FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR THOMES-NEWVILLE RESERVOIR PROJECT

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June 23, 1997

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INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for Thomes-Newville Reservoir Project* 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 Thomes-Newville Reservoir Project. The Thomes-Newville Reservoir Project would develop flows from Stony and Thomes Creeks as well as surplus flows from the Sacramento River. This evaluation considered two alternative storage capacities at Newville Reservoir: 1.84 million acre-feet (maf), and 3.08 maf. The general location of the Thomes-Newville Reservoir Project is shown in 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 specific objectives of the Thomes-Newville Reservoir Project 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 Thomes-Newville Reservoir Project was determined by escalating the costs in the Department of Water Resources (DWR), Division of Design and Construction, September 1981 report, *SWP Future Supply Program, Thomes-Newville Plan, Addendum to the Cost Estimate for Thomes-Newville Project Plan I and II, Vol. I, Memorandum Report, June 1980*, and in the DWR, Northern District, November 1980 report, *Thomes-Newville and Glenn Reservoir Plans, Engineering Feasibility.* The cost estimates presented by DWR in these reports

have been reviewed and adapted 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

Water supply planning on the Stony and Thomes Creeks watersheds dates back to the 1860s. The first canal diverted water from Stony Creek in 1866, and in the late 1890s several irrigation districts had been formed to divert water from Stony Creek and Thomes Creek.

Variations of the Thomes-Newville Reservoir Project were investigated in the early 1900s. In 1957, DWR completed *The California Water Plan* (Bulletin No. 3), a 10-year study investigating California's water resources and formulating plans for their orderly development. This report included Paskenta Reservoir on Thomes Creek, which would spill excess flows into a Newville Reservoir located on the North Fork Stony Creek. Under that proposed plan, Newville Reservoir supplies would be supplemented by additional diversions from upper Stony Creek and Grindstone Creek, a tributary to Stony Creek.

After completing Bulletin No. 3, DWR focused on identifying potential sites within the Sacramento Valley for storage of water diverted from the Eel, Trinity, and Klamath Rivers. One possibility was the Millsite-Newville Reservoir which required dams on Stony Creek and North Fork Stony Creek. Detailed investigations revealed, however, that the topography of the Millsite location was not as favorable as the Rancheria Dam site three miles upstream. DWR formally introduced the combined Newville and Rancheria Reservoirs as the Glenn Reservoir Complex in

the 1961 report, *Progress Report on North Coastal Area Investigation.* In 1964, DWR published a report titled *North Coastal Area Investigation* (Bulletin No. 136) which suggested that upper Eel River water could be routed either through Clear Lake or elements of Glenn Reservoir to supplement Delta water supplies.

In 1975, DWR began to reevaluate tributary storage opportunities on the upper Sacramento River. DWR completed a report titled *Major Surface Water Development Opportunities in the Sacramento Valley* which identified four plans in detail: (1) the Tributary Storage Plan, (2) the Tuscan Buttes Reservoir, (3) the Glenn Reservoir-River Diversion Plan, and (4) the Colusa Reservoir-River Diversion Plan. The Glenn Reservoir-River Diversion Plan was the first formal consideration of using the Glenn Reservoir for offstream storage of Sacramento River water.

The Thomes-Newville Reservoir Plan Concept was completed by DWR in 1978. This plan was a much smaller project than the Glenn Reservoir-River Diversion Plan. DWR's perception at that time was that the Thomes-Newville Reservoir Plan would be easier to implement and would not preempt the U.S. Bureau of Reclamation's (Reclamation) planned West Sacramento Canal Unit, which was to supply Sites Reservoir in Colusa County through the Tehama-Colusa Canal.

In November 1980, DWR's Northern District released a report titled *Thomes-Newville and Glenn Reservoir Plans, Engineering Feasibility* (Glenn Reservoir Feasibility Report) which presented three water supply plans: (1) the Thomes-Newville Plan, (2) the Glenn Reservoir Plan, and (3) the staged Glenn Reservoir Plan. This report assessed the physical and operational feasibility of these plans. DWR concluded that both the Thomes-Newville and Glenn Reservoirs were feasible from an engineering standpoint. Further, DWR stated in that report that the Thomas-Newville Plan would better meet expected future demands. Construction was tentatively scheduled for the mid-1990s.

The conclusions of the 1980 DWR report led to the preparation by DWR's Division of Design and Construction of a memorandum report titled *SWP Future Supply Program, Thomes-Newville Plan: Addendum to the Reconnaissance Study and Cost Estimate for Thomes-Newville Project Plan I and II, Vol. I, Memorandum Report, June 1980* (Thomes-Newville Plan Report) which developed cost estimates for Newville Dam and Reservoir with three alternative water surface elevations: 870, 900, and 920 feet above mean sea level (MSL). The Newville Dam and Reservoir alternative, with a water surface elevation of 900 feet MSL, served as the basis of the Newville Reservoir configurations utilized in this evaluation.

FACILITIES DESCRIPTIONS

This section provides an overview of the major features of the Thomes-Newville Reservoir Project and of existing projects in the Thomes and Stony Creek watershed. The principal reference used for this synopsis was the Thomes-Newville Plan Report, which provides a cost estimate and facilities description for the Newville Reservoir. Additional information for associated facilities was taken from the Glenn Reservoir Feasibility Report.

The Thomes-Newville Reservoir Project has been evaluated at two storage capacities: 1.84 maf and 3.08 maf. The Thomes-Newville Project would provide instream storage for available flows from Thomes Creek, North Fork Stony Creek and Stony Creek, and off-stream storage for available flows from the Sacramento River. The Thomes-Newville Reservoir facilities include the following features: Newville and Tehenn Reservoirs located on North Fork Stony Creek; a diversion facility from Thomes Creek to Newville Reservoir; a two-way conveyance facility from Tehenn Reservoir to the existing Black Butte Reservoir on the mainstem of Stony Creek; and a two-way conveyance canal facility from the Tehama-Colusa Canal to Black Butte Reservoir. The Tehama-Colusa Canal would provide water from the Sacramento River.

EXISTING FACILITIES

There are currently three storage facilities constructed on Stony Creek: East Park Reservoir, Stony Gorge Reservoir, and Black Butte Reservoir. No storage facilities have been developed on Thomes Creek.

The East Park Reservoir was constructed by the U.S. Reclamation Service (predecessor to the U.S. Bureau of Reclamation) in 1909 in the upper watershed of the mainstem of Stony Creek. This reservoir was the first facility constructed for the Orland Project. The Orland Project, part of the Central Valley Project (CVP), serves approximately 20,000 acres of irrigated land around the town of Orland in Glenn County. This area is located west of the Sacramento River about 100 miles north of Sacramento (see Figure 1). Stony Gorge Reservoir, completed in 1928, and Black Butte Reservoir, completed in 1970, are also facilities of the Orland Project.

Development of the three existing reservoirs on Stony Creek resulted from investigations by the U.S. Geological Survey (USGS), the U.S. Reclamation Service, and the U.S. Army Corp of Engineers (COE). Investigations by the USGS and the Reclamation Service in the early 1900s led to the development of East Park and Stony Gorge Reservoirs. Investigations by the COE, beginning in the mid-1940s, led to development of Black Butte Reservoir, in part for flood control on lower Stony Creek. The Black Butte Reservoir is the main regulating facility for the distribution system of the Orland Project.

PROJECT LOCATION

The Thomes-Newville Reservoir Project would be located on the North Fork Stony Creek and would develop flows of the North Fork and mainstem of Stony Creek, and the flows of Thomes Creek. Additional water would be developed from surplus flows diverted from the Sacramento River at the Red Bluff Diversion Facility.

