raised 144 feet to an elevation of 725 feet above MSL. The crest length of the enlarged dam would be 7,500 feet.

Enlarging Friant Dam would require approximately 3.8 millon cubic yards of concrete. Concrete added to the downstream face of the dam would have a face slope of 0.7:1.0. The existing face of the dam would have to be chipped and roughed to secure a good bond between the existing and new structures. The mass concrete of the new downstream face would be poured in lifts, which would leave a four-foot horizontal opening between the downstream face of the existing structure and the upstream face of the new structure. The

opening would be progressively filled with aggregate as the new mass concrete is placed. As the temperature of the new mass concrete is cooled to about the temperature of the existing dam structure, the aggregate layer will ensure minimal shrinkage and cracking. The aggregate layer would be grouted after the new concrete mass cools to avoid damaging temperature stresses. Enlarging the dam in this manner would provide adequate stability and produce a monolithic behavior for the entire structure.

Spillway

The spillway of the existing dam would be dismantled and modified for replacement on the enlarged dam. The capacity of the spillway would remain the same as the existing dam (90,000 cfs). The spillway would be located in the center of the dam, as with the existing dam. The sill of the spillway would be at an elevation of 702 feet above MSL, and the maximum water surface elevation would be at 720 feet above MSL, corresponding to the top of the spillway gates.

Outlet Works

The three outlet works of the enlarged dam would have the same capacity as the outlet works of the existing dam. These capacities are 5,300 cfs, 1,275 cfs, and 17,000 cfs for the Friant-Kern Canal, Madera Canal, and river outlet works, respectively. The outlet works would require modification to compensate for the increased thickness of the dam. The 110-inch and 91-inch diameter steel pipes for the Friant-Kern and Madera Canals, respectively, would be extended through the new downstream face. The 110-inch diameter steel outlet pipes for the river outlet would also be extended.

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 the Department of Water Resources (DWR) Division of Safety of Dams. With this criterion, the emergency drawdown flow for an enlarged Millerton Lake would be about 19,700 cfs for 10 days. The combined outlet works would have a release capacity of over 23,000 cfs and would be capable of handling the emergency release.

Enlarged Millerton Lake

An enlarged Millerton Lake would have a normal water surface elevation of 700 feet above MSL, with a corresponding storage volume of 1.24 maf. At the normal water surface elevation, Millerton Lake would inundate an additional 3,500 acres. The increased surface area and water surface elevation would inundate the Millerton Lake Recreational Area and PG&E's Kerckhoff Powerhouses No. 1 and No. 2. The increased inundation area is shown in Figure 2, along with the location of the Millerton Lake Recreation Area and the Kerckhoff Powerhouses.

Power Plants

The existing power plants would be enlarged to generate additional power. The river outlet power generating capacity would be increased from 2.0 3.0 MW. The Friant-Kern Canal power generating capacity would be increased from 15.0 to 22.0 MW. The Madera Canal power generating capacity would be increased from 8.0 to 12.0 MW. The increase in power generation capacity would be due to the increased head from the expanded facilities and increased capacity of upsized power plants.

The increased power generation at the Millerton Lake Enlargement would partly offset the lost generating capacity of the Kerckhoff powerhouses. Any increase in water levels above 578 feet above MSL would impact the operation of Kerckhoff No. 2 Powerhouse and an increase above 635 feet above MSL could impact operations at Kerckhoff No. 1 Powerhouse (PG&E pers. comm. March 1997).

Dikes

Three dikes would be needed for the enlargement of Millerton Lake. The approximate locations of the dikes are shown on Figure 2. Two of the dikes would be adjacent to the main dam; the third dike would be about three miles east of the main dam. The dikes would have a crest elevation of 725 feet above MSL and have an estimated embankment volume of 10 million cubic yards.

COST ESTIMATE

The cost estimates for the facilities described in the previous sections are based on previous estimates performed by Reclamation. Only items included in the previous estimates are included in the present cost estimate and are expressed in October 1996 dollars. Items not included in this estimate are environmental documentation, operation and maintenance costs, power costs, reservoir filling costs, interest during construction, and the relocation costs of Kerckhoff No. 1 and No. 2 Powerhouses or the Millerton Lake State Recreation Area.

COST ESTIMATE METHODOLOGY

The July 1982 Reclamation cost estimates have been reviewed and adapted for the present cost estimate update. Reclamation cost estimate has been reviewed and adapted for the

present cost estimate update. Several items in the previous cost estimate were modified to ensure that current design standards and safety factors were incorporated.

General

The cost estimate for the Millerton Lake Enlargement was determined by escalating the costs provided in the unpublished August 1982 Reclamation report entitled *Friant Dam Reconnaissance Cost Estimate*. The costs were escalated to October 1996 dollars using Reclamation's Construction Cost Trends (CCT) indices. Table 2 provides a detailed breakdown of the estimated costs of the Millerton Lake Enlargement. Table 2 also includes 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 includes Reclamation's CCT index for the month and year in which the estimated cost was developed and for October 1996. These 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, current unit costs were determined 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 $3,000 per acre were used based on land use costs developed by Reclamation, Land Resource Branch (February 1997). The total project lands that need to be acquired 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.

