
**FACILITY DESCRIPTIONS
AND UPDATED COST ESTIMATES
FOR THE LOS VAQUEROS RESERVOIR ENLARGEMENT**

**Prepared by the CALFED Storage and Conveyance Refinement Team
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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for the Los Vaqueros Reservoir Enlargement* 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 the 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 enlarging the Los Vaqueros Reservoir (which is currently under construction) from a storage capacity of 100,000 acre-feet to 1,065,000 acre-feet. The general location of the Los Vaqueros Reservoir is shown on Figure 1. This evaluation and others being performed by CALFED are intended to provide facilities evaluations and updated cost estimates of representative storage and conveyance components. The objectives of the Los Vaqueros Reservoir Enlargement evaluation are (1) to provide an updated estimate of the capital cost of constructing this project 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 Los Vaqueros Reservoir Enlargement Project is based primarily on the California Department of Water Resources (DWR) report *Los Vaqueros Offstream Storage Unit Studies: Wrap-Up Report* and the construction costs of the 100,000 acre-foot Los Vaqueros Reservoir currently being constructed by the Contra Costa Water District (CCWD). These costs have been reviewed and adapted by Bookman-Edmonston Engineering. Several items in the previous cost estimates were modified to ensure that current design standards and safety factors were incorporated. Also, additional project costs such as environmental documentation or

mitigation, operation and maintenance, power, and interest during construction were not included in this evaluation.

A preliminary evaluation of the environmental considerations associated with the Los Vaqueros Reservoir Enlargement has 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

Various reservoir projects have been examined over the past four decades in the Kellogg Creek watershed. These have included several sizes of reservoirs at the Los Vaqueros site and the Kellogg site. Some of these studies were in response to CCWD's desire to improve its water quality and increase system reliability. Other investigations were initiated as an attempt to find ways to increase the yield of the Central Valley Project (CVP) and the State Water Project (SWP).

In 1960, the U.S. Bureau of Reclamation (Reclamation) undertook several studies of Kellogg Creek reservoir sites at the request of CCWD. Reclamation's 1967 feasibility report recommended a 135,000 acre-foot reservoir at the Kellogg site, but other federal priorities prevented funding for its design and construction. In 1970, Leeds, Hill and Jewett, Inc., under contract to CCWD, recommended a 105,000 acre-foot reservoir at the Los Vaqueros site as an alternative to the Kellogg site. However, because other agencies had expressed their intentions to pursue the project, CCWD did not. DWR also studied the Los Vaqueros site in the late 1970s and 1980s as a potential storage location to increase its supply of good quality water. In July 1987, DWR Bulletin 76, *Delta Water Facilities*, was published, which recommended additional feasibility and environmental studies for the Los Vaqueros Offstream Storage Unit. In 1981, the

Central District of DWR prepared a report *Los Vaqueros Offstream Storage Unit, Engineering Feasibility*, which concluded that a 1,065,000 acre-foot Los Vaqueros Reservoir was technically feasible and that advanced planning studies should continue. However, in June 1982, this project died when Ballot Proposition 9, which tied Los Vaqueros with the controversial Peripheral Canal was defeated.

In 1980, Congress had also authorized the Kellogg Unit Reformulation Study, which included an investigation of moving the Contra Costa Canal intake to a Delta location that would provide better water quality. In 1985, Reclamation initiated the Offstream Storage Investigation, which included the Los Vaqueros and Kellogg sites.

Also in 1985, CCWD acted to preserve the Kellogg watershed for a reservoir in a response to the Contra Costa County's approval of a residential subdivision within the watershed. To this end, CCWD funded a study to analyze alternative methods of improving water quality and system reliability. In February 1986, a Stage 1 Environmental Impact Report (EIR) was prepared pursuant to the California Environmental Quality Act (CEQA). As a result of these efforts, in September 1986, the CCWD Board of Directors (Board) certified the Stage 1 EIR, approving the Los Vaqueros project concept, and authorizing purchase of land in the watershed. In 1988, after further studies, the CCWD Board approved a 100,000 acre-foot reservoir on Kellogg Creek at the Los Vaqueros site. After voter approval and the preparation and certification of the Final Stage 2 EIR in 1993, design and construction was authorized. As of this writing, the 100,000 acre-foot Los Vaqueros Reservoir was under construction.

Currently, CALFED is developing a long-term comprehensive plan that will restore the ecological health and improve water management for beneficial uses of the Bay-Delta system. As part of this effort, the possibility of an enlarged Los Vaqueros Reservoir Project has been identified as a possible element to meet CALFED's objectives. This evaluation summarizes the

principal features, estimated costs and environmental considerations of enlarging the Los Vaqueros Reservoir to provide 1,065,000 acre-feet of storage.

FACILITIES DESCRIPTION

This section provides an overview of the major features included in the proposed Los Vaqueros Reservoir Enlargement Project. The principal reference used for this synopsis is the April 1983 DWR, *Los Vaqueros Offstream Storage Unit Studies: Wrap-Up Report*.

PROJECT LOCATION

As shown in Figure 2, the proposed Los Vaqueros Reservoir Enlargement Project would be located in Contra Costa County, on the eastern slope of the Coast Range. Los Vaqueros Reservoir is located about 11 miles south of Antioch and 7 miles northwest of the Clifton Court Forebay.

PROJECT DESCRIPTION

The Los Vaqueros Reservoir Enlargement Project would be a multipurpose water storage project designed to improve water quality and reliability of the CVP and SWP. The project would consist of an enlarged off-stream storage reservoir, a forebay, pumping-generating plants, and conveyance facilities. The Los Vaqueros Dam, which is currently being constructed, would be removed to build a larger earthfill dam. The Los Vaqueros Reservoir Enlargement Project would be operated to augment the yield of the CVP and SWP and to increase operational flexibility of Delta export operations for both projects. Available Delta flows would be pumped from Clifton Court Forebay, first to Kellogg Forebay, and then into the enlarged Los Vaqueros Reservoir via the Los Vaqueros Pumping-Generating Plant. Storage releases would also generate energy at the

Los Vaqueros Pumping-Generating Plant. The Tuway Canal would convey water in either direction between Kellogg Forebay and the California Aqueduct.

PRINCIPAL FACILITIES

The following section provides an overview of the major features of the Los Vaqueros Reservoir Enlargement Project with a storage capacity of 1,065,000 acre-feet. As shown in Figure 2, the principal features would generally include the main Los Vaqueros Dam and Reservoir, the Kellogg Forebay, and conveyance facilities including canals, pipelines, and pumping-generating plants. Table 1 provides a summary of the physical characteristics of each of the major features associated with the Los Vaqueros Reservoir Enlargement Project.

Los Vaqueros Dam and Reservoir

The Los Vaqueros Reservoir Enlargement Project would consist of a main dam and four saddle dams that would create a reservoir with a normal water surface elevation of 780 feet above mean sea level (MSL). At that elevation, the reservoir would have a water surface area of 4,830 acres and a storage capacity of 1,065,000 acre-feet. The main dam would be a zoned earth embankment with an impervious core. This earthfill structure would be built across Kellogg Creek and would have a crest elevation of 800 feet above MSL, a dam height of 505 feet above the streambed, and a crest length of 2,700 feet. The dam embankment volume would be 35.5 million cubic yards and would have a downstream face slope of 2.5:1 and an upstream face slope of 3.5:1. Figure 3 provides a schematic profile of the Los Vaqueros Reservoir Enlargement Project and Figure 4 shows the area-capacity relationship.

In addition, the Los Vaqueros Dam and Reservoir would have a concrete-lined, chute-type spillway structure located on the right abutment of the dam site. The spillway length would be 2,200 feet. The spillway and river outlet works facilities would safely pass the maximum

probable flood flow. The inlet-outlet works would serve three purposes: (1) to enable rapid release of reservoir storage during an emergency situation, (2) to provide a choice of reservoir depths from which to make releases during normal operation, and (3) to provide a means to pumping water into the reservoir. It would consist of three concrete and steel-lined pressure tunnels (lower, middle, and upper) with a normal operating capacity of 5,000 cfs and an emergency capacity of 11,800 cfs to meet the release requirements of DWR's Division of Safety of Dams.

Kellogg Forebay

The Kellogg Forebay would serve as a transfer facility between the Kellogg Pumping Plant and the Los Vaqueros Pumping-Generating Plant. It would have a normal water surface elevation of 244 feet above MSL, a surface area of 124 acres, and a storage capacity of 4,270 acre-feet. The forebay would be formed by a dam on Kellogg Creek and one saddle dam. The Kellogg Forebay Dam, located about 1.5 miles south of Camino Diablo Road and approximately 3 miles downstream of the Los Vaqueros Dam, would be a zoned earthen embankment with an impervious core. This earthfill structure would have a height of 90 feet and a crest elevation of 260 feet above MSL. The dam embankment volume would be 0.14 million cubic yards with a downstream face slope of 2.5:1 and an upstream face slope of 3.5:1.

In addition, the main Kellogg Forebay Dam would have a concrete-lined, chute type spillway structure located on the right abutment of the dam site. The spillway length would be 340 feet. The spillway and river outlet works could safely pass the maximum probable flood flow. The outlet works would have a maximum release capacity of 45 cfs designed to meet the emergency release requirements of DWR's Division of Safety of Dams.