The watershed of Stony Creek upstream of Black Butte Dam (which includes the North Fork) is about 740 square miles and has an annual runoff of about 400,000 acre-feet per year (AF/year). The drainage area includes portions of Lake, Colusa, Glenn, and Tehama Counties at elevations ranging from 400 to 6,300 feet above MSL. The Thomes Creek drainage basin is located north and west of the Newville Reservoir site and drains an area of roughly 194 square miles and has average annual runoff of about 200,000 AF/year upstream of the gage at the Town of Paskenta. The diversion facility on Thomes Creek would be located 5 miles upstream of the Paskenta gage and would receive about 97 percent of the estimated flows at the Paskenta gage.

The Newville Dam site is located about 10 miles upstream of Black Butte Dam. Newville Dam would fill a low gap in the north-south trending Rocky Ridge. The dam site is within the Coast Range geomorphic province immediately west of the boundary with the Great Valley geomorphic province. This is an area of low-to-moderate seismicity. There are several known faults in the area, including the Stony Creek Fault, Coast Range Thrust Fault, and Paskenta Fault Zone. It is possible that additional undiscovered faults could be located in this area.

PRINCIPAL FACILITIES

This section provides a description of the principal facilities associated with the Thomes-Newville Reservoir Project. Table 1 provides a summary of the physical characteristics of the major features of the Thomes-Newville Project for the two alternative storage capacities of 1.84 maf and 3.08 maf. Figure 2 shows the locations of the features which would be developed by the Thomes-Newville Reservoir Project.

The Newville Reservoir would receive inflows from four water sources: (1) North Fork Stony Creek, which would discharge directly into Newville Reservoir; (2) Thomes Creek flows, which would be diverted from Thomes Creek and conveyed to Newville Reservoir through a gravity canal; (3) Mainstem Stony Creek, which would be conveyed from Black Butte Reservoir to

Newville Reservoir via Tehenn Canal, Tehenn Pumping-Generating Plant, Tehenn Reservoir, and Newville Pumping-Generating Plant; and (4) flows from the Sacramento River, which would be diverted into the Tehama-Colusa Canal and conveyed into Black Butte Reservoir via Sour Grass Canal and Sour Grass Pumping-Generating Plant and from Black Butte Reservoir into Thomes-Newville Reservoir via the Tehenn Canal and Reservoir. Figure 3 shows a schematic representation of the Thomes-Newville Reservoir Project.

Newville Reservoir and Dam--1.84 maf Alternative

Newville Reservoir, with a storage capacity of 1.84 maf, would have a normal pool elevation of 900 feet above MSL. The reservoir would have a surface area of 13,900 acres at normal pool. Newville Dam would consist of a zoned earthfill dam with an embankment volume of about 16 million cubic yards, which would rise 320 feet above the existing streambed. The crest of the dam would be at an elevation of 920 feet above MSL, with a crest length of approximately 2,400 feet. The area-capacity curves for Newville Reservoir are shown on Figure 4.

Inlet-Outlet Works

The inlet-outlet works for Newville Dam would have a capacity of 5,000 cfs to convey water pumped into the reservoir and to facilitate releases from the reservoir. The primary features of the inlet-outlet works would be a 2,100 foot-long tunnel through the right abutment of the dam and a sloping intake conduit with nine evenly spaced levels of inlets between the minimum and normal pool elevations.

Spillway

The spillway for the 1.84 maf Newville Reservoir would have a capacity of 35,700 cfs and would be located 200 feet west of the right dam abutment. The spillway would consist of two

submerged radial gates in a rectangular reinforced concrete-lined channel. The gates would be 20 feet wide and 30 feet high. The gate sill would be at an elevation of 850 feet above MSL. The emergency spillway would consist of two uncontrolled weirs, each 20 feet long at a crest elevation of 905 feet above MSL. The emergency spillway would have a capacity of 8,000 cfs. The gated spillway and the emergency spillway would discharge into a common concrete-lined tailrace and stilling basin.

In the event of a potential emergency condition, the outlet works and spillway must be capable of evacuating 10 percent of the maximum water depth within 10 days, as required by DWR's Division of Safety of Dams. With this criterion, the emergency drawdown release for Newville Reservoir would be about 21,000 cfs. This release requirement is within the capacity of the gated spillway; thus no adjustment to the outlet works would be required.

Saddle Dams

For a storage capacity of 1.84 maf, only one saddle dam, the Burrow's Gap Saddle Dam, would be required. Burrow's Gap Saddle Dam would be located about three miles south of Newville Dam at a saddle in Rocky Ridge. It would consist of a 70-foot-high earthfill dam with an embankment volume of approximately 197,000 cubic yards. It would have a crest length of approximately 520 feet at an elevation of 920 feet above MSL.

Newville Reservoir and Dam--3.08 maf Alternative

Newville Reservoir, with a storage capacity of 3.08 maf, would have a normal pool elevation of 980 feet above MSL. The reservoir would have a surface area of 16,700 acres at normal pool. Figure 3 contains a schematic of the Thomes-Newville Reservoir Project and Figure 4 shows the area-capacity curves for Newville Reservoir. Both figures contain information for the 1.84 and 3.08 maf alternatives.

For the 3.08 maf alternative, Newville Dam would be an earthfill embankment structure with a volume of approximately 25 million cubic yards. The dam would rise 400 feet above the existing streambed to an elevation of 1,000 feet above MSL. The crest length of the dam would be approximately 3,200 feet.

Inlet-Outlet Works

The configuration and capacity (5,000 cfs) of the inlet-outlet works for the 3.08 maf reservoir would be identical to the inlet-outlet works for the 1.84 maf reservoir.

Spillway

The maximum spillway capacity would be 35,700 cfs for the 3.08 maf Newville Reservoir, identical to the 1.84 maf reservoir. The configuration and dimensions of the submerged radial gates would also be the same for both alternative storage volumes. The sill of the gates would be at an elevation of 930 feet above MSL. The emergency spillway would consist of two uncontrolled weirs, each 20 feet long at an elevation of 985 feet above MSL. As with the 1.84 maf reservoir, the emergency spillway for the 3.08 maf reservoir would have a capacity of 8,000 cfs. The gated spillway and the emergency spillway would discharge into a common concrete lined tailrace and stilling basin.

The emergency release requirement of the 3.08 maf reservoir would be 32,000 cfs. This release can be made through the gated spillway and the inlet-outlet works of the dam; therefore, no adjustment to the outlet works is necessary to comply with DWR's Division of Safety of Dams.

Saddle Dams

Increasing the storage capacity to 3.08 maf would require 10 saddle dams. The largest saddle dam would be Chrome Dike, with an earthfill embankment volume of approximately 2.9 million cubic yards. The remaining saddle dams would be located on Rocky Ridge on the eastern and northern boundaries of the reservoir.

Newville Pumping-Generating Plant

The configuration of the Newville Pumping-Generating Plant would be the same for either a 1.84 maf or 3.08 maf Newville Reservoir. The plant would be located at the toe of Newville Dam to lift water from Tehenn Reservoir into Newville Reservoir and to generate power from releases from Newville Reservoir into Tehenn Reservoir. The plant would have a total capacity of 5,000 cfs. For the 1.84 maf Newville Reservoir, the required total dynamic head for the pumping facility would be 300 feet, with a power requirement of about 136,000 horsepower. For the 3.08 maf Newville Reservoir, the required total dynamic head would be 380 feet, with a power requirement of about 287,000 horsepower.

Thomes Creek Diversion Structure and Canal

The Thomes Creek Diversion Structure would be identical for either storage volume alternative. The diversion structure would be located in Thomes Creek approximately 9.0 miles upstream of Paskenta.

The diversion structure would consist of a conventional concrete gravity dam founded on the Stony Creek Formation. The dam crest would be about 90 feet above the existing streambed at an elevation of 1,050 feet above MSL. A 500-foot-wide overflow section with a crest elevation of 1,035 feet above MSL would be located on the left abutment. Two additional 20-foot-wide

and 50-foot-high radial gates located in the right abutment would have a capacity of 41,000 cfs. The sill of the gates would be located 25 feet above the original streambed. These gates would be opened to allow flood flows to pass and flush accumulated sediment out of the diversion pool. During most of the winter, the gates would be closed so water could be diverted to Newville Reservoir.