Generating Plant Costs

The 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 Millerton Lake Generating Facilities. To develop a cost for the Millerton Lake Generating Facilities, the actual construction cost of the Waddell Pumping-Generating Plant (escalated to October 1996 dollars) was factored by the following empirical equation:

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

Where HP is equal to horsepower.

The cost factor was applied to the incremental increase in power generator capacity in excess of the existing capacity. The 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 selected by historical engineering judgment based on a review of previous studies with similar levels 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. Costs for

the initial filling of the reservoirs, interest during construction, and environmental mitigation are not included in this estimate.

PRELIMINARY COST FINDINGS

Costs of enlarging Friant Dam and its supporting facilities have been updated to an October 1996 basis as described above. The cost of enlarging Friant Dam and constructing the necessary dikes would be $411 million, roughly 50 percent of the total estimated project cost. Table 3 summarizes estimated costs within selected project categories. The total cost of the Millerton Lake Enlargement is estimated to be about $842 million with a resulting calculated range of costs between $758 million and $968 million.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The Environmental Considerations section needs to be reevaluated by DWR to ensure consistency with the information in the previous sections.]

This portion of the report provides a summary of environmental considerations related to the proposal for developing an enlarged Millerton Lake. Fish, wildlife, plant, and cultural resources that could be affected by the proposal are described and the extent of the impacts is 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

Depending on the reservoir configuration selected, the project could inundate up to 3,000 acres of wildlife habitat consisting primarily of blue-oak woodland, annual grassland, and chaparral. Other habitat types located around and upstream of Millerton Lake include montane hardwood - conifer, blue oak - digger pine, valley foothill riparian, and riverine. These habitats provide foraging areas and cover for a number of wildlife species.

Fish, Amphibians, Reptiles, and Invertebrates

The fishery in the existing Millerton Lake consists primarily of game fish: spotted bass, bluegill, striped bass, and American shad. Representative nongame species include hardhead, Sacramento squawfish, threadfin shad, and golden shiner.

Existing conditions in the portion of the San Joaquin River below Millerton Lake are generally suitable for warm water fish species and unfavorable for fall Chinook salmon, trout, American shad, and striped bass.

Enlarging Millerton Lake would initially provide additional shoreline fish habitat and temporarily increase nutrient levels in the lake. This would improve fish production in the lake, however, if reservoir operations call for large fluctuations in lake levels, largemouth bass spawning would continue to be adversely affected. The proposed enlargement would also inundate several miles of spawning habitat for American shad and striped bass in the San Joaquin River upstream of the lake, resulting in lower productivity for these species. Depending on how the project is operated, reduced flows in the San Joaquin River below the lake could adversely affect fishery resources in the river.

Several species of common amphibians and reptiles may occur in and around the Millerton Lake area. Common species that may be observed include bullfrog, Pacific tree frog, California toad, western fence lizard, side-blotched lizard, Pacific gopher snake, coast and aquatic gopher snake, and Pacific rattlesnake.

General Wildlife

Lands surrounding the existing Millerton Lake support diverse wildlife. Game species that can be found around Millerton Lake include mule deer, California quail, mountain quail, and mourning dove. Furbearers that can be found in the area include racoon, spotted and striped skunk, bobcat, gray fox, badger, coyote, and ringtail. Nongame birds include gulls, grebes, great blue herons, egrets, and various song bird species. Raptors include golden eagles, kestrels, red-tailed hawks, harriers, and white-tailed kites. The lake is also a wintering and rafting area for several species of waterfowl.

The project would have both beneficial and adverse effects on wildlife. Enlarging the lake would create additional open water shoreline habitat for gulls, grebes, waterfowl, shorebirds, and wading birds. Project-related flow changes however, could adversely affect waterfowl using the lower portions of the San Joaquin River.

Sensitive and Listed Fish and Wildlife Species

According to the California Department of Fish and Game's California Natural Diversity Data Base records (CNDDB - Version 8/96), there are three wildlife species that are federally listed, and six wildlife species that are either candidates for listing and/or species designated by California Department of Fish and Game (CDFG) as "species of special concern," that

have been known to occur in the area affected by the proposed enlargement of Millerton Lake.

Listed wildlife species that could be affected by the proposed enlarged Millerton Reservoir include Vernal Pool Fairy Shrimp (Federal Threatened), Vernal Pool Tadpole Shrimp (Federal Endangered), and Valley Elderberry Longhorn Beetle (Federal Threatened).