Conveyance Facilities

In general, the conveyance facilities would consist of the Los Vaqueros Pipeline, the Los Vaqueros Pumping-Generating Plant, the Tuway Canal, the widened North San Joaquin Intake Channel, the Kellogg Pumping Plant, and the Kellogg Pumping Plant Discharge Facility.

Water released from the enlarged Los Vaqueros Reservoir would pass through the Los Vaqueros Pipeline, through the turbines of the Los Vaqueros Pumping-Generating Plant and into Kellogg Forebay. (The enlarged Los Vaqueros Reservoir would also have a connection to CCWD's existing pipeline.) Kellogg Forebay water would be released to the Tuway Canal where it would flow by gravity to the California Aqueduct.

During reservoir filling operations, the Kellogg Pumping Plant would pump water from the North San Joaquin Intake Channel leading to Harvey O. Banks Pumping Plant, into the Tuway Canal. Tuway Canal, which can convey flows in either direction, would transport the pumped Delta water to Kellogg Forebay. From the forebay, water would be pumped through the Los Vaqueros Pipeline into the enlarged Los Vaqueros Reservoir.

Los Vaqueros Pipeline

The Los Vaqueros Pipeline would be located between the Los Vaqueros Reservoir and the Los Vaqueros Pumping-Generating Plant. This 5,000 cfs pipeline would consist of nine 11,000-foot-long, 144-inch diameter pipes and would convey water to and from the Los Vaqueros Reservoir. Also, a connection would be made to CCWD's existing water supply pipeline from the 100,000 acre-foot Los Vaqueros Reservoir which is currently under construction.

Los Vaqueros Pumping-Generating Plant

The 5,000 cfs Los Vaqueros Pumping-Generating Plant located at Kellogg Forebay would lift water from Kellogg Forebay to Los Vaqueros Reservoir through the Los Vaqueros Pipeline. The pumping plant would also generate power from storage releases from Los Vaqueros Reservoir to Kellogg Forebay. The pumping-generating plant would have a capacity of 5,000 cfs, a total dynamic head of 552 feet, and a total horsepower of 418,000.

Tuway Canal

The Tuway Canal would connect Kellogg Forebay to the California Aqueduct. It would convey water pumped by the existing Harvey O. Banks Delta Pumping Plant or by the Kellogg Pumping Plant to Kellogg Forebay. The Tuway Canal would be a 4.5-mile-long, concrete-lined structure and have a capacity of 5,000 cfs in either direction. Included in this 4.5-mile canal would be a 2,900-foot-long siphon structure, which would consist of six 23' x 23' concrete boxes. The right-of-way for the canal would consist of 410 acres. Figures 5a and 5b show the typical cross-section of the Tuway Canal in fill and in cut, respectively. The typical cross section of the canal would generally consist of a trapezoidal section with side slopes of 2:1. The canal would have a top width of 135 feet, a bottom width of 60 feet, and a depth of 25 feet from the normal operating water surface elevation.

North San Joaquin Intake Channel Widening

The North San Joaquin Intake Channel conveys water from Clifton Court Forebay to Harvey O. Banks Pumping Plant. The intake channel would be widened to increase its capacity from 10,900 cfs to 15,900 cfs. Widening of this channel was found to be more economical and technically feasible than construction of a separate intake channel for the Kellogg Pumping Plant, which would pump water into the Tuway Canal. The typical cross-section of this channel would

consist of a trapezoidal section with side slopes of 2:1. The 2-mile-long channel would have a top width of 304 feet, a bottom width of 120 feet, and a depth of 46 feet from the normal operating water surface elevation.

Kellogg Pumping Plant

The Kellogg Pumping Plant would be located near the top of the North San Joaquin Intake Channel on the north side of Harvey O. Banks Pumping Plant. The pumping plant would lift water from the enlarged intake channel into the Tuway Canal. The Kellogg Pumping Plant would have a capacity of 5,000 cfs, a total dynamic head of 255 feet, and a total horsepower requirement of 193,000.

Kellogg Pumping Plant Discharge Facility

The Kellogg Pumping Plant Discharge Facility would have a capacity of 5,000 cfs and would consist of nine 3,200-foot-long, 144-inch-diameter pipelines, a 1,000 foot-long canal, and three 25' x 55' radial gates.

COST ESTIMATE

The cost estimate for the Los Vaqueros Reservoir Enlargement Project is based on the DWR report, *Los Vaqueros Offstream Storage Unit Studies: Wrap-Up Report*. Additional project costs such as environmental documentation or mitigation, operation and maintenance, power, and interest during construction were not included.

COST ESTIMATE METHODOLOGY

The basis of this cost estimate originates from the cost estimates in the DWR report and have been reviewed and adapted by Bookman-Edmonston Engineering. Several items in the previous cost estimates were modified to ensure that current design standards and safety factors were incorporated.

General

The cost estimate for the Los Vaqueros Reservoir Enlargement Project was determined by applying current unit costs to quantities found in the DWR report. In addition, current unit costs were determined by escalating the unit costs found in the 1988 CCWD-sponsored report *Los Vaqueros: Dam Construction Cost Estimates*; the 1990 DWR report entitled *Los Banos Grandes Facilities Feasibility Report, Appendix A: Designs and Costs Estimates*; the 1978 DWR report *SWP Future Supply Program, Enlarged Berryessa Reservoir Reconnaissance Study*; and the 1995 DWR report *Isolated Transfer Facility Cost Estimate*. The unit costs were escalated to October 1996 dollars by using the Reclamation's Construction Cost Trends Indices. Wherever possible, these escalated unit costs were applied to quantities in the DWR Los Vaqueros report. If there was insufficient detail to apply escalated unit costs or if there was no unit cost for a specific item, a unit cost or a lump sum cost was developed by Bookman-Edmonston Engineering. These, as well as all of the costs, were reviewed and verified with the construction costs of the Los Vaqueros Reservoir, which is currently under construction.

Right-of-Way Costs

Right-of-way costs of \$3,500 per acre were based on actual right-of-way costs for the Los Vaqueros Reservoir project currently under construction. The total project lands to be acquired would be approximately 7,000 acres.

Inlet-Outlet Capacity Adjustments

The inlet-outlet works on the Los Vaqueros Reservoir currently under construction can release 1,300 cfs under emergency release conditions. In the event of potential emergency conditions, the inlet-outlet works and spillway must be able to evacuate 10 percent of the maximum water depth in ten days as required by DWR's Division of Safety of Dams. Using this criteria, the enlarged Los Vaqueros Reservoir would require a release capacity of 11,800 cfs. To determine the cost of the inlet-outlet works with that capacity, the actual construction cost of the 1,300 cfs inlet-outlet works facility was factored by the following empirical equation:

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

where Q is equal to capacity in cfs.

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 which is similar in size and scope to the Los Vaqueros Pumping-Generating Plant. To develop a cost for the Los Vaqueros Pumping-Generating Plant, 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 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, legal, 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, legal, 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 1,065,000 million acre-foot Los Vaqueros Reservoir Enlargement Project would consist of an earthfill dam and associated facilities that would increase the total storage available at the site by about ten times the storage capacity of the smaller Los Vaqueros Reservoir currently being constructed. Table 3 summarizes estimated costs within selected project categories. The total cost of the Los Vaqueros Reservoir Enlargement Project is estimated to be about \$2,129 million, with a resulting calculated range of costs between \$1,920 million and \$2,450 million.

ENVIRONMENTAL CONSIDERATIONS

This portion of the report provides a summary of the environmental considerations related to enlarging the Los Vaqueros Reservoir. Fish, wildlife, plant, and cultural resources that could be affected by this project are described, and the extent of the impacts is identified. 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 configuration selected and the amount of right-of-way needed, enlarging the Los Vaqueros Reservoir Enlargement could impact approximately 3,340 acres of primarily annual grasslands and terrestrial wildlife habitat. It should be noted that the proposed enlargement could inundate lands that have been set aside for mitigating the impacts of the smaller 100,000 acre-foot reservoir. Additional lands could be impacted if the intake for the reservoir is significantly modified or relocated.

Fish, Amphibians, Reptiles, and Invertebrates

Typical amphibians and reptiles that may be found in project area grasslands include Pacific treefrog, western fence lizard, and gopher snake. Wetland communities such as stock ponds, intermittent streams, alkali marshes, and rock outcrop intermittent pools within the project area may support aquatic invertebrates such as fairy shrimp and crawling water beetles and amphibian species such as western toads and salamanders.

General Wildlife

The Kellogg Creek watershed contains a diversity of species and habitats characteristic of several different ecoregions. Wildlife habitats contained within the project area include grasslands, wetlands, riparian and oak woodland, chaparral, and rock outcrops.

Birds known to breed in these grasslands include horned larks, western meadowlarks, and burrowing owls. Mammals that may be found in the area include deer mice, desert cottontail, California ground squirrels, striped skunks, foxes, and coyotes. In the spring these grasslands provide most of the forage for black-tailed deer.

Oak woodlands provide food, shade, shelter, and nesting habitat for many wildlife species including golden eagles and red-tailed hawks.