A concrete-lined canal would convey water 13,000 feet from Thomes Creek to Newville Reservoir. The canal would have a rectangular cross section 30 feet wide and 16.5 feet deep. The canal would have a capacity of 10,000 cfs.

Tehenn Reservoir

Tehenn Reservoir would be located on North Fork Stony Creek immediately downstream of Newville Dam (see Figure 2). Tehenn Reservoir would inundate Stony Creek back to the base of Newville Dam. Tehenn Reservoir would have a gross storage capacity of 32,500 acre-feet at a normal pool elevation of 610 feet above MSL. Tehenn Dam would rise 112 feet above the original streambed. The dam would have a crest length of 2,500 feet and a total embankment volume of 2.6 million cubic yards.

The spillway for Tehenn Reservoir would be a concrete-lined ungated chute-type on the left abutment with a capacity of 50,000 cfs. The chute would extend 1,300 feet ending in a concrete stilling basin. The spillway crest length would be 250 feet. The inlet-outlet works for Tehenn Dam would consist of a cut-and-cover steel-lined concrete conduit under the left abutment with a capacity of 5,000 cfs.

Tehenn Pumping-Generating Plant

The Tehenn Pumping-Generating Plant would lift water from Black Butte Reservoir and the Tehenn Canal into Tehenn Reservoir and would also generate power from releases from Tehenn Reservoir to Black Butte Reservoir. The plant would have a total capacity of 5,000 cfs. The total dynamic head would be 190 feet, with a power requirement of about 144,000 horsepower.

Tehenn Canal

Tehenn Canal would deliver a maximum flow of 5,000 cfs in either direction between Black Butte Reservoir and the Tehenn Pumping-Generating Plant. It would be approximately five miles long, and the alignment would roughly follow the natural channel of North Fork Stony Creek. The canal would be trapezoidal in shape and unlined. The canal would have an invert elevation of 410 feet above MSL, and the water surface elevation would fluctuate with the storage in Black Butte Reservoir. The minimum flood control drawdown of Black Butte Reservoir is at elevation 430 feet above MSL. The long canal and low invert elevation would allow continuous pumping from Black Butte Reservoir to Tehenn Reservoir at low water levels. The canal would require a maximum cut of 120 feet.

Black Butte Pumping-Generating Plant

The Black Butte Pumping-Generating Plant would lift water from the Black Butte Canal into Black Butte Reservoir and would generate power from releases from Black Butte Reservoir to the Black Butte Canal. The plant would be located just downstream of the existing Black Butte Dam and would be connected to the dam's inlet-outlet works by a new 1,800-foot tunnel. The pumping-generating plant would have a capacity of 5,000 cfs. The total dynamic head would be 144 feet, with a power requirement of about 109,000 horsepower.

Black Butte Canal

The Black Butte Canal would be a two-way conveyance facility connecting the Black Butte Pumping-Generating Plant and Black Butte Reservoir with the Sour Grass Pumping-Generating Plant. The Black Butte Canal would have a capacity of 5,000 cfs, matching the capacity of the pumping-generating plants. The canal would have a total length of 4.5 miles between the Black Butte and Sour Grass Pumping-Generating Plants. The canal would be trapezoidal in shape and concrete-lined. The invert elevation of the canal would be at an elevation of 310 feet above MSL, and the water surface elevation would be about 340 feet above MSL. Near Black Butte, the canal would require a maximum cut of about 190 feet.

Sour Grass Pumping-Generating Plant

The Sour Grass Pumping-Generating Plant would lift flow into the Black Butte Canal during pumping operations and would generate power during release operations from Black Butte Reservoir. Releases would be made through this plant and the Black Butte Pumping-Generating Plant to supply supplemental water from storage in Newville Reservoir for use in the Tehama-Colusa Canal.

The pumping-generating plant would have a capacity of 5,000 cfs. The total dynamic head would be 115 feet, with a power requirement of about 87,000 horsepower.

Sour Grass Canal

The Sour Grass Canal would convey water, in either direction, from the Tehama-Colusa Canal to the Sour Grass Pumping-Generating Plant. The canal would have a capacity of 5,000 cfs and would have a total length of 4.5 miles. The canal alignment would generally follow Sour Grass

Creek. The canal would be trapezoidal in shape and concrete lined. The canal would have a water surface elevation of about 235 feet above MSL and an invert of about 205 feet above MSL.

Road Relocations

This area is sparsely populated with relatively few structures. Approximately eight miles of public roads exist within the inundation area of Newville Reservoir. The Paskenta-Round Valley Road, a paved two-lane county road, passes through the north end of the reservoir, and another county road crosses northwestward through the reservoir from the dam site to Paskenta-Round Valley Road. These roads would be relocated and upgraded to current county road standards. The total length of new road construction would be about 10 miles.

COST ESTIMATE

The estimated capital cost of the facilities identified in the previous sections are based on DWR's September 1981 Thomes-Newville Plan Report and DWR's November 1980 Glenn Reservoir Feasibility Report. Project costs not identified in the DWR reports are not included in the present updated cost estimate. Some of these additional costs include environmental documentation and mitigation, operation and maintenance, power, filling of the reservoir, recreational development, and interest during construction.

COST ESTIMATE METHODOLOGY

The 1981 DWR cost estimates have been reviewed and adapted for the present cost estimate update. Several items in the previous cost estimates were modified to incorporate that current design standards and safety factors.

General

The cost estimates for the Thomes-Newville Reservoir Project were determined by escalating the costs provided in the 1980 DWR *Thomes-Newville and Glenn Reservoir Plans, Engineering Feasibility* report and the 1981 DWR *SWP Future Supply Program, Thomes-Newville Plan, Addendum to the Cost Estimate for Thomes-Newville Project Plan I and II, Volume I, Memorandum Report.* The cost estimates provided in these reports were escalated to October 1996 dollars using the Reclamation's Construction Cost Trends (CCT) indices and by applying current unit costs to quantities found in these reports. Tables 2a and 2b provide a detailed breakdown of the estimated capital costs of the Thomes-Newville Reservoir Project, with a storage capacity of 1.84 and 3.08 maf, respectively. These tables 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 Tables 2a and 2b provide 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 Reclamation, Land Resource Branch (Personal Communication February 1997). Reclamation provided land use cost estimates at a subappraisal level for all storage and conveyance components reviewed by CALFED. The total project lands associated with the reservoirs include a buffer around the maximum water surface area. The ratio of total project land acquired for a reservoir 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.

The total right of way needed would be 18,350 and 22,060 acres for the 1.84 maf and 3.08 maf alternatives, respectively.

Canal Costs

To develop costs for Black Butte and Tehenn Canals the cost estimates provided in the 1980 Glenn Reservoir Facilities Report were updated and 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.

The capacities of the two canals in the 1980 report were 3,000 cfs. The empirical equation was used to factor the cost to a capacity of 5,000 cfs.

The cost factor formula is typically valid over moderate ranges in capacity; the validity over larger ranges is undetermined. The impact of any error resulting from utilizing this ratio beyond its valid range is considered to be within the range of 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 pumping-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.

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.

Reservoir Clearing

The total area that needs to be cleared is assumed to be ten percent of the water surface area (based on the DWR report titled, *SWP Future Supply Program Thomes-Newville Plan*, September 1981). The reservoir clearing areas needed would be 1,390 and 1,670 acres for the 1.84 maf and 3.08 maf alternatives, respectively.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by 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 total estimated cost associated with constructing the Thomes-Newville Reservoir Project as it has been described within this evaluation ranges from $1,540 to $1,970 million and $1,590 to $2,030 million for a project with 1.84 and 3.08 maf of storage at Newville Reservoir, respectively.