Based on information provided by the U.S. Fish and Wildlife Service, listed species that may occur in the Millerton Lake area, or be indirectly affected by the proposed reservoir include: Delta Smelt (Federal Threatened), Giant Garter Snake (Federal Threatened\State Endangered), Blunt-nosed Leopard Lizard (Federal Endangered, State Endangered), Bald Eagle (Federal Threatened\State Endangered), Aleutian Canada Goose (Federal Threatened), American Peregrine Falcon (Federal Endangered), and the Fresno Kangaroo Rat (Federal Endangered/State Endangered).

Wildlife species that are either candidates for State or federal listing, or considered species of special concern by the CDFG that have been recorded as occurring in the area that would be affected by the proposed project include California Tiger Salamander, Western Spadefoot, Golden Eagle, Prairie Falcon, California Mastiff Bat, and Moestan Blister Beetle.

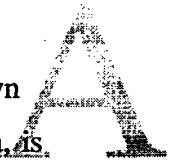
According to the USFWS, it is also possible that several other sensitive wildlife species proposed for federal listing or candidates for listing may be affected directly or indirectly. These species include California Red-legged Frog, Sacramento Splittail, Spotted Bat, Yuma Myotis, Small-footed Myotis, Greater Western Mastiff Bat, Long-eared Myotis Bat, Fringed Myotis Bat, Long-legged Myotis Bat, Pacific Western Big-eared Bat, Southern Grasshopper Mouse, San Joaquin Pocket Mouse, Northern Goshawk, Tricolored Blackbird, Western Burrowing Owl, Mountain Plover, Little Willow Flycatcher, White-faced Ibis, Northwestern

Pond Turtle, Southwestern Pond Turtle, California Horned Lizard, Foothill Yellow-legged Frog, Green Sturgeon, River Lamprey, Kern Brook Lamprey, Pacific Lamprey, Longfin Smelt, San Joaquin Tiger Beetle, Molestan Blister Beetle, Bohart's Blue Butterfly, and Sierra Pygmy Grasshopper.

Vegetation

Vegetation in the area surrounding Millerton Lake is classified as Upper Sonoran Life Zone. Common species found in this zone include manzanita, chamise, ceanothus, digger pine, valley oak, blue oak, and live oak.

There are two significant natural areas near Millerton Lake. The Friant South Significant Natural Area is located just below Friant Dam along the San Joaquin River. This area contains northern hardpan vernal pool habitat and the plant, succulent owl's-clover is known to occur in this natural area. The other area, Big Table Mountain Significant Natural Area, is located on the southeast side of Millerton Lake. Northern basalt flow vernal pool habitat, molestan blister beetle, Boggs lake hedge-hyssop, succulent owl's-clover, and San Joaquin Valley orcutt grass are known to occur within this natural area.



Sensitive and Listed Plant Species and Communities

According to CDFG's NDDB records, the following federal or State listed plant species are known to occur in or near Millerton Lake: Succulent Owls' Clover (Federal proposed threatened, State endangered), San Joaquin Valley Orcutt Grass (Federal proposed threatened, State endangered), and Hartwig's Golden Sunburst (Federal proposed endangered, state endangered). An additional federal proposed threatened plant species that may occur in the Millerton Lake area is the Fleshy Owl's-clover.

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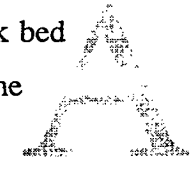
Madera Linanthus and Spiny-sepaled Coyote Thistle, listed by the California Native Plant Society as being rare, threatened or endangered in California and elsewhere, or considered a candidate for federal listing, could also be found in the area.

The area surrounding Millerton Lake contains several special status habitats including Northern Hardpan Vernal Pool, Northern Basalt Vernal Pool, Great Valley Mixed Riparian Forest, and Sycamore Alluvial Woodland.

Wetlands

Many of the creeks and drainages flowing into Millerton Lake have one or more areas which support stands of cattails and tules. These wet areas occur both naturally along the creek bed and artificially in areas where impoundments have been constructed across the creek. The area that would be impacted by the proposed enlargement is estimated to support approximately ten miles of intermittent streambed, two miles of scrub-shrub wetlands (wet meadow), five miles of emergent temporarily flooded wetlands (wet meadow), three miles of upper perennial rock wetlands, and three miles of diked/impounded, emergent seasonally flooded wetlands (shallow marsh).



Two special status wetland habitats, Northern Hardpan Vernal Pool and Northern Basalt Flow Vernal Pool, could be affected by the proposed enlargement of Millerton Lake.

Cultural Resources

An estimated 53 non-significant, ten significant prehistoric sites and four non-significant historic sites could potentially be affected by the proposed enlargement of Millerton Lake.