Rock outcrops within the area provide important nesting habitat for several species of raptors including golden eagles, prairie falcons, red-tailed hawks, turkey vultures, common barn owls, and great horned owls. Ravens also commonly nest there and large colonies of cliff swallows are known to use these outcrops.

Sensitive and Listed Fish and Wildlife Species

No special-status fish species are known to exist within the area of the proposed Los Vaqueros Reservoir enlargement.

According to the California Department of Fish and Game's California Natural Diversity Data Base records (CNDDDB - Version 2/97), there are four wildlife species that are State or federally listed, and five wildlife species that are either candidates for listing, and/or species designated by CDFG as species of special concern, that occur in or near the area affected by the Los Vaqueros

Reservoir Enlargement. These wildlife species as well as an additional 14 listed and 21 candidate or species of concern that could potentially be found in the proposed project area are listed in Tables 4 and 5.

The Bay checkerspot butterfly is known to occur in isolated colonies throughout the San Francisco Bay Area. In the project area it could potentially occur in the Kellogg Creek watershed since suitable habitat is available in the western portion of the watershed. Previously recorded populations in the area are thought to be extinct due to habitat loss and the elimination of the butterfly's host plant (*Plantago erecta*) due to drought.

The Valley elderberry longhorn beetle prefers riparian habitats with elderberry shrubs and may potentially occur along Vasco Road in the project area, and along Middle and Old Rivers.

The vernal pool tadpole shrimp may potentially be found in vernal pools within the project area. The vernal pool fairy shrimp may also be found in these pools as well as the sandstone rock outcrop pools in the project area.

The Alameda whipsnake is generally known to occur throughout Alameda and Contra Costa Counties. This species prefers valleys, foothills, and low mountains in ecotonal areas of dry coastal shrub with grassland, oak woodland, or riparian vegetation. Suitable habitat for this species is available in the Kellogg Creek watershed.

Bald eagle, American peregrine falcon, and Aleutian Canada goose have been observed in the Delta, but none are confined exclusively to the area. Bald eagles are considered uncommon winter visitors in the Kellogg watershed area, primarily because of its low-quality foraging habitat. The peregrine falcon is known to nest throughout California (except in deserts) on cliffs, and forages in wetlands, grasslands, and coastal areas. Like the bald eagle, the peregrine is considered an uncommon winter visitor. The Aleutian Canada goose winters in the Central

Valley and prefers grain crops and pasture for foraging, and ponds for resting. Little or no suitable habitat for this species is available in the project area.

VEGETATION

Enlarging the Los Vaqueros Reservoir from 100,000 acre-feet to just over one million acre-feet would impact approximately 3,340 acres. Approximately 92 percent of these lands are grasslands, seven percent are woodlands, and the remaining one percent is riparian.

Sensitive and Listed Plant Species

Sensitive plants species and communities that have been found or could possibly be found in the area of the proposed enlarged Los Vaqueros are identified in Table 6.

Wetlands

From information gathered from the USFWS's National Wetland Inventory maps, wetlands that would be affected by the project include eight miles of emergent, temporarily flooded wetland (wet meadow), 2.5 miles of emergent, seasonally flooded wetland (shallow marsh), 4.25 miles of scrub-shrub, temporarily flooded wetland (wet meadow), one mile of scrub-shrub, seasonally flooded wetland (shallow marsh), one mile of forested, temporarily flooded wetland (wet meadow), two acres of emergent, temporarily flooded wetland (wet meadow), 1.5 acres of diked or impounded, unconsolidated bottom, permanently flooded wetlands (stock ponds), and five acres of emergent, seasonally flooded ponds (shallow marsh).

CULTURAL RESOURCES

The cultural resource values in the Los Vaqueros project area are significant. The Los Vaqueros Historic District is on the National Register of Historic Places. It consists of 43 significant prehistoric sites, 32 significant prehistoric/historic sites, and eight non-significant historic sites.

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**Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
LOS VAQUEROS RESERVOIR ENLARGEMENT**

Los Vaqueros Dam and Reservoir	
Capacity at Normal Pool Elevation (acre-feet)	1,065,000
Dam Type	Earthfill
Dam Height (feet)	505
Crest Elevation (feet)	800
Normal Pool Elevation (feet above MSL)	780
Reservoir Area (acres)	4,830
Crest Length (feet)	2,700
Dam Embankment Volume (cubic yards)	35.5 million
Number of Saddle Dams	4
Saddle Dam Embankment Volume (cubic yards)	3.2 million
Emergency Release Capacity (cfs)	11,800
Outlet Works Capacity (cfs)	5,000
Spillway Length (feet)	2,200
Spillway Capacity (cfs)	PMF
Downstream Face Slope (horizontal on vertical)	2.5:1
Upstream Face Slope (horizontal on vertical)	3.5:1
Freeboard (feet)	20
Los Vaqueros Pipeline	
Size	9 - 144 inch diameter barrels
Length (feet)	11,000
Capacity (cfs)	5,000
Kellogg Forebay	
Capacity at Normal Pool Elevation (acre-feet)	4,267
Dam Type	Earthfill
Dam Height (feet)	90
Crest Elevation (feet)	260
Normal Pool Elevation (feet above MSL)	244
Reservoir Area (acres)	124
Crest Length (feet)	600
Dam Embankment Volume (cubic yards)	0.4 million
Number of Saddle Dams	1
Saddle Dam Embankment Volume (cubic yards)	0.14 million
Emergency Release Capacity (cfs)	45
Downstream Face Slope (horizontal on vertical)	2.5:1
Upstream Face Slope (horizontal on vertical)	3.5:1
Spillway Length (feet)	340
Outlet Capacity (cfs)	45
Freeboard (feet)	24
Los Vaqueros Pumping - Generation Plant	
Capacity (cfs)	5,000
Total Dynamic Head (feet)	552
Horsepower (HP)	418,000

Table 1 (Continued)
SUMMARY OF PHYSICAL CHARACTERISTICS
LOS VAQUEROS RESERVOIR ENLARGEMENT

Tuway Canal	
Capacity (cfs)	5,000
Type	Lined Canal
Length Including Siphons (miles)	4.5
Top Width (feet)	135
Bottom Width (feet)	60
Depth (feet)	25
Side Slopes (horizontal on vertical)	2:1
Excavation Volume (cubic yards)	4,070,000
Compacted Embankment Volume (cubic yards)	183,000
Right-of-Way (acres)	410
Siphons	
Size (width x height x thickness)	23'x23'x30"
Number	6
Total Length (feet)	2900
North San Joaquin Intake Channel Widening	
Existing Capacity (cfs)	10,900
Widening Capacity (cfs)	15,900
Type	Earthen Channel
Length (miles)	2
Top Width (feet)	304
Bottom Width (feet)	120
Depth (feet)	46
Side Slope (horizontal on vertical)	2:1
Excavation Volume (cubic yards)	850,000
Kellogg Pumping Plant	
Capacity (cfs)	5,000
Total Dynamic Head (feet)	255
Horsepower (HP)	193,000
Kellogg Pumping Plant Discharge Facility	
Type	Pipe and Canal
Length (feet)	4,200
Capacity (cfs)	5,000

Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
A. LOS VAQUEROS DAM AND RESERVOIR					
I. MOBILIZATION	JOB	LS	\$1,000,000	\$1,000,000	1
II. DEMOLITION OF SPILLWAY & INTAKE STRUCT.	JOB	LS	\$500,000	\$500,000	1
III. REMOVE EXISTING DAM & STOCKPILE MAT'LS	2,700,000	CY	\$3.00	\$8,100,000	1
IV. LAND ACQUISITION	6,400	AC	\$3,500.00	\$22,400,000	
V. RESERVOIR CLEARING	340	AC	\$1,097	\$372,980	2
VI. MAIN DAM					
Stripping/Excavation	3,920,000	CY	\$2.11	\$8,271,200	1
Foundation Preparation	609,000	SY	\$0.81	\$493,290	1
Foundation Special Treatment	426,300		\$1.64	\$699,132	1
Dewatering	JOB	LS	\$412,000	\$412,000.00	1
Impervious Core	8,140,000	CY	\$7.95	\$64,713,000	1
Filter & Drain	3,330,000	CY	\$33.05	\$110,056,500	1
Sandstone & Shale	21,630,000	CY	\$8.22	\$177,798,600	1
Pit Run	1,520,000	CY	\$14.00	\$21,280,000	1
Riprap & Bedding	887,000	CY	\$50.94	\$45,183,780	1
Grout Curtain					
Drill Holes	120,600	LF	\$3.62	\$436,572	1
Grout	60,300	SKS	\$22.32	\$1,345,896	1
Consolidation Grout					
Drill Holes	33,500	LF	\$3.91	\$130,985	1
Grout	20,100	SKS	\$26.03	\$523,203	1
Instrumentation	JOB	LS	\$172,000	\$172,000	1
SUBTOTAL MAIN DAM				\$431,516,158	
VII. SADDLE DAMS					
Stripping/Excavation	1,036,000	CY	\$2.11	\$2,185,960	1
Foundation Preparation	161,000	SY	\$0.81	\$130,410	1
Foundation Special Treatment	113,000	SY	\$1.64	\$185,320	1
Impervious Core	734,000	CY	\$7.95	\$5,835,300	1

Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Filter & Drain	300,000	CY	\$33.05	\$9,915,000	1
Sandstone & Shale	1,950,000	CY	\$8.22	\$16,029,000	1
Pit Run	137,000	CY	\$14.00	\$1,918,000	1
Riprap & Bedding	80,000	CY	\$50.94	\$4,075,200	1
Grout Curtain					
Drill Holes	28,000	LF	\$3.62	\$101,360	1
Grout	14,000	SKS	\$22.32	\$312,480	1
Consolidation Grout					
Drill Holes	7,800	LF	\$3.91	\$30,498	1
Grout	4,700	SKS	\$26.03	\$122,341	1
SUBTOTAL SADDLE DAMS				\$40,840,869	
VIII. SPILLWAY					
Excavation	438,000	CY	\$5.66	\$2,479,080	1
Slope Protection	41,000	SY	\$19.24	\$788,840	1
Riprap (Exit Channel)	27,000	CY	\$50.94	\$1,375,380	1
Riprap Bedding	14,000	CY	\$50.94	\$713,160	1
Control Structure Concrete	6,900	CY	\$453.00	\$3,125,700	1
Chute Concrete	18,000	CY	\$453.00	\$8,154,000	1
Stilling Basin Concrete	11,000	CY	\$453.00	\$4,983,000	1
SUBTOTAL SPILLWAY				\$21,619,160	
IX. OUTLET WORKS					
Excavation	56,000	CY	\$5.66	\$316,960	1
Slope Protection	8,000	SY	\$19.24	\$153,920	1
Outlet Tunnel	4,000	LF	\$2,037	\$8,148,000	1
Cut and Cover Conduit	310	LF	\$2,490	\$771,900	1
Steel Liner	2,800	LF	\$1,698	\$4,754,400	1
Middle Outlet Tunnel	1,036	LF	\$2,037	\$2,110,332	1
Upper Outlet Tunnel	725	LF	\$2,037	\$1,476,825	1
Shaft	660	LF	\$4,075	\$2,689,500	1
Shaft House Concrete	660	CY	\$453.00	\$298,980	1
Control House Concrete	1,000	CY	\$453.00	\$453,000	1
Stilling Basin Concrete	1,500	CY	\$453.00	\$679,500	1
Wheel Gate (In Shaft)	4	EA	\$226,000	\$904,000	1
Control Gates (In Control House)	2	EA	\$170,000	\$340,000	1

Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Guard Gates (In Control House)	2	EA	\$170,000	\$340,000	1
Bifurcations	35,000	LBS	\$4.53	\$158,550	1
Trashracks and Misc. Metal	32,000	LBS	\$2.26	\$72,320	1
Electrical	JOB	LS	\$340,000	\$340,000	1
Riprap Bedding	4,000	CY	\$50.94	\$203,760	1
Riprap	8,000	CY	\$50.94	\$407,520	1
SUBTOTAL				\$24,619,467	
FACTOR FOR EMERGENCY RELEASE	2.29				
SUBTOTAL OUTLET WORKS				\$56,378,579	
X. ACCESS ROADS	9,900	LF	\$78.00	\$772,200	
SUBTOTAL LOS VAQUEROS DAM AND RESERVOIR				\$583,000,000	
B. KELLOGG FOREBAY					
I. LAND ACQUISITION	164	AC	\$3,500	\$574,000	3
II. RESERVOIR CLEARING	13	AC	\$1,097	\$14,261	2
III. MAIN DAM					
Stripping/Excavation	146,000	CY	\$2.11	\$308,060	1
Foundation Preparation	23,000	SY	\$0.81	\$18,630	1
Foundation Special Treatment	16,000	SY	\$1.64	\$26,240	1
Dewatering	JOB	LS	\$15,000	\$15,000.00	1
Impervious Core	92,000	CY	\$7.95	\$731,400	1
Filter & Drain	38,000	CY	\$33.05	\$1,255,900	1
Sandstone & Shale	244,000	CY	\$8.22	\$2,005,680	1
Pit Run	17,000	CY	\$14.00	\$238,000	1
Riprap & Bedding	10,000	CY	\$50.94	\$509,400	1
Grout Curtain					
Drill Holes	3,400	LF	\$3.62	\$12,308	1
Grout	1,700	SKS	\$22.32	\$37,944	1
Consolidation Grout					
Drill Holes	1,000	LF	\$3.91	\$3,910	1

Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Grout	600	SKS	\$26.03	\$15,618	1
SUBTOTAL MAIN DAM				\$5,178,090	
IV. SADDLE DAMS					
Stripping/Excavation	56,000	CY	\$2.11	\$118,160	1
Foundation Preparation	8,700	SY	\$0.81	\$7,047	1
Foundation Special Treatment	6,100	SY	\$1.64	\$10,004	1
Impervious Core	31,000	CY	\$7.95	\$246,450	1
Filter & Drain	13,000	CY	\$33.05	\$429,650	1
Sandstone & Shale	82,215	CY	\$8.22	\$675,807	1
Pit Run	5,800	CY	\$14.00	\$81,200	1
Riprap & Bedding	3,400	CY	\$50.94	\$173,196	1
Grout Curtain					
Drill Holes	900	LF	\$3.62	\$3,258	1
Grout	450	SKS	\$22.32	\$10,044	1
Consolidation Grout					
Drill Holes	250	LF	\$3.91	\$978	1
Grout	150	SKS	\$26.03	\$3,905	1
SUBTOTAL SADDLE DAMS				\$1,759,698	
V. SPILLWAY					
Excavation	67,000	CY	\$5.66	\$379,220	1
Slope Protection	6,300	SY	\$19.24	\$121,212	1
Riprap (Exit Channel)	4,200	CY	\$50.94	\$213,948	1
Riprap Bedding	2,100	CY	\$50.94	\$106,974	1
Control Structure Concrete	1,100	CY	\$453.00	\$498,300	1
Chute Concrete	2,700	CY	\$453.00	\$1,223,100	1
Stilling Basin Concrete	1,700	CY	\$453.00	\$770,100	1
SUBTOTAL SPILLWAY				\$3,312,854	
VI. OUTLET WORKS					
Excavation	56,000	CY	\$5.66	\$316,960	1
Slope Protection	8,000	SY	\$19.24	\$153,920	1
Outlet Tunnel	670	LF	\$2,037	\$1,364,790	1
Cut and Cover Conduit	50	LF	\$2,490	\$124,500	1
Steel Liner	470	LF	\$1,698	\$798,060	1

Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Middle Outlet Tunnel	170	LF	\$2,037	\$346,290	1
Upper Outlet Tunnel	120	LF	\$2,037	\$244,440	1
Shaft	105	LF	\$4,075	\$427,875	1
Shaft House Concrete	105	CY	\$453.00	\$47,565	1
Control House Concrete	1,000	CY	\$453.00	\$453,000	1
Stilling Basin Concrete	1,500	CY	\$453.00	\$679,500	1
Wheel Gate (In Shaft)	4	EA	\$226,000	\$904,000	1
Control Gates (In Control House)	2	EA	\$170,000	\$340,000	1
Guard Gates (In Control House)	2	EA	\$170,000	\$340,000	1
Bifurcations	35,000	LBS	\$4.53	\$158,550	1
Trashracks and Misc. Metal	32,000	LBS	\$2.26	\$72,320	1
Electrical	JOB	LS	\$340,000	\$340,000	1
Riprap Bedding	4,000	CY	\$50.94	\$203,760	1
Riprap	8,000	CY	\$50.94	\$407,520	1
SUBTOTAL				\$7,723,050	
FACTOR FOR EMERGENCY RELEASE	0.29				
SUBTOTAL OUTLET WORKS				\$2,239,685	
VII. ACCESS ROADS	300	LF	\$78.00	\$23,400	
SUBTOTAL KELLOGG FOREBAY				\$13,000,000	
C. CONVEYANCE FACILITIES					
I. LOS VAQUEROS PIPELINE (Q=5,000 CFS) - 9 BARRELS	99,000	LF	\$720	\$71,280,000	1
II. LOS VAQUEROS PUMPING-GENERATING PLANT (Q=5,000 cfs, TDH=552 ft., HP = 418,000)	JOB	LS	\$313,000,000	\$313,000,000	1
III. TUWAY CANAL (Q=5,000CFS)					
Canal					
Excavation	4,066,000	CY	\$2.00	\$8,132,000	1
Compacted Embankment	183,000	CY	\$0.80	\$146,400	1
Common Embankment	155,000	CY	\$0.50	\$77,500	1
Clearing and Grubbing	8,767,000	SF	\$0.03	\$219,175	4