The difference in cost of the two alternatives is attributed primarily to the difference in Newville Reservoir storage capacity. The 1.84 maf Newville Reservoir has a total estimated cost of $418 million, with $217 million attributable to the Newville Pumping-Generating Plant. The 3.08 maf Newville Reservoir has a total estimated cost of $556 million, with $250 million attributable to the Newville Pumping-Generating Plant.

The costs of the remaining facilities (Thomes Diversion Facility, Tehenn Reservoir, Tehenn Pumping-Generating Plant, Tehenn Canal, Black Butte Pumping-Generating Plant, Black Butte Canal, Sour Grass Pumping-Generating Plant, and the Sour Grass Canal) are the same for both alternatives. The costs and configuration of the above facilities are based on a conveyance capacity of 5,000 cfs from the Tehama-Colusa Canal to Newville Reservoir and on a conveyance capacity of 10,000 cfs from the Thomes Creek Diversion Facility to Newville Reservoir. The total estimated costs of these facilities is about $642 million. Contingencies and engineering, administrative, and legal services make up the remaining cost of constructing these projects.

ENVIRONMENTAL CONSIDERATIONS

[NOTE: The Environmental Considerations section of this report 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 a Thomes-Newville Reservoir Project. This section describes the fish,

wildlife, plant, and cultural resources that could be affected, and identifies, where possible, the extent of the effect of the proposal on these resources. 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 13,900 acres of terrestrial wildlife habitat, and up to 35 miles of perennial stream habitat.

One of the more significant results of constructing this complex would be the loss of over 2,000 acres of critical winter range for an estimated 1,100 deer of the Thomes Creek (Lake Hollow) herd and the displacement of over 600 migratory and resident deer. Potential impacts to steelhead and salmon may also result from the loss of a portion of their periodic run. The impact of run blockage for Sacramento squawfish and suckers, is expected to be significant. Indirect fish losses can be expected at the project's Sacramento River diversion.

Fish, Amphibians, Reptiles, and Invertebrates

Aquatic habitat in the project area include perennial pools and seasonally flowing streams, with some cooler streams from the mountains. The streams and numerous tributaries within the potential inundation zone provide habitat for a number of cold- and warm-water fish species. Fish habitat zones within the project area include the Rainbow Trout, California Roach, and Squawfish-Sucker-Hardhead zones. Representative species that are supported by these zones include rainbow trout, brown trout, chinook salmon, smallmouth bass, green sunfish, redear sunfish, channel catfish, white catfish, brown bullhead, black bullhead, threespine stickleback, Pacific lamprey, hard head, Sacramento squawfish, Sacramento sucker, hitch, golden shinner,

mosquitofish, and prickly sculpin. The principal gamefish are trout and bass. Small numbers of chinook salmon and steelhead enter Stony Creek and Thomes Creek during the fall and winter.

The project could result in creek flow reductions which would limit spawning and rearing habitat for a small populations of chinook salmon and steelhead trout. Flow reductions in Thomes Creek may also limit spawning and rearing opportunities for non-game species such as Sacramento squawfish and Sacramento suckers. The latter impact is expected to be greater because of the much larger size of the squawfish and sucker runs. Altered stream flows could cause the composition in some of the area's creeks to change. In some cases, stabilized water levels in the new reservoirs will have a beneficial effect on warm water fish species such as striped bass.

In addition, indirect effects on fish in the Sacramento River and Delta could occur as a result of stoppage of gravel recruitment causing eventual degradation of additional spawning, incubation, and rearing habitat. Other effects include reduced insect production due to increased current velocities over rifle areas, increased backwater fish production due to higher flows, increased estuarine productivity due to higher flows which would transport more nutrients and detritus, a possible increase in aquatic organism survival due to the dilution of toxicant caused by higher flows, possible changes in the timing and location of striped bass spawning due to streamflow alterations, possible improvement of American shad survival due to higher flows, increased salmon mortalities at alternative Sacramento River pump diversions, and unknown estuary changes in the Delta due to reductions in uncontrolled flows.

The Thomes-Newville Reservoir Project supports 12 different species of amphibians and over 20 species of reptiles.

General Wildlife

Lands within the Thomes-Newville Reservoir Project area support diverse wildlife. The primary game species include black-tailed deer, California quail, mourning dove, wild turkey, and furbearers. Non-game species include numerous species of songbirds and mammals. The grasslands within the project area provide valuable foraging opportunities for raptors such as golden eagles and prairie falcons. Previous surveys have identified up to 145 species of birds in four different habitat types within the project area.

The project would provide benefits to water-associated birds by increasing available habitat.

Significant numbers of wintering deer migrate through sections of the project area and use the area as wintering habitat. About 19 percent of the current winter range of the Thomes Creek (Lake Hollow) deer herd would be inundated by the proposed facilities. It may be possible to lessen this impact by improving habitats in the Thomes Creek drainage upstream of the proposed Newville Reservoir.

Sensitive and Listed Fish and Wildlife Species

Several State or federally listed fish species are known to exist within the area of the proposed Thomes-Newville Reservoir Project. According to the California Department of Fish and Game's (CDFG) Natural Diversity Data Base (Version 8/96), there are two wildlife species that are State or federally listed and two wildlife species that are either candidates for listing and/or species designated by CDFG as "species of special concern."

Listed wildlife species that have been known to occur in or near the area affected by the proposed complex include bald eagle (federal threatened/State endangered), and northern spotted owl

(federal threatened). Other listed species that may be found in the project area include bank swallow, willow flycatcher, and Swainson's hawk.

Wildlife species that are either candidates for state or federal listing, or considered "species of special concern" by the CDFG that could be affected by the proposed project include northern goshawk tailed frog (federal candidate/CDFG species of special concern), and prairie falcon CDFG species of special concern). Other CDFG species of special concern that may be found using the project area include golden eagle, osprey, Cooper's hawk, yellow warbler, and tricolored blackbird.

Wintering southern bald eagles currently use the riparian areas within the project complex for roosting. Reductions in riparian habitat will reduce roosting habitat for eagles and a reduction of squawfish and suckers would reduce forage opportunities for eagles. Maintenance of riparian habitat below project diversions and sustained fish populations in the new reservoirs could lessen the impact of the project on these wintering eagles. Golden eagles, most abundant during the winter, can be found using the project area year-round.

Bank swallows are summer visitors to the project area. Nesting colonies have been known to occur in the past along Thomes Creek.

VEGETATION

Vegetation at the Thomes-Newville Reservoir Project consists primarily of grasslands, oak-pine woodland, and chaparral. Riparian vegetation occurs along the numerous rivers and streams in the area. Vernal pools have been scattered throughout the project area in the past.

Sensitive and Listed Plant Species

One listed plant species, Indian valley brodiaea (federal candidate, State endangered), is known to occur within the area proposed for the Thomes-Newville Reservoir. Other sensitive plant species or plants that are candidates for federal or state listing, could possibly be found in the project area. These species include drymaria-like western flax, Tehama County western flax, Brandegee's eriastrum, adobe lily, Ahart's paronychia, Shasta clarkia, and Butte County fritillary.

Two additional plants, diamorphic snapdragon and dwarf soaproot, listed by the California Native Plant Society as being rare, threatened or endangered in California and elsewhere could also be affected by the proposed project.

There are two special-status habitats in the area affected by the proposed project: Great Valley cottonwood riparian forest and northern interior cypress forest.

Wetlands

Based on wetland information from USFWS's National Wetlands Inventory Maps, the following lands would be directly affected by the project: 36 miles of intermittent streambeds; 35 miles of perennial streams, 10 miles of emergent seasonally flooded wetlands (shallow marsh), one mile of emergent temporarily flooded wetlands (wet meadow), one mile of shrub-scrub wetlands, one mile of forested wetlands, one mile of forested/scrub-shrub wetland, 71 acres of open water, artificially flooded wetlands, 25 acres of forested wetland (wet meadow), seven acres of shrub-scrub (wet meadow), 4 acres of emergent shallow marsh, and 45 acres of ponds.