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Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
MILLERTON LAKE ENLARGEMENT

	Existing	Enlarged
Reservoir		
Normal Water Surface Elevation (feet above MSL)	578	700
Capacity (acre-feet)	520,000	1,240,000
Reservoir Area (acres)	4,900	8,400
Main Dam		
Type	Concrete gravity	Concrete gravity
Height (feet)	319	463
Top of Dam (feet MSL)	581	725
Crest Length (feet)	3,488	7,500
Downstream Face Slope (horizontal on vertical)	0.7:1	0.7:1
Upstream Face Slope (horizontal on vertical)	Vertical	Vertical
Saddle Dams		
Number Required	0	3
Spillway		
Gated Elevation (feet MSL)	578	720
Invert Elevation (feet MSL)	560	702
Length (feet)	3,000	3,000
Design Flow (cfs)	90,000	90,000
Outlet Works		
River Release (cfs)	17,000	17,000
Friant-Kern Canal (cfs)	5,300	5,300
Madera Canal (cfs)	1,275	1,275
Power Capacity		
River Outlet (MW)	2.0	3.0
Friant-Kern Canal (MW)	15.0	22.0
Madera Canal (MW)	8.0	12.0

Table 2
ESTIMATED COSTS
MILLERTON LAKE ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 82	USBR INDEX OCT. 96	UNIT COST APR. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. LAND								
Reservoir Rights-of-Way	5,280	AC				$3,000	$15,840,000	1
SUBTOTAL LAND AND RIGHTS							$15,840,000	
II. RELOCATION OF HOMES								
Homes	7	EA	144	217	$100,000	$150,694	$1,054,858	2
SUBTOTAL RELOCATION OF HOMES							$1,054,858	
III. CLEARING LANDS								
Reservoir Clearing	4,000	AC				$1,097	$4,388,000	3, item IVa
SUBTOTAL CLEARING LANDS							$4,388,000	
IV. FRIANT DAM ENLARGEMENT (includes Spillway and Outlet Works)								
Diversion and Care of River	JOB	LS	146	203	$375,000	$521,404	$521,404	2
Excavation								
All Classes of Dam & Stilling Basin Foundations	448,000	CY	146	203	$2.40	$3.34	$1,494,970	2
Excavation Concrete	11,800	CY	146	203	$12.00	$16.68	$196,882	2
Chipping and Roughening of Concrete Surfaces	112,600	SY	146	203	$5.00	$6.95	$782,801	2
Backfill and Compacted Backfill	39,000	CY	146	203	$6.00	$8.34	$325,356	2
Pressure Grouting Const. Joints & Cooling System	62,000	CF	146	203	$90.00	$125	$7,758,493	2
Concrete in Dam	3,842,500	CY	146	203	$53.00	$73.69	$283,160,668	2
Prepackt Concrete in Dam	86,500	CY	146	203	$102	$142	$12,267,596	2
Concrete in Spillway Crest & Piers	9,700	CY				$401	$3,889,700	3, avg IIh, IIIc
Concrete in Spillway Training Walls	4,220	CY				$401	$1,692,220	3, avg IIh, IIIc
Concrete in Stilling Basin Walls	3,180	CY				$401	$1,275,180	3, avg IIh, IIIc
Concrete in Stilling Basin Floors and Aprons	24,900	CY				$293	$7,295,700	3, item IIId
Concrete in Sidewalks, Curbs and Parapets	6,300	CY				$401	$2,526,300	3, avg IIh, IIIc
Concrete Cooling Treatment	3,842,000	CY	146	203	$3.40	$4.73	$18,162,660	2
F&P Cement	22,000,000	CW	146	203	$6.50	$9.04	$198,828,767	2
F&P Rebars	5,317,000	LBS	146	203	$0.65	$0.90	$4,805,330	2
Install Metal Tubing & Fittings for:								2
Grouting Concrete Construction joints	331,000	LBS	146	203	$0.40	$0.56	$184,090	2