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Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Concrete Lining	37,900	CY	\$80.00	\$3,032,000	1
Operating Road-Gravel Surfacing	10,200	TONS	\$11.20	\$114,240	4
Siphons					
Siphon	51,000	CY	\$600.00	\$30,600,000	1
Inlet and Outlet Transitions	3,500	CY	\$600.00	\$2,100,000	1
Outlet Works Facility					
Check Structure	1,170	CY	\$600.00	\$702,000	1
Concrete	3,250	CY	\$600.00	\$1,950,000	
Radial Gates (25ft x 55ft)	3	EA	\$690,000	\$2,070,000	
Outlet Structure Concrete	1,700	CY	\$600.00	\$1,020,000	1
144" Dia. Pipe	900	LF	\$720.00	\$648,000	1
Control Building	1,000	SF	\$150.00	\$150,000	1
Electrical Installation	JOB	LS	\$500,000	\$500,000	1
Misc. Metalwork	JOB	LS	\$150,000	\$150,000	1
Cofferdam Sheetpiling	50,300	SF	\$28.00	\$1,408,400	5
Cofferdam Gravel Fill	9,310	CY	\$21.00	\$195,510	5
Land Acquisition					
Canal	330	AC	\$3,500	\$1,155,000	3
Pipeline	80	AC	\$3,500	\$280,000	3
SUBTOTAL LOS VAQUEROS INTAKE CANAL				\$54,650,225	
IV. NORTH SAN JOAQUIN INTAKE CHANNEL WIDENING					
Cofferdam Sheetpiling	2,513,000	SF	\$28.00	\$70,364,000	5
Cofferdam Gravel Fill	465,000	CY	\$21.00	\$9,765,000	5
Excavation	850,000	CY	\$3.00	\$2,550,000	1
Salvage Riprap and Replace on New Sideslope	JOB	LS		\$1,800,000	1
SUBTOTAL NORTH SAN JOAQUIN INTAKE CHANNEL WIDENING				\$84,479,000	
V. KELLOGG PUMPING PLANT					
Pumping Plant (Q=5,000cfs, TDH=255ft, HP=193,000)	JOB	LS	\$169,000,000	\$169,000,000	1
VI. KELLOGG PUMPING PLANT DISCHARGE FACILITY					
144" Dia. Pipeline	28,800	LF	\$720.00	\$20,736,000	1
Canal	1,000	LF	\$570.00	\$570,000	1
Check Structure					
Concrete	3,250	CY	\$600.00	\$1,950,000	1

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Table 2
ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

DESCRIPTION	QUANTITY	UNIT	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Radial Gates (25ft x 55ft)	3	EA	\$690,000.00	\$2,070,000	1
Land Acquisition					
Canal	14	AC	\$3,500	\$49,000	3
Pipeline	14	AC	\$3,500	\$49,000	3
SUBTOTAL KELLOGG PUMPING PLANT DISCHARGE FACILITY				\$25,424,000	
SUBTOTAL CONVEYANCE FACILITIES				\$718,000,000	
SUBTOTAL PROJECT COST				\$1,814,000,000	
CONTINGENCIES @ 20%				\$262,800,000	
CONTRACT COST SUBTOTAL				\$1,577,000,000	
ENG., LEGAL, AND ADM. @ 35%				\$552,000,000	
TOTAL PROJECT COST				\$2,129,000,000	
TOTAL PROJECT COST RANGE					
LOW (-10%)				\$1,920,000,000	
HIGH (+15%)				\$2,450,000,000	

Footnotes:

^aCY=cubic yard; LB=pound; EA=each; LS=lump sum; LF=linear foot; SF=square foot; TON=ton; MI=mile; AC=acre

Cost Reference:

1. Cost developed by Bookman-Edmonston Engineering.
2. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, Table 4, December 1990.
3. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.
4. California Department of Water Resources, Division of Design and Construction, *SWP Future Supply Program, Enlarged Berryessa Reservoir Reconnaissance Study*, July 1978.
5. California Department of Water Resources, Division of Design and Construction, *Isolated Transfer Facility Cost Estimate*, September 1995

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
LOS VAQUEROS RESERVOIR ENLARGEMENT

Cost Item	Estimated Cost (\$ Millions)
Los Vaqueros Dam and Reservoir	
Mobilization	1.0
Demolition of Spillway	0.5
Remove Existing Dam	8.1
Land Acquisition	22.4
Reservoir Clearing	0.4
Main Dam	431.5
Saddle Dam	40.8
Spillway	21.6
Outlet Works	56.4
Access Roads	0.8
Kellogg Forebay	
Land Acquisition	0.6
Main Dam	5.2
Saddle Dam	1.8
Spillway	3.3
Outlet Works	2.2
Conveyance Facilities	
Los Vaqueros Pipeline	71.3
Los Vaqueros Pumping-Generating Plant	313.0
Tuway Canal	54.6
North San Joaquin Intake Channel	84.5
Kellogg Pumping Plant	169.0
Kellogg Pumping Plant Discharge Facility	25.4
SUBTOTAL	
	1,314.0
Contingencies (20%)	262.8
Estimated Construction Cost	1,577.0
Engineering, Legal, and Project Administration (35%)	552.0
ESTIMATED CAPITAL COST	
	2,129.0
Capital Cost Range (minus 10% - Plus 15%)	\$1,920 - \$2,450

**Table 4
LISTED WILDLIFE SPECIES
LOS VAQUEROS RESERVOIR ENLARGEMENT**

SPECIES	FEDERAL STATUS	STATE STATUS
EUPHYDRYUS EDITHA BAYENSIS Bay Checkerspot Butterfly	Threatened	None
DESMOCERUS CALIFORNICUS DIMORPHUS Valley Elderberry Longhorn Beetle	Threatened	None
BRANCHINECTA LYNCHI Vernal Pool Fairy Shrimp	Threatened	None
LEPIDURUS PACKARDI Vernal Pool Tadpole Shrimp	Endangered	None
BRANCHINECTA LONGIANTENNA Longhorn Fairy Shrimp	Endangered	None
THAMNOPHIS COUCHI GIGAS Giant Garter Snake	Threatened	Threatened
RANA AURORA DRAYTONII California Red-legged Frog	Threatened	None
MASTICOPHIS LATERALIS EURYXANTHUS Alameda Whipsnake	Proposed Endangered	Threatened
BRANTA CANADENSIS LEUCOPAREIA Aleutian Canada Goose	Threatened	None
LATERALLUS JAMAICENSIS COTURNICULUS California Black Rail	Species of Concern	Threatened
RALLUS LONGIROSTRIS OBSOLETUS California Clapper Rail	Endangered	Endangered
GRUS CANADENSIS TABIDA Greater Sandhill Crane	None	Threatened
STERNA ANTILLARUM BROWNI California Least Tern	Endangered	Endangered
HAELIAEETUS LEUCOCEPHALUS Bald Eagle	Threatened	Endangered
FALCO PEREGRINUS ANATUM American Peregrine Falcon	Endangered	Endangered
BUTEO SWAINSONI Swainson's Hawk	None	Threatened
REITHRODONTOMYS RAVIVENTRIS Salt Marsh Harvest Mouse	Endangered	Endangered
VULPES MACROTIS MUTICA San Joaquin Kit Fox	Endangered	Threatened

**Table 5
CANDIDATE WILDLIFE SPECIES AND WILDLIFE SPECIES OF SPECIAL CONCERN
LOS VAQUEROS RESERVOIR ENLARGEMENT**

SPECIES	FEDERAL STATUS	STATE/LOCAL STATUS
HYGROTUS CURVIPES Curve-footed Hygrotus Diving Beetle	Species of Concern	None
LYTTA MOESTA Mosetan Blister Beetle	Species of Concern	None
LYTTA MOLESTA Molestan Blister Beetle	Species of Concern	None
RANA AURORA DRAYTONI California Red-legged Frog	Species of Concern	CDFG - Special Concern
AMBYSTOMA CALIFORNIENSE California Tiger Salamander	Candidate	CDFG - Special Concern
CLEMMYS MARMORATA Western Pond Turtle	None	CDFG - Special Concern
PHRYNOSOMA CORONATUM FRONTALE California Horned Lizard	None	CDFG - Special Concern
NUMENIUS AMERICANUS Long-billed Curlew	Species of Concern	None
AQUILA CHRYSÆTOS Golden Eagle	None	CDFG - Special Concern
PANDION HALIAETUS Osprey	None	CDFG - Special Concern
FALCO MEXICANUS Prairie Falcon	None	CDFG - Special Concern
CIRCUS CYANEUS Northern Harrier	None	CDFG - Special Concern
BUTEO REGALIS Ferruginous Hawk	Species of Concern	None
ACCIPITER STRIATUS Sharp-shinned hawk	None	CDFG - Special Concern
ACCIPITER COOPERII Cooper's Hawk	None	CDFG - Special Concern
ATHENE CUNICULARIA Burrowing Owl	None	CDFG - Special Concern
EREMOPHILA ALPESTRIS ACTIA California Horned Lark	None	CDFG - Special Concern
AGELAIUS TRICOLOR Tricolored Blackbird	Species of Concern	CDFG - Special Concern

Table 5 (Continued)
CANDIDATE WILDLIFE SPECIES AND WILDLIFE SPECIES OF SPECIAL CONCERN
LOS VAQUEROS RESERVOIR ENLARGEMENT