CULTURAL RESOURCES

There are 188 non-significant and an estimated 35 significant prehistoric sites in the proposed project's area. There is also an estimate of 50 non-significant, 20 significant historic sites, and 35 ethnographic sites.

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Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
THOMES-NEWVILLE RESERVOIR PROJECT

	1.84 MAF	3.08 MAF
Newville Reservoir		
Normal Pool Elevation (feet above MSL)	900	980
Capacity at Normal Pool Elevation (MAF)	1.84	3.08
Inundation Area (acres)	13,900	16,700
Main Dam		
Type	Zoned Earthfill	Zoned Earthfill
Height above Streambed (feet)	320	400
Top of Dam (feet above MSL)	920	1,000
Embankment Volume (million cubic yards)	16,000,000	25,000,000
Freeboard (feet)	20	20
Downstream Face Slope (horizontal on vertical)	2.5:1	2.5:1
Upstream Face Slope (horizontal on vertical)	3.25:1	3.25:1
Crest Length (feet)	2,400	3,200
Spillway Capacity (cfs)	35,700	35,700
Emergency Spillway (cfs)	8,000	8,000
Inlet/Outlet Capacity (cfs)	5,000	5,000
Saddle Dams		
Number Required	1	10
Embankment Volume (cubic yards)	197,000	4,700,000
Thomes Creek Diversion Structure		
Dam Type	Conventional Concrete Gravity	
Top of Dam (feet above MSL)	1,050	1,050
Overflow Section Width (feet)	500	500
Overflow Section Elevation (feet above MSL)	1,035	1,035
Gated Spillway Capacity (cfs)	41,000	41,000
Conveyance Canal Length (feet)	13,100	13,100
Conveyance Canal Capacity (cfs)	10,000	10,000
Concrete Chute Length (feet)	2,150	0
Tehenn Reservoir		
Normal Pool Elevation (feet above MSL)	610	610
Capacity at Normal Pool Elevation (acre-feet)	32,500	32,500
Tehenn Dam		
Type	Earthfill	Earthfill
Embankment Volume (cubic yards)	2,600,000	2,600,000
Height Above Streambed (feet)	112	112
Crest Length (feet)	2,500	2,500
Spillway Capacity (cfs)	50,000	50,000
Outlet Works Capacity (cfs)	5,000	5,000
Tehenn Canal		
Invert Elevation (feet above MSL)	410	410
Capacity (cfs)	5,000	5,000
Length (MI)	5.0	5.0

Table 1 (Continued)
SUMMARY OF PHYSICAL CHARACTERISTICS
THOMES-NEWVILLE RESERVOIR PROJECT

	1.84 MAF	3.08 MAF
Pumping Plants		
Capacity (cfs)		
Newville	5,000	5,000
Tehenn	5,000	5,000
Black Butte	5,000	5,000
Sour Grass	5,000	5,000
TDM (feet)		
Newville	300	380
Tehenn	190	190
Black Butte	144	144
Sour Grass	115	115
HP		
Newville	226,912	287,422
Tehenn	143,711	143,711
Black Butte	108,918	108,918
Sour Grass	86,983	86,983
Black Butte Canal		
Invert Elevation	310	310
Capacity (cfs)	5,000	5,000
Length (mile)	4.5	4.5
Sour Grass Canal		
Invert Elevation	205	205
Capacity (cfs)	5,000	5,000
Length (mile)	4.5	4.5
Black Butte Reservoir (Existing)		
Normal Pool Elevation (feet above MSL)	474	474
Capacity at Normal Pool Elevation (acre-feet)	392,000	392,000

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. LANDS								
Newville Reservoir Right of Way	18,350	AC				$1,500	$27,525,000	5
Thomes Creek Diversion Right of Way	125	AC				$1,500	$187,500	5
Tehenn Reservoir right of Way	1,250	AC				$1,500	$1,875,000	5
Tehenn Canal Right of Way	212	AC				$1,500	$318,000	5
Black Butte Canal Right of Way	191	AC				$1,500	$286,500	5
Sour Grass Canal Right of Way	191	AC				$1,500	$286,500	5
SUBTOTAL LANDS							$30,478,500	
II. DAM								
Mobilization	JOB	LS	132	159	$2,300,000	$2,770,455	$2,770,455	1, page 39
Care of Water	JOB	LS	132	159	$150,000	$180,682	$180,682	1, page 39
Foundation Excavation and Stripping	1,946,670	CY				$3.23	$6,287,744	2, item I-d
Imported Borrow - Impervious	4,301,200	CY				$3.22	$13,849,864	2, item I-e
Place and Compact Impervious Material	3,910,200	CY				$0.95	$3,714,690	2, item I-f
Furnish and Compact Filter and Drain	1,595,300	CY				$8.54	$13,623,862	2, item I- i &j
Furnish and Compact Random Material	1,677,800	CY				$3.11	$5,217,958	2, item I-l
Furnish and Compact Sand and Gravel	8,816,930	CY				$5.90	$52,019,887	2, item I- g&h
Drill Grout Holes	35,300	LF				$18.70	$660,110	2, item I-q
Grout Connections	380	EA	132	159	$50.00	$60.00	$22,800	1, page 39
Grouting	870	CY	132	159	$190.00	$229	$199,230	1, page 39
Grout Pipe	1,140	LF	132	159	$8.00	$10.00	$11,400	1, page 39
Instrumentation	JOB	LS	132	159	$350,000	$421,591	$421,591	1, page 39
SUBTOTAL DAM							$98,980,273	
III. OUTLET WORKS								
Dewatering	JOB	LS	141	206	$100,000	$146,099	$146,099	1, page 42
Excavations for:								
Gate Chamber	1,500	CY	141	206	$100	$146	$219,000	1, page 42
Intake and Gate Chamber	12,000	CY				$6.76	$81,120	2, item VI - I
Penstocks and Tunnel	37,000	CY				$128.27	$4,745,990	2, item VI - s
Portal	127,000	CY	141	206	$6.00	$9.00	$1,143,000	1, page 42
By-pass and Trifureation	9,000	CY	141	206	$4.00	$6.00	$54,000	1, page 42
Shaft	1,000	CY				$147	$146,590	2, item II - c
Diversion Channel	71,000	CY	141	206	$4.00	$6.00	$426,000	1, page 42
Compaction Backfill	7,000	CY	141	206	$20.00	$29.00	$203,000	1, page 42
Granular Structural Backfill	2,000	CY				$18.99	$37,980	2, item VI - h