Table 2
ESTIMATED COSTS
MILLERTON LAKE ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX APR. 82	USBR INDEX OCT. 96	UNIT COST APR. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Grouting Concrete Cooling Systems	4,765,000	LBS	146	203	$0.25	$0.35	$1,656,327	2
F&P Metal Seal Strips	87,000	FT	146	203	$4.25	$5.91	$514,104	2
Misc. Metal Work	46,000	LBS				$3.04	$139,840	3, item II-k
Electrical Conduit and Outlets	JOB	LS	146	203	$39,100	$54,365	$54,365	2
Track Rails	85,000	LBS	146	203	$1.10	$1.53	$130,003	2
Drum Gate	1,435,000	LBS	146	203	$0.40	$0.56	$798,096	2
Drum Gate Mechanisms	102,000	LBS	146	203	$0.40	$0.56	$56,729	2
Outlet Pipe Extensions	915,000	LBS	146	203	$0.40	$0.56	$508,890	2
Dismantling, modifying & Reinstalling Gantry	370,000	LBS	146	203	$0.50	$0.70	$257,226	2
Moving, Modifying and Resetting Gantry Cranes	22,000	LBS	146	203	$0.50	$0.70	$15,295	2
Moving, Modifying and Resetting Outlet Valves	1,160,000	LBS	146	203	$0.50	$0.70	$806,438	2
Dismantling Existing Drum Screen Gates	1,430,000	LBS	146	203	$0.25	$0.35	$497,072	2
Backfill	100,000	CY	146	203	$0.60	$0.83	$83,425	2
SUBTOTAL FRIANT DAM ENLARGEMENT							$313,365,270	
V. DIKES								
Excavation, Common								
Stripping Dike								
Embankment Foundation	76,000	CY	135	176	$0.85	$1.11	$84,219	2
Stripping Borrow Pits & Haul to Embankment	96,000	CY				$3.23	$310,080	3, item I-d
Borrow Pits & Haul to Embankment	202,000	CY	135	176	$1.00	$1.30	$263,348	2
Rock for Grout Caps	9,000,000	CY	135	176	$2.00	$2.61	$23,466,667	2
Earthfill in Embankments	6,400	CY	135	176	$85.00	$111	$709,215	2
Rockfill in Embankments	10,100,000	CY	135	176	$3.00	$3.91	$39,502,222	2
F&P Riprap	85,000	CY	135	176	$1.50	$1.96	$166,222	2
F&P Sand and Gravel	278,000	CY				$31.64	$8,795,920	3, item I-n
8" Diameter Sewer Pipe Drains in Gravel	371,000	CY	135	176	$10.00	$13.04	$4,836,741	2
10" Diameter Sewer Pipe Drains in Gravel	12,500	LF	135	176	$17.00	$22.16	$277,037	2
Grout Drilling	9,500	LF	135	176	$20.00	$26.07	$247,704	2
Grout	637,500	LF				$18.70	$11,921,250	3, item I-g
Concrete in Curbs and Parapets	36,000	SKS	135	176	$0.65	$0.85	$30,507	2
Concrete in Vertical Cut-off Wall	8,000	CY	135	176	$300.00	$391	$3,128,889	2
Concrete in Grout Cap	4,100	CY	135	176	$300.00	$391	$1,603,556	2
Cement	6,400	CY	135	176	$107.00	$139	$892,776	2
Rebar	36,000	CY	135	176	$6.50	$8.47	$305,067	2
	1,200,000	LBS	135	176	$0.65	$0.85	$1,016,889	2

Table 2
ESTIMATED COSTS
MILLERTON LAKE ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 82	USBR INDEX OCT. 96	UNIT COST APR. 82	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Seeding and Watering	16	AC	135	176	$1,000.00	$1,304	$20,859	2
SUBTOTAL DIKES							$97,579,168	
VI. POWER PLANTS								
River Outlet Power Plant (3.0 MW)	JOB	LS					$13,436,000	4
Friant-Kern Outlet Power Plant (22.0 MW)	JOB	LS					$43,183,000	4
Meadra Outlet Power Plant (12.0 MW)	JOB	LS					$30,867,000	4
SUBTOTAL POWER PLANTS							$87,486,000	
SUBTOTAL							$520,000,000	
CONTINGENCIES @ 20%							$104,000,000	
ESTIMATED CONSTRUCTION COST							$624,000,000	
ENG., LEGAL, AND ADM. @ 35%							$218,000,000	
ESTIMATED CAPITAL COST							$842,000,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10%)							$758,000,000	
HIGH (+15%)							$968,000,000	

Footnotes:

[a]CY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre, SCK= sack

Cost Reference:

1. U.S. Bureau of Reclamation, Land and Resources Branch, Graham McMullen, CALFED Component Land Costs, February 1997.
2. U. S. Bureau of Reclamation, *Cost Estimate for Friant Dam Enlargement*, Dated July 1982.
3. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, Table 4, December 1990.
4. Costs Developed by Bookman-Edmonston Engineering.

Table 3

SUMMARY OF ESTIMATED COSTS

MILLERTON RESERVOIR

Cost Item	Estimated Cost ($Million)
Land	15.8
Relocation of Homes	1.1
Clearing Lands	4.4
Friant Dam Enlargement	313.4
Dikes	97.6
Power Plant	87.5
SUBTOTAL	520.0
Contingencies (20%)	104.0
ESTIMATED CONSTRUCTION COST	624.0
Engineering, Legal, and Project Administration (35%)	218.0
ESTIMATED TOTAL CAPITAL COST	842.0
Capital Cost Range (minus 10% - plus 15%)	$758 - $968