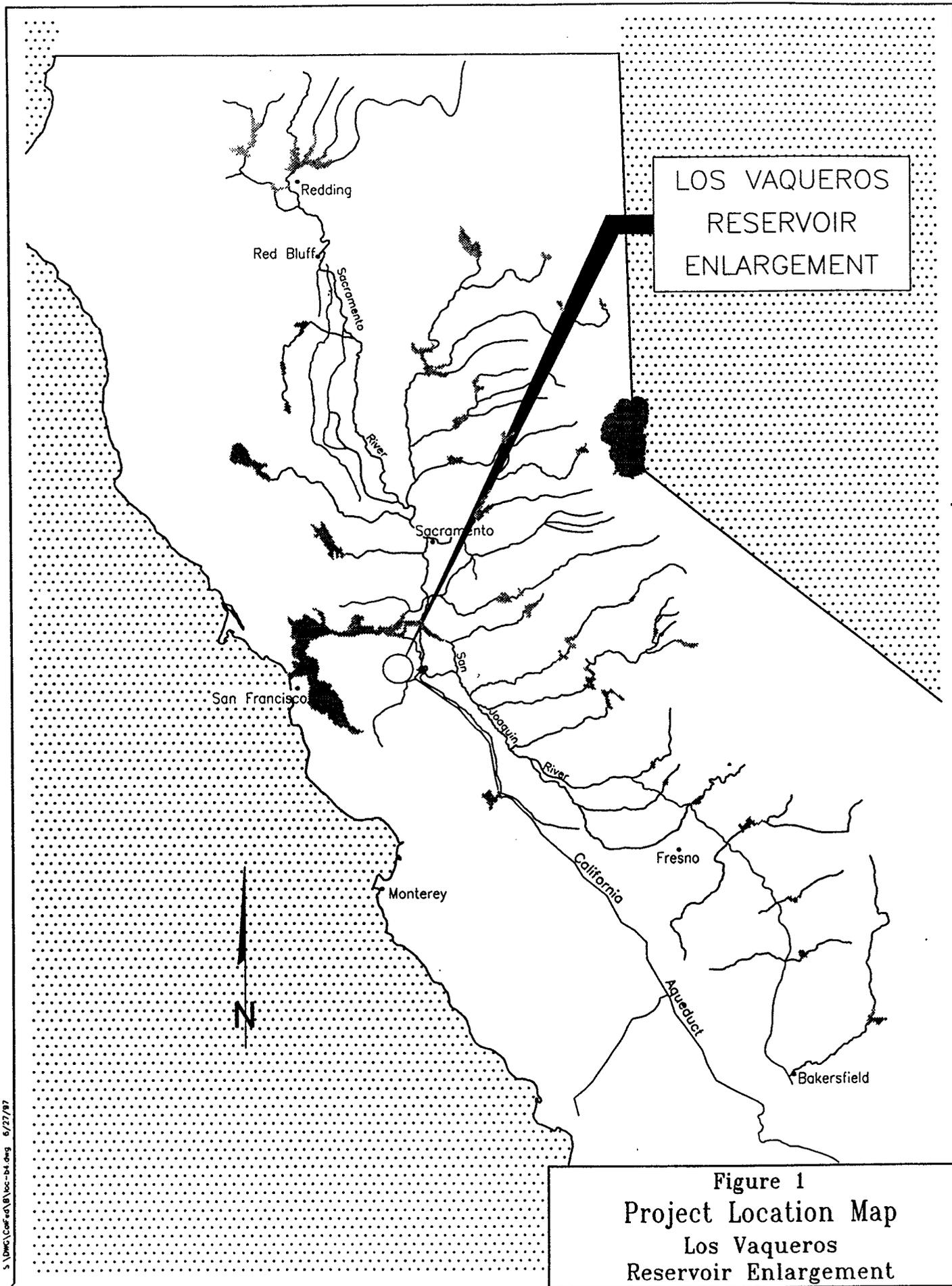
SPECIES	FEDERAL STATUS	STATE/LOCAL STATUS
GEOTHELYPIS TRICHAS SINUOSA Saltmarsh Common Yellow-throat	Species of Concern	CDFG - Special Concern
MELOSPIZA MELODIA MAXILLARIS Suisun Song Sparrow	Species of Concern	CDFG - Special Concern
SOREX VAGRANS HALICOETES Saltmarsh Wandering Shrew	Species of Concern	CDFG - Special Concern
SOREX ORNATUS SINUOSUS Suisun Shrew	Species of Concern	CDFG - Special Concern
PLECOTUS TOWNSENDII TOWNSENDII Townsend's Western Big-eared Bat	Species of Concern	CDFG - Special Concern
PEROGNATHUS INORNATUS INORNATUS San Joaquin Pocket Mouse	None	CDFG - Special Concern
MICROTUS CALIFORNICUS SANPABLOENSIS San Pablo Vole	Species of Concern	CDFG - Special Concern
TAXIDEA TAXUS Americian Badger	None	CDFG - Special Concern

**Table 6
SENSITIVE PLANT SPECIES/COMMUNITIES
LOS VAQUEROS RESERVOIR ENLARGEMENT**

SPECIES	FEDERAL STATUS	STATE/LOCAL STATUS
AMSINKA GRANDIFLORA Large-flowered Fiddleneck	Endangered	Endangered
LASTHENIA CONJUGENS Contra Costa Goldfields	Proposed Endangered	CNPS 1B
HELIANTHELLA CASTANEA Diablo Helianthella	Species of Concern	CNPS 1B
TROPIDOCARPUM CAPPARIDEUM Caper-fruited Tropicocarpum	Species of Concern	CNPS 1A
ATRIPLEX JOAQUINIANA San Joaquin Saltbush	Species of Concern	CNPS 1B
ASTER CHILENSIS VAR. LENTUS Suisun Marsh aster	Species of Concern	CNPS 1B
CIRSIUM CRASSICAULE Slough Thistle	Species of Concern	CNPS 1B
CORDYLANTHUS PALMATUS Palmate-bracted Bird's Beak	Endangered	Endangered/ CNPS 1B
ERIOGONUM TRUNCATUM Mt. Diablo Buckwheat	None	CNPS 1A
ESCHSCHOLZIA RHOMBIPETALA Diamond-petaled California poppy	Species of Concern	CNPS 1A
FRITILLARIA LILACEA Fragrant Fritillary	Species of Concern	CNPS 1B
LATHYRUS JEPSONII SSP. JEPSONII Delta Tule Pea	Species of Concern	CNPS 1B
LILAEOPSIS MASONII Masons Lilaeopsis	Species of Concern	Rare/CNPS 1B
NEOSTAPFIA COLUSANA Colusa Grass	Proposed Threatened	Endangered/CNPS 1B
OENOTHERA DELTOIDES SSP. HOWELLII Antioch Dunes Evening Primrose	Endangered	Endangered/CNPS 1B
PHACELIA PHACELIODES Mt. Diablo Phacelia	Species of Concern	CNPS 1B
SAGITTARIA SANFORDII Sanfords Arrowhead	Species of Concern	CNPS 1B
TRIFOLIUM AMOENUM Showy Indian Clover	Proposed Endangered	CNPS 1B

Table 6 (Continued)
SENSITIVE PLANT SPECIES/COMMUNITIES
LOS VAQUEROS RESERVOIR ENLARGEMENT

SPECIES	FEDERAL STATUS	STATE/LOCAL STATUS
TUCTORIA MUCRONATA Crampton's Tuctoria	Endangered	Endangered/CNPS 1B
ATRIPLEX CORDULATA Heartscale	Species of Concern	CNPS 1B
HESPEROLINON BREWERI Brewer's Western Flax	Species of Concern	CNPS 1B
DELPHINIUM RECURVATUM Recurved Larkspur	Species of Concern	CNPS 1B
CALOCHORTUS PULCHELLUS Mt. Diablo Fairy-lantern	None	CNPS 1B
ARCTOSTAPHYLOS AURICULATA Mt. Diablo Manzanita	None	CNPS 1B
ARCTOSTAPHYLOS PALLIDA Alameda Manzanita	Proposed Threatened	Endangered/CNPS 1B
ASTRAGALUS TENER VAR. TENER Alkali Milk-vetch	None	CNPS 1B
ATRIPLEX DEPRESSA Brittlescale	None	CNPS 1B
FRITILLARIA AGRESTIS Stinkbells	None	CNPS 1B
VALLEY SINK SCRUB	None	None
WILLOW-COTTONWOOD RIPARIAN	None	None
CENTRAL COAST LIVE OAK RIPARIAN WOODLAND	None	None
MIXED RIPARIAN WOODLAND	None	None
OAK WOODLAND	None	None
VALLEY NEEDLEGRASS GRASSLAND	None	None
NORTHERN CLAYPAN VERNAL POOL	None	None
CISMONTANE ALKALI MARSH	None	None
ALKALI MEADOW	None	None
ALKALI	None	None