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Concrete								
Penstock-Tunnel	10,500	CY				$321	$3,367,140	2, item VI - t
Intake and Gate Chamber Access Tunnel	3,600	CY				$321	$1,154,448	2, item VI - t
Gate Chambers	700	CY				$340	$237,650	2, item VI - k
Low Intake	500	CY				$340	$169,750	2, item VI - k
Low Intake Foundation	400	CY				$270	$108,180	2, item VI - j
Control Valve House	700	CY				$340	$237,650	2, item VI - k
Vertical Shaft	300	CY				$340	$101,850	2, item VI - k
Grouting Cement	21,000	BBL	141	206	$18.00	$26.00	$546,000	1, page 42
Mass Concrete	4,000	CY				$293	$1,172,360	2, item III - d
Ring Girder	72,000	LBS	141	206	$2.00	$3.00	$216,000	1, page 42
Overhead Hoist Rails	150,000	LBS				$3.63	$544,500	2, item VI - p
2 1/2 " x 2 1/2 " x 1/4 " Angles	27,000	LBS				$3.63	$98,010	2, item VI-m
1 1/2 " x 30 " x 20 " Bearing Plate	30,000	LBS				$3.63	$108,900	2, item VI-m
Walkway Plate	54,000	LBS				$3.63	$196,020	2, item VI-m
Gantry Crane (20 ton)	1	EA	141	206	$195,000	$284,894	$284,894	1, page 41
Trashrack 6 ' x 18 '	6	EA	141	206	$10,000	$14,610	$87,660	2, item VI-q
60 " Dia. Gate Valve	12	EA	141	206	$77,000	$112,496	$1,349,952	1, page 41
84 " Dia. Howell Bunger Valve	2	EA	141	206	$300,000	$438,298	$876,596	1, page 41
84 " Dia. Gate Valve	2	EA	141	206	$310,000	$452,908	$905,816	1, page 41
90 " Dia Gate Valve	1	EA	141	206	$350,000	$511,348	$511,348	1, page 41
Valve Thimbles	12	EA	141	206	$15,000	$21,915	$262,980	1, page 41
Valve Operator	12	EA	141	206	$20,000	$29,220	$350,640	1, page 41
120 " Dia. Steel Penstock	1,050,000	LBS				$1.65	$1,732,500	2, item VII-c
90 " Dia. Steel By-pass	200,000	LBS				$1.65	$330,000	2, item VII-c
72 " Dia. Steel By-pass	50,000	LBS				$1.65	$82,500	2, item VII-c
60 " Dia. Steel By-pass	97,000	LBS				$1.65	$160,050	2, item VII-c
Grouting Pipe	13,630	LBS	132	159	$8.00	$10.00	$136,300	1, page 41
Bifurcation 10 ' to 8 '	2	EA	141	206	$17,000	$24,837	$49,674	1, page 41
Reducer 10 ' to 6'	1	EA	141	206	$10,000	$14,610	$14,610	1, page 41
Bifurcation 10 ' to 5 '	2	EA	141	206	$14,000	$20,454	$40,908	1, page 41
Timber for Tunnel Supports	300	MBF				$1,930	$579,000	2, item VI - w
Grout Drilling Holes	18,500	LF				$17.70	$327,450	2, item I - g
Standby Generator	1	EA	141	206	$45,000	$65,745	$65,745	1, page 41
Architectural Features	JOB	LS	141	206	$300,000	$438,298	$438,298	1, page 41
Cathodic Protection	JOB	LS	141	206	$35,000	$51,135	$51,135	1, page 41
Protective Coatings	JOB	LS	141	206	$100,000	$146,099	$146,099	1, page 41

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
SUBTOTAL							$24,245,392	
Increase Capacity from 1,500 cfs to 5,000 cfs, factor cost by $(5,000/1,500)^{3/8} = 1.57$								
SUBTOTAL OUTLET WORKS							$38,065,265	
IV. SPILLWAY								
Mobilization	JOB	LS	143	186	$300,000	$390,210	$390,210	1, page 44
Drill Grout Holes	920	LF				$18.70	$17,204	2, item I-g
Grout Connections	15	EA	143	186	$25.00	$33.00	$495	1, page 44
Grouting	23	CY	143	186	$280	$364	$8,372	1, page 44
Grout Pipe	68	LF	132	159	$8.00	$10.00	$680	1, page 44
Excavation (blasting)	725,000	CY				$7.66	$5,553,500	2, item V-b3
Excavation	249,000	CY				$4.03	$1,003,470	2, av. item IIa, IIIa
Rock Riprap	2,000	CY				$31.64	$63,280	2, item I-n
Granular Backfill	5,800	CY				$45.09	$261,522	2, item II-n
Structural Backfill	8,100	CY	143	186	$20.00	$26.00	$210,600	1, page 44
Compacted Backfill	44,700	CY				$8.17	$365,199	2, item III-f
Aggregate Base	480	TON				$19.15	$9,192	2, item V-d
Asphalt Concrete	400	TON				$58.92	$23,568	2, item V-e
Mass Concrete	6,200	CY				$293	$1,817,158	2, item III-d
Structural Concrete	20,700	CY				$401	$8,307,117	2, av. item IIh, IIIc
Embedded Metal	JOB	LS	143	186	$35,000	$45,524	$45,524	1, page 44
Misc. Metal	JOB	LS	143	186	$50,000	$65,035	$65,035	1, page 44
Radial Gate (20 ' x 30 ')	2	EA	143	186	$270,000	$351,189	$702,378	1, page 44
Radial Gate Hoist Assembly	2	EA	143	186	$90,000	$117,063	$234,126	1, page 44
Stop Log (6 ' x 21 ')	12	EA	143	186	$14,000	$18,210	$218,520	1, page 44
Stop Log Storage Rack	JOB	LS	143	186	$20,000	$26,014	$26,014	1, page 44
Stop Log Lifting Beam	JOB	LS	143	186	$5,000	$6,503	$6,503	1, page 44
Electrical Work	JOB	LS	143	186	$30,000	$39,021	$39,021	1, page 44
Control Building (12 ' x 16 ')	JOB	LS	143	186	$26,000	$33,818	$33,818	1, page 44
Standby Generator	JOB	LS	143	186	$40,000	$52,028	$52,028	1, page 44
SUBTOTAL SPILLWAY							$19,454,534	
V. RESERVOIR								
Reservoir Clearing (Newville and Tehenn)	1,515	AC				$1,097	$1,661,955	2, item IV-a
Improvements	JOB	LS	137	176	$30,000	$38,540	$38,540	1, page 47
Construction Facilities	JOB	LS	137	176	$20,000	$25,693	$25,693	1, page 47
Excavate Overlook	48,400	CY	137	176	$14.00	$18.00	$871,200	1, page 47

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Aggregate Base for Overlook	2,000	TON				$19.15	$38,300	2, item V-d
Asphalt Concrete for Overlook	511	TON				$58.92	$30,108	2, item v-e
Liquid Asphalt Prime and Seal	85	TON				$324.03	$27,543	2, av. item V- f&g
Landscaping Overlook	JOB	LS	137	176	$24,000	$30,832	$30,832	1, page 47
Visitor's Center	JOB	LS	137	176	$200,000	$256,934	$256,934	1, page 47
SUBTOTAL RESERVOIR							$2,981,105	
VI. OVERLOOK ACCESS ROAD								
Excavation	106,000	CY				$3.98	$421,880	2, item V-b1
Class II Aggregate Base	5,710	TON				$19.15	$109,347	2, item V-d
Asphalt Concrete	941	TON				$58.92	$55,444	2, item V-e
Liquid Asphalt Prime and Seal Coat	157	TON				$324	$50,873	2, av. item V-f&g
Guard Rail	2,650	LF	160	237	$20.00	$30.00	$79,500	1, page 50
18 " CMP	180	LF				$44.78	$8,060	2, item V-j
24 " CMP	490	LF				$53.53	$26,230	2, item V-k
30 " CMP	200	LF	160	237	$45.00	$67.00	$13,400	1, page 50
Structure Excavation	350	CY	160	237	$12.00	$18.00	$6,300	1, page 50
Structure Backfill	270	CY	160	237	$20.00	$30.00	$8,100	1, page 50
SUBTOTAL OVERLOOK ACCESS ROAD							$779,133	
VII. ROAD RELOCATIONS								
Newville to Paskenta								
48 " CSP	140	LF	146	219	$60.00	$90.00	$12,600	1, page 51
26 " CSP	240	LF	146	219	$40.00	$60.00	$14,400	1, page 51
24 " CSP	160	LF	146	219	$30.00	$45.00	$7,200	1, page 51
18 " CSP	570	LF	146	219	$25.00	$38.00	$21,660	1, page 51
Structure Excavation	4,700	CY	146	219	$25.00	$38.00	$178,600	1, page 51
Structure Backfill	4,400	CY	146	219	$45.00	$68.00	$299,200	1, page 51
Roadway Excavation	1,033,000	CY				$3.98	$4,111,340	2, item V-b1
Aggregate Base	31,000	TON				$19.15	$593,650	2, item V-d
Asphalt Concrete	15,000	TON				$58.92	$883,800	2, item V-e
Down Drains	24	EA	146	219	$1,000	$1,500	$36,000	1, page 51
Fence	66,800	LF	146	219	$2.00	$3.00	$200,400	1, page 51
SUBTOTAL NEWVILLE TO PASKENTA ROAD							$6,358,850	
Cattle Crossings (6 total)								
11' - 5" x 73 " Multiple Steel Pipe	432	LF	146	219	$180	$270	$116,640	1, page 51