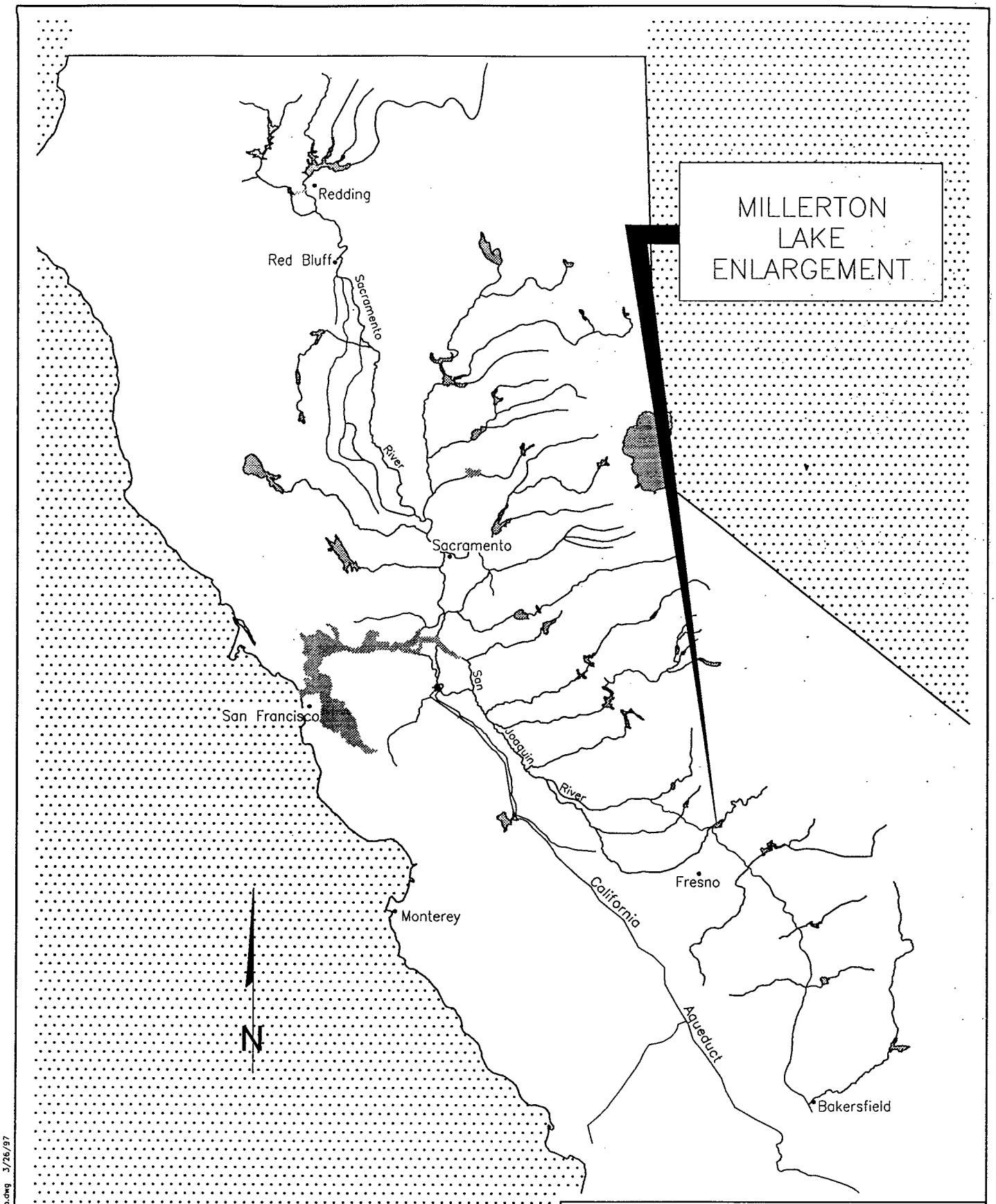

Figure 1
Project Location Map
Millerton Lake Enlargement

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CALFED BAY-DELTA PROGRAM

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