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CALIFED
BAY-DELTA
PROGRAM

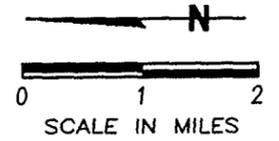
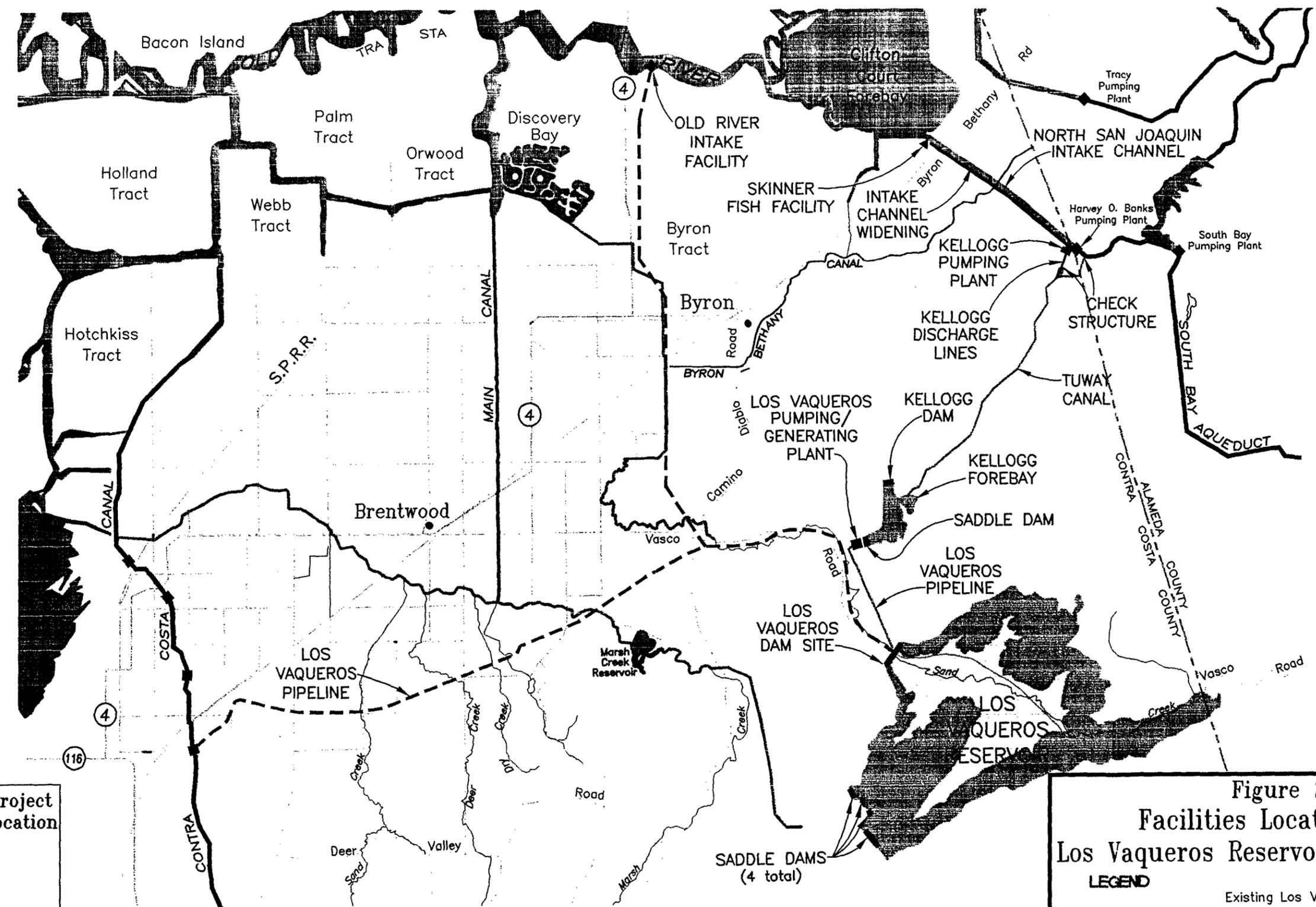


Figure 2
 Facilities Location Map
 Los Vaqueros Reservoir Enlargement

LEGEND

- Existing Los Vaqueros Reservoir
- Enlarged Los Vaqueros Reservoir
- Existing Roads and Highways
- Existing Canals
- Existing Conveyance Pipeline
- Dams and Saddle Dams
- Proposed Conveyance Facility
- Pumping Plants