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Structure Excavation	1,710	CY	146	219	$25.00	$38.00	$64,980	1, page 51
Structure Backfill	1,100	CY	146	219	$45.00	$68.00	$74,800	1, page 51
SUBTOTAL CATTLE CROSSINGS							$256,420	
Round Valley Road								
48 " CSP	300	LF	146	219	$60.00	$90.00	$27,000	1, page 51
24 " CSP	2,120	LF	146	219	$30.00	$45.00	$95,400	1, page 51
Roadway Excavation	233,000	CY	146	219		$3.98	$927,340	2, item V-b1
Structure Excavation	2,000	CY	146	219	$25.00	$38.00	$76,000	1, page 51
Structure Backfill	1,600	CY	146	219	$45.00	$68.00	$108,800	1, page 51
Aggregate Base	9,100	TON				$19.15	$174,265	2, item V-d
Asphalt Concrete	4,400	TON				$58.92	$259,248	2, item V-e
Down Drains	12	EA	146	219	$1,000	$1,500	$18,000	1, page 51
Fence	20,000	LF	146	219	$2.00	$3.00	$60,000	1,page 51
Compacted Embankment and Overhaul	211,000	CY				$1.36	$286,960	2, item V-c1
Bridge D/S of Newville Spillway	6,800	SF				$100	$680,000	3
SUBTOTAL ROUND VALLEY ROAD							$2,713,013	
Chrome to Burrows Gap Road								
60 " CSP	250	LF	146	219	$70.00	$105	$26,250	1, page 52
24 " CSP	920	LF	146	219	$30.00	$45.00	$41,400	1, page 52
Roadway Excavation	202,000	CY				$3.98	$803,960	2, item V-b1
Structure Excavation	1,600	CY	146	219	$25.00	$38.00	$60,800	1, page 52
Structure Backfill	1,800	CY	146	219	$45.00	$68.00	$122,400	1, page 52
Aggregate Base	9,100	TON				$19.15	$174,265	2, item V-d
Asphalt Concrete	5,300	TON				$58.92	$312,276	2, item V-e
Fence	53,000	LF	146	219	$2.00	$3.00	$159,000	1, page 52
Bridge over Stony Creek Diversion	6,800	SF				$100	$680,000	3
SUBTOTAL CHROME TO BURROWS GAP ROAD							$2,380,351	
SUBTOTAL ROAD RELOCATIONS							$11,708,634	

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
VIII. BURROWS GAP SADDLE DAM								
Mobilization	JOB	LS	132	159	$86,000	$103,591	$103,591	1, page 54
Clear and Grub	3	AC	132	159	$4,000	$4,818	$14,454	1. page 54
Foundation Excavation	87,400	CY				$3.23	$282,302	2, item I-d
Drill Grout Holes	2,700	LF				$18.70	$50,490	2, item I-g
Grout Connections	50	EA	132	159	$50.00	$60.00	$3,000	
Grouting	67	CY	132	159	$280	$337	$22,579	
Grout Pipe	225	LF	132	159	$8.00	$10.00	$2,250	
Borrow - Impervious Material	176,500	CY				$3.22	$568,330	2, item I-e
Filter and Drain Material	26,600	CY				$8.54	$227,164	2, item I- i&j
Riprap	6,640	CY				$31.64	$210,090	2, item I-n
Riprap Bedding	3,320	CY				$1.79	$5,943	2, item I-m
Placed Impervious	160,500	CY				$0.95	$152,475	2, item I-f
Instrumentation	JOB	LS	132	176	$50,000	$66,667	$66,667	1, page 54
SUBTOTAL CONVEYANCE FACILITIES							$1,709,334	

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 79	USBR INDEX OCT. 96	UNIT COST OCT. 79	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
IX. THOMES CREEK DIVERSION FACILITIES								
Diversion Structure	JOB	LS	121	207	$7,940,000	$13,583,306	$13,583,306	4, page 4-13
Intake Structure	JOB	LS	122	213	$1,150,000	$2,007,787	$2,007,787	4, page 4-13
Canal and Roads	JOB	LS	120	199	$21,740,000	$36,052,167	$36,052,167	4, page 4-13
Outlet Chute	JOB	LS	122	213	$1,860,000	$3,247,377	$3,247,377	4, page 4-13
SUBTOTAL THOMES CREEK DIVERSION FACILITIES							$54,890,637	

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 80	USBR INDEX OCT. 96	UNIT COST APR. 80	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
X. CONVEYANCE FACILITIES								
Tehama Colusa Canal Turnout	JOB	LS				$1,543,000	$1,543,000	3
Sour Grass Canal	JOB	LS	127	199	$13,220,222	$20,715,151	$20,715,151	4- page 9-17
Sour Grass Pumping-Generating Plant								
Q=5,000 cfs, TDH = 115 ft., HP = 86,983	JOB	LS				$121,911,000	$121,911,000	3

Table 2a
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (1.84 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 80	USBR INDEX OCT. 96	UNIT COST APR. 80	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Black Butte Canal , factored by (5,000/10,000)$^{3/8}$	JOB	LS	127	199	$15,453,000	$24,213,756	$24,213,756	4- page 9-17
Black Butte Pumping-Generating Plant								
Q=5,000 cfs, TDH = 144 ft. , HP =108,918	JOB	LS				$139,522,000	$139,522,000	3
Tehenn Canal, factored by 5,000/3,000)$^{3/8}$	JOB	LS	127	199	$47,658,000	$74,676,709	$74,676,709	4- page 5-19
Tehenn Reservoir	JOB	LS	127	176	$29,010,000	$40,202,835	$40,202,835	4- page 5-19
Tehenn Pumping-Generating Plant								
Q=5,000 cfs, TDH = 190 ft., HP = 143,711	JOB	LS				$164,770,000	$164,770,000	3
Newville Pumping-Generating Plant								
Q=5,000 cfs, TDH = 300 ft., HP = 226,912	JOB	LS				$216,720,000	$216,720,000	3
SUBTOTAL CONVEYANCE FACILITIES							$804,274,451	
SUB TOTAL FOR THOMES-NEWVILLE							$1,061,600,000	
CONTINGENCIES @ 20%							$212,300,000	
ESTIMATED CONSTRUCTION COST							$1,273,900,000	
ENG., LEGAL, AND ADM. @ 35%							$445,900,000	
ESTIMATED CAPITAL COST FOR THOMES-NEWVILLE							$1,719,800,000	
ESTIMATED CAPITAL COST RANGE FOR THOMES-NEWVILLE								
LOW (-10%)							$1,548,000,000	
HIGH (+15%)							$1,978,000,000	

Footnotes:

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

Cost Reference:

1. California Department of Water Resources, *SWP Future Supply Program, Thomes-Newville Plan*, September 1981.
2. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, December 1990.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, *Thomes-Newville and Glenn Reservoir Plans - Engineering Feasibility*, November 1980.
5. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.