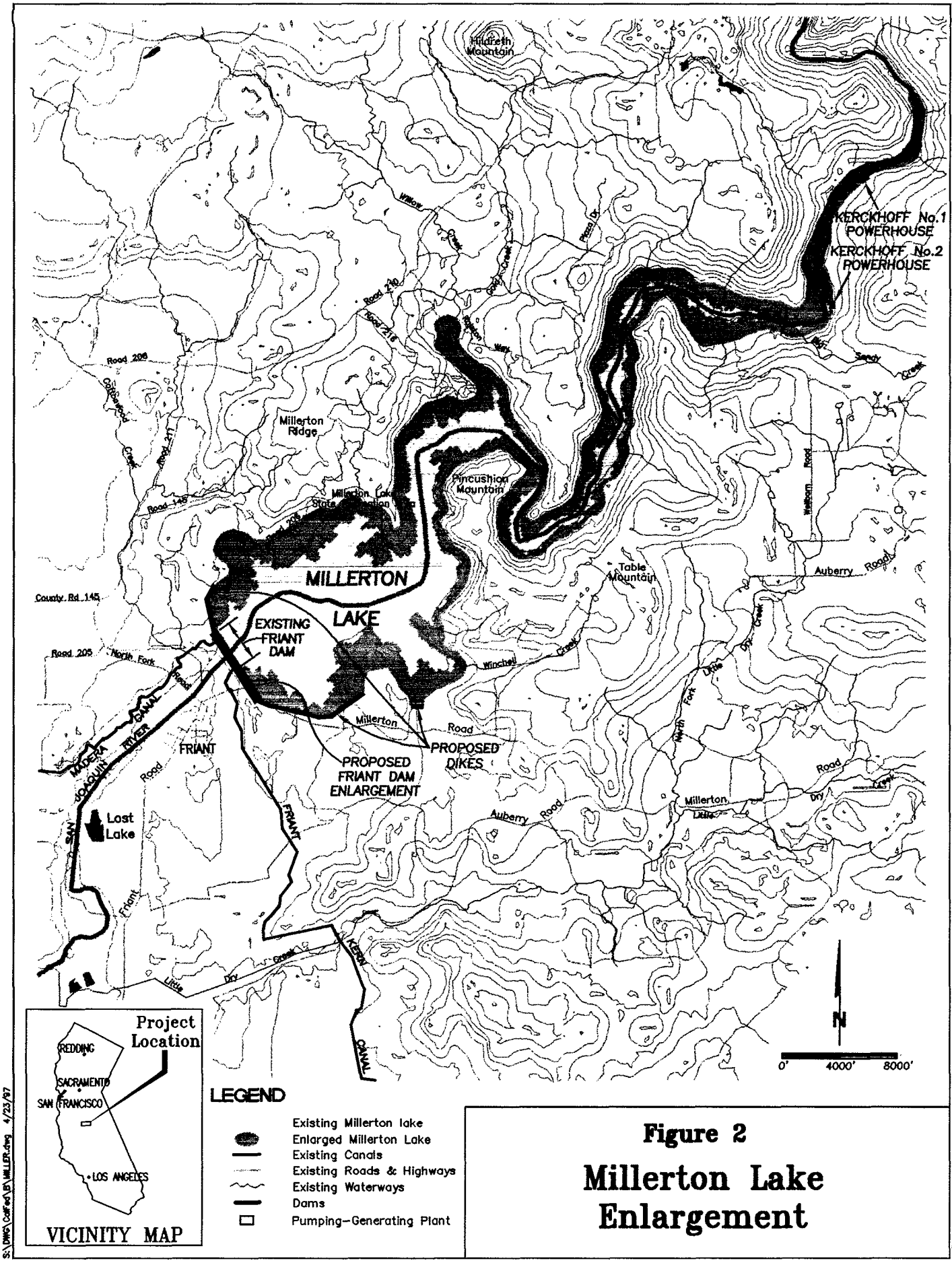

Figure 2

Millerton Lake Enlargement

CALFED BAY-DELTA PROGRAM

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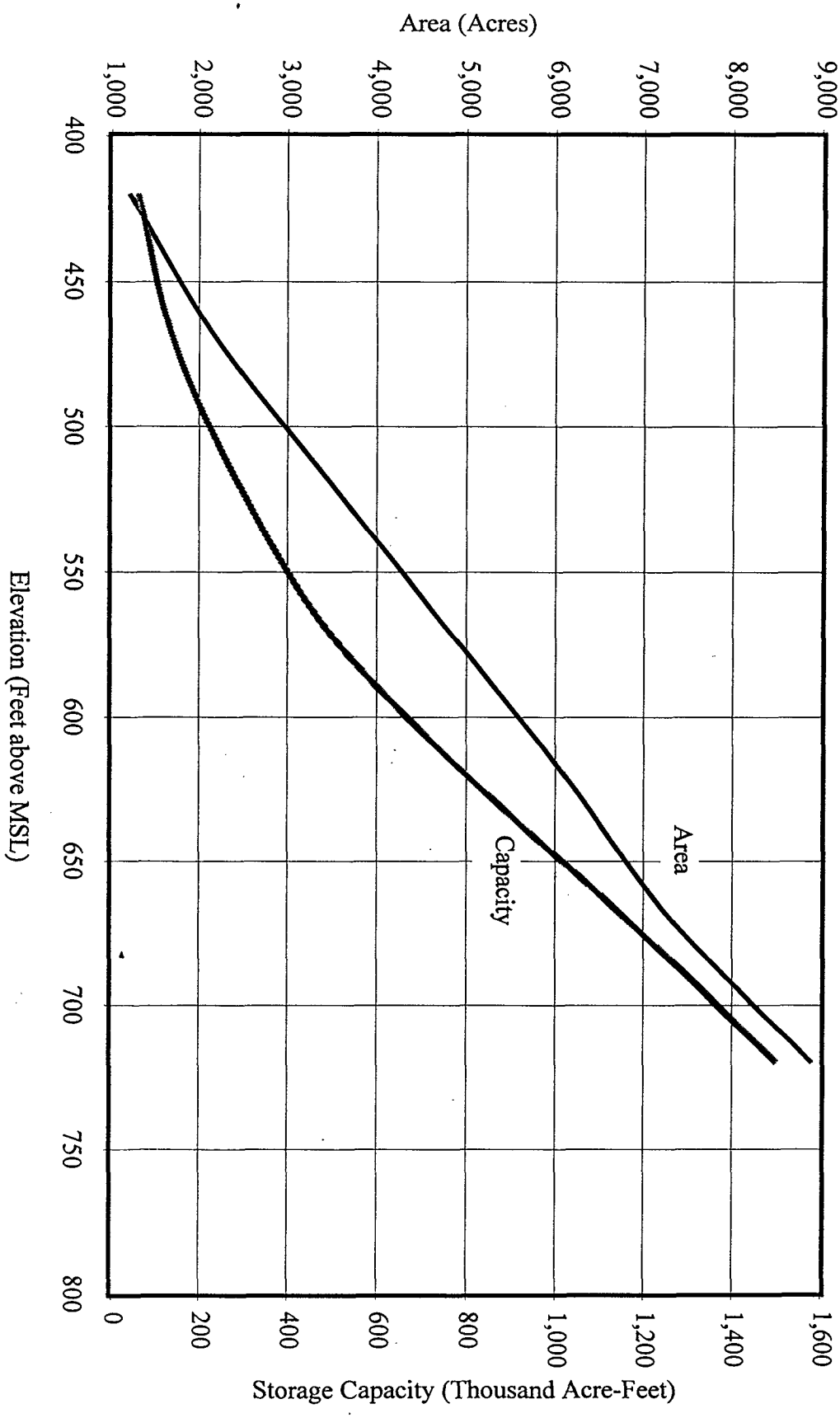