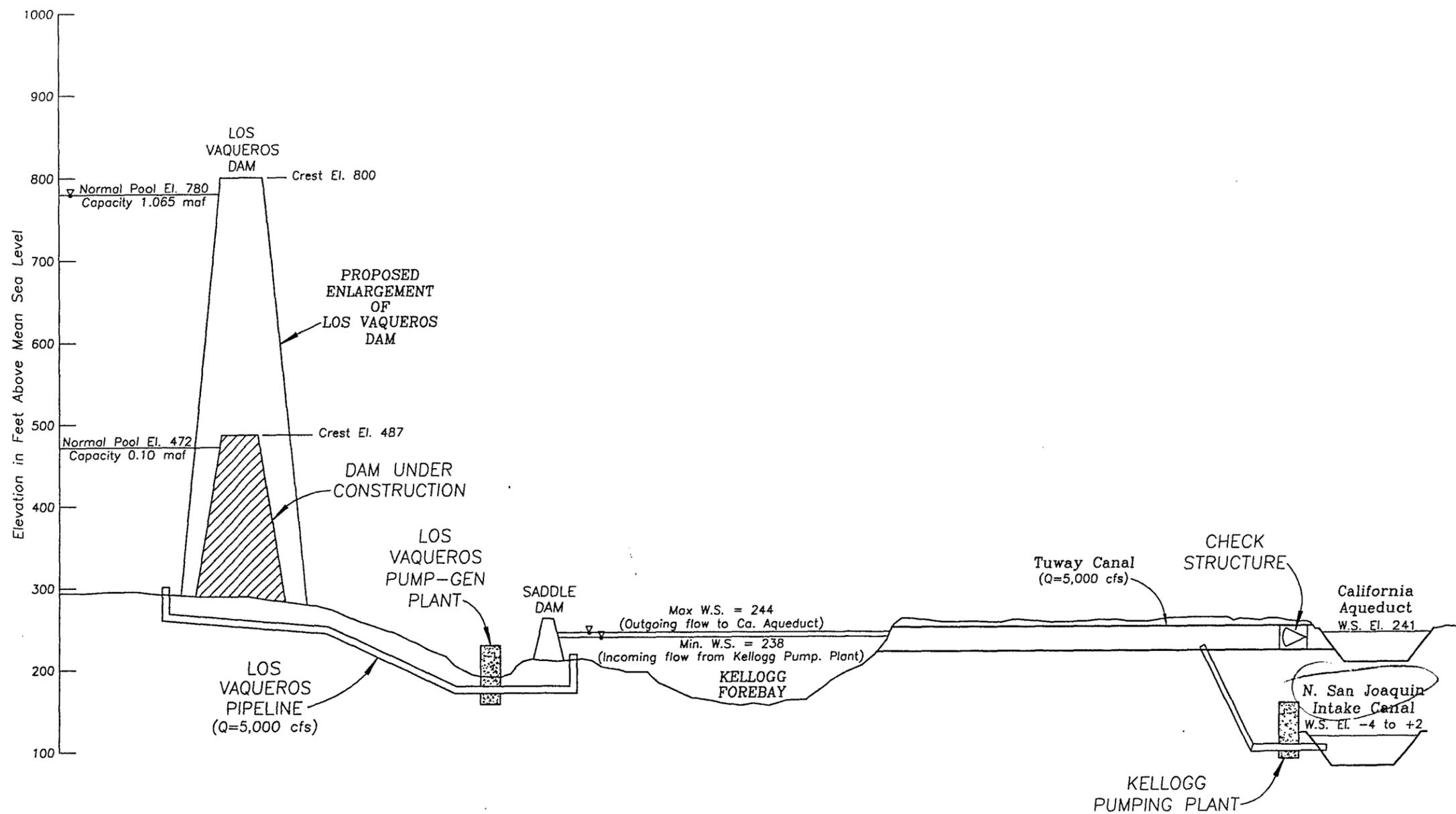
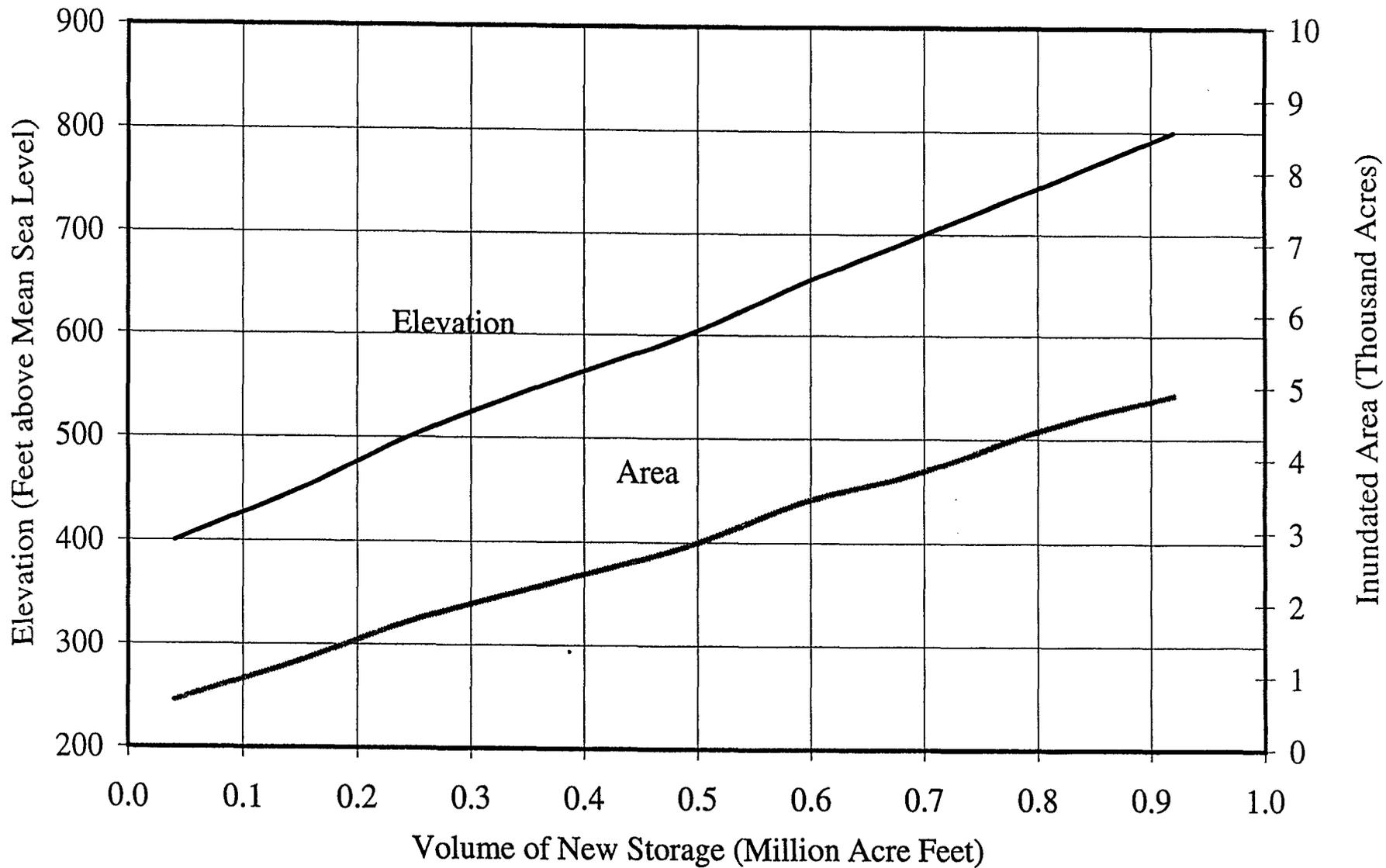
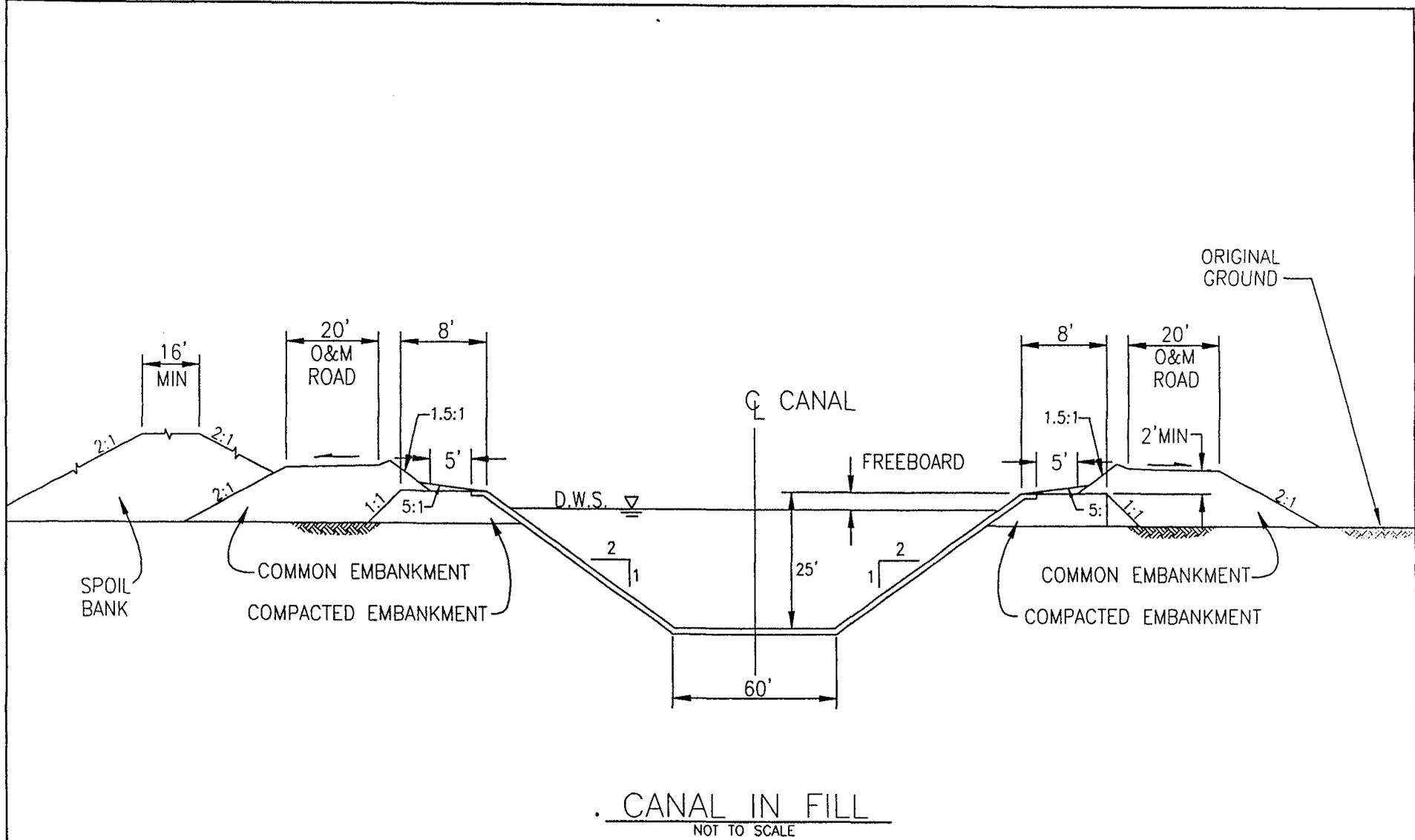


Figure 3
Los Vaqueros Reservoir
Schematic Profile

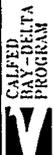
Figure 4
Area-Elevation-Capacity Curves
Los Vaqueros Reservoir Enlargement

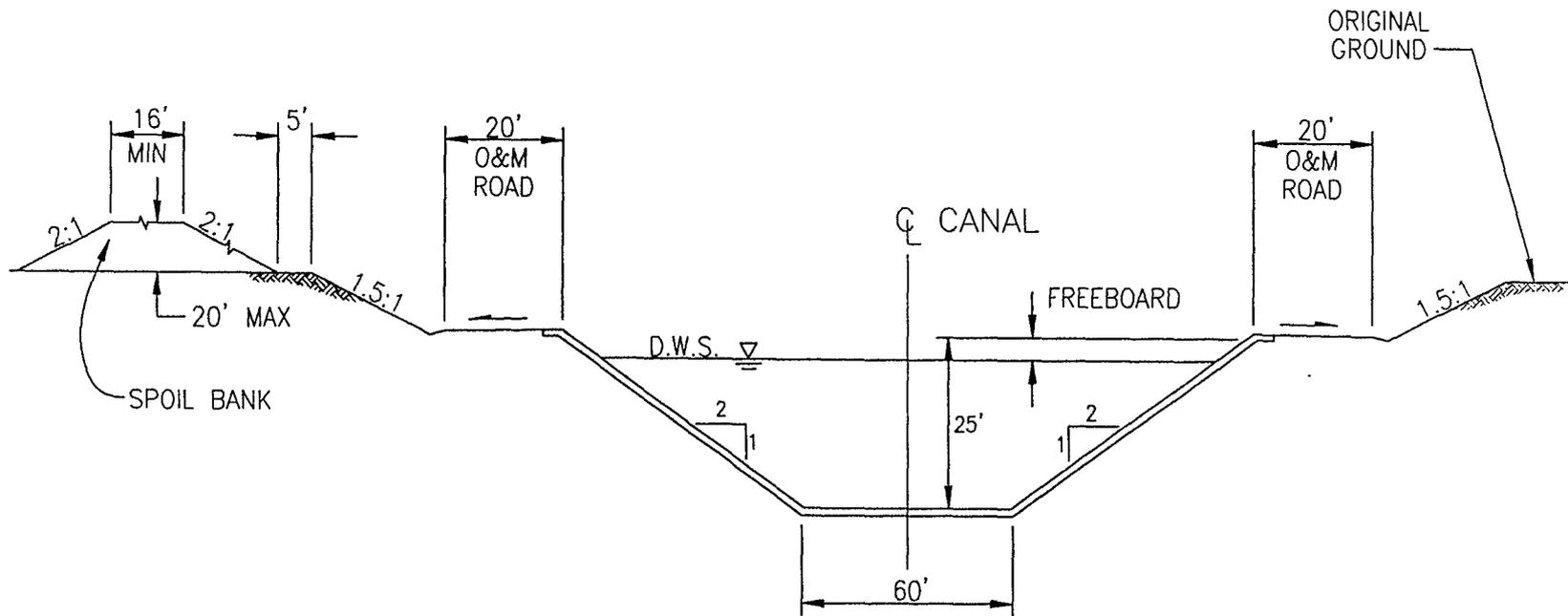




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Figure 5a
 Tuway Canal
 Typical Canal Section





CANAL IN CUT
NOT TO SCALE

Figure 5b
Tuway Canal
Typical Canal Section



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