Figure 3
AREA-CAPACITY CURVES
MILLERTON LAKE

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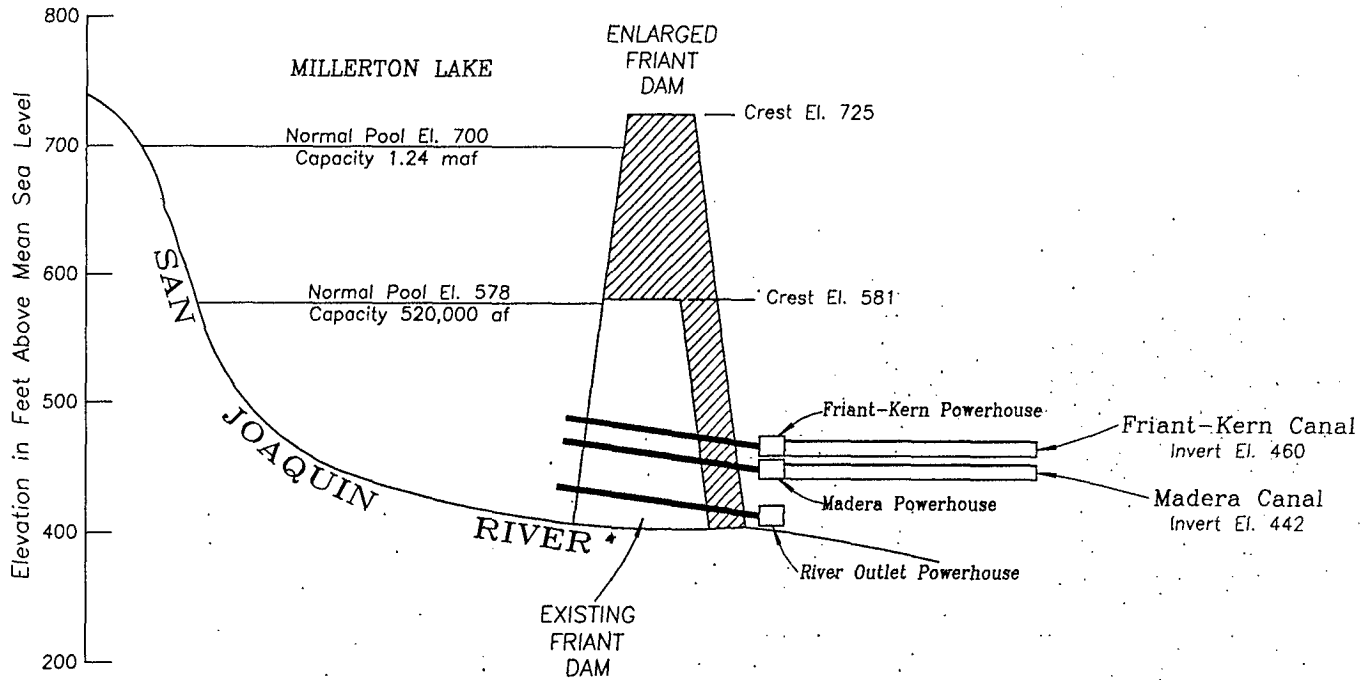

Figure 4

Millerton Lake Enlargement

Schematic Profile

CALFED BAY-DELTA PROGRAM