Table 2b
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. LANDS								
Newville Reservoir Right of Way	22,060	AC				$1,500	$33,090,000	5
Thomes Creek Diversion Right of Way	107	AC				$1,500	$160,500	5
Tehenn Reservoir Right of Way	1,250	AC				$1,500	$1,875,000	5
Tehenn Canal Right of Way	212	AC				$1,500	$318,000	5
Black Butte Canal Right of Way	191	AC				$1,500	$286,500	5
Sour Grass Canal Right of Way	191	AC				$1,500	$286,500	5
SUBTOTAL LANDS							$36,016,500	
II. DAM								
Mobilization	JOB	LS	132	159	$2,300,000	$2,770,455	$2,770,455	1, page 39
Care of Water	JOB	LS	132	159	$150,000	$180,682	$180,682	1, page 39
Foundation Excavation and Stripping	2,994,000	CY				$3.23	$9,670,620	2, item I-d
Imported Borrow - Impervious	6,615,300	CY				$3.22	$21,301,266	2, item I-e
Place and Compact Impervious Material	6,013,900	CY				$0.95	$5,713,205	2, item I-f
Furnish and Compact Filter and Drain	2,453,600	CY				$8.54	$20,953,744	2, item I- i &j
Furnish and Compact Random Material	2,580,500	CY				$3.11	$8,025,355	2, item I-l
Furnish and Compact Sand and Gravel	13,560,400	CY				$5.90	$80,006,360	2, item I- g&h
Drill Grout Holes	54,290	LF				$18.70	$1,015,223	2, item I-q
Grout Connections	585	EA	132	159	$50.00	$60.00	$35,100	1, page 39
Grouting	1,340	CY	132	159	$190.00	$229	$306,860	1, page 39
Grout Pipe	1,755	LF	132	159	$8.00	$10.00	$17,550	1, page 39
Instrumentation	JOB	LS	132	159	$350,000	$421,591	$421,591	1, page 39
SUBTOTAL DAM							$150,418,011	
III. OUTLET WORKS								
Dewatering	JOB	LS	141	206	$100,000	$146,099	$146,099	1, page 42
Excavations for:								
Gate Chamber	1,500	CY	141	206	$100	$146	$219,000	1, page 42
Intake and Gate Chamber	12,000	CY				$6.76	$81,120	2, item VI - l
Penstocks and Tunnel	37,000	CY				$128.27	$4,745,990	2, item VI - s
Portal	127,000	CY	141	206	$6.00	$9.00	$1,143,000	1, page 42
By-pass and Trifureation	9,000	CY	141	206	$4.00	$6.00	$54,000	1, page 42
Shaft	1,000	CY				$147	$146,590	2, item II - c
Diversion Channel	71,000	CY	141	206	$4.00	$6.00	$426,000	1, page 42
Compaction Backfill	7,000	CY	141	206	$20.00	$29.00	$203,000	1, page 42
Granular Structural Backfill	2,000	CY				$18.99	$37,980	2, item VI - h
Concrete								
Penstock-Tunnel	10,500	CY				$321	$3,367,140	2, item VI - t
Intake and Gate Chamber Access Tunnel	3,600	CY				$321	$1,154,448	2, item VI - t
Gate Chambers	700	CY				$340	$237,650	2, item VI - k

Table 2b
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

DESCRIPTION	QUANTITY	UNIT	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Low Intake	500	CY				$340	$169,750	2, item VI - k
Low Intake Foundation	400	CY				$270	$108,180	2, item VI - j
Control Valve House	700	CY				$340	$237,650	2, item VI - k
Vertical Shaft	300	CY				$340	$101,850	2, item VI - k
Grouting Cement	21,000	BBL	141	206	$18.00	$26.00	$546,000	1, page 42
Mass Concrete	4,000	CY				$293	$1,172,360	2, item III - d
Ring Girder	72,000	LBS	141	206	$2.00	$3.00	$216,000	1, page 42
Overhead Hoist Rails	150,000	LBS				$3.63	$544,500	2, item VI - p
2 1/2 " x 2 1/2 " x 1/4 " Angles	27,000	LBS				$3.63	$98,010	2, item VI-m
1 1/2 " x 30 " x 20 " Bearing Plate	30,000	LBS				$3.63	$108,900	2, item VI-m
Walkway Plate	54,000	LBS				$3.63	$196,020	2, item VI-m
Gantry Crane (20 ton)	1	EA	141	206	$195,000	$284,894	$284,894	1, page 41
Trashrack 6 ' x 18 '	6	EA	141	206	$10,000	$14,610	$87,660	2, item VI-q
60 " Dia. Gate Valve	12	EA	141	206	$77,000	$112,496	$1,349,952	1, page 41
84 " Dia. Howell Bunger Valve	2	EA	141	206	$300,000	$438,298	$876,596	1, page 41
84 " Dia. Gate Valve	2	EA	141	206	$310,000	$452,908	$905,816	1, page 41
90 " Dia Gate Valve	1	EA	141	206	$350,000	$511,348	$511,348	1, page 41
Valve Thimbles	12	EA	141	206	$15,000	$21,915	$262,980	1, page 41
Valve Operator	12	EA	141	206	$20,000	$29,220	$350,640	1, page 41
120 " Dia. Steel Penstock	1,050,000	LBS				$1.65	$1,732,500	2, item VII-c
90 " Dia. Steel By-pass	200,000	LBS				$1.65	$330,000	2, item VII-c
72 " Dia. Steel By-pass	50,000	LBS				$1.65	$82,500	2, item VII-c
60 " Dia. Steel By-pass	97,000	LBS				$1.65	$160,050	2, item VII-c
Grouting Pipe	13,630	LBS	132	159	$8.00	$10.00	$136,300	1, page 41
Bifurcation 10 ' to 8 '	2	EA	141	206	$17,000	$24,837	$49,674	1, page 41
Reducer 10 ' to 6'	1	EA	141	206	$10,000	$14,610	$14,610	1, page 41
Bifurcation 10 ' to 5 '	2	EA	141	206	$14,000	$20,454	$40,908	1, page 41
Timber for Tunnel Supports	300	MBF				$1,930	$579,000	2, item VI - w
Grout Drilling Holes	18,500	LF				$17.70	$327,450	2, item I - g
Standby Generator	1	EA	141	206	$45,000	$65,745	$65,745	1, page 41
Architectural Features	JOB	LS	141	206	$300,000	$438,298	$438,298	1, page 41
Cathodic Protection	JOB	LS	141	206	$35,000	$51,135	$51,135	1, page 41
Protective Coatings	JOB	LS	141	206	$100,000	$146,099	$146,099	1, page 41
SUBTOTAL							$24,245,392	
Increase Capacity from 1,500 cfs to 5,000 cfs, factor cost by $(5,000/1,500)^{3/8} = 1.57$								
SUBTOTAL OUTLET WORKS							$38,065,265	
IV. SPILLWAY								
Mobilization	JOB	LS	143	186	$300,000	$390,210	$390,210	1, page 44
Drill Grout Holes	1,150	LF				$18.70	$21,505	2, item I-g
Grout Connections	19	EA	143	186	$25.00	$33.00	$627	1, page 44

Table 2b
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Grouting	29	CY	143	186	$280	$364	$10,556	1, page 44
Grout Pipe	85	LF	132	159	$8.00	$10.00	$850	1, page 44
Excavation (blasting)	906,000	CY				$7.66	$6,939,960	2, item V-b3
Excavation	311,000	CY				$4.03	$1,253,330	2, av. item IIa, IIIa
Rock Riprap	2,500	CY				$31.64	$79,100	2, item I-n
Granular Backfill	7,300	CY				$45.09	$329,157	2, item II-n
Structural Backfill	10,100	CY	143	186	$20.00	$26.00	$262,600	1, page 44
Compacted Backfill	55,900	CY				$8.17	$456,703	2, item III-f
Aggregate Base	600	TON				$19.15	$11,490	2, item V-d
Asphalt Concrete	500	TON				$58.92	$29,460	2, item V-e
Mass Concrete	7,750	CY				$293	$2,271,448	2, item III-d
Structural Concrete	25,900	CY				$401	$10,393,929	2, av. item IIh, IIIc
Embedded Metal	JOB	LS	143	186	$35,000	$45,524	$45,524	1, page 44
Misc. Metal	JOB	LS	143	186	$50,000	$65,035	$65,035	1, page 44
Radial Gate (20 ' x 30 ')	2	EA	143	186	$270,000	$351,189	$702,378	1, page 44
Radial Gate Hoist Assembly	2	EA	143	186	$90,000	$117,063	$234,126	1, page 44
Stop Log (6 ' x 21 ')	12	EA	143	186	$14,000	$18,210	$218,520	1, page 44
Stop Log Storage Rack	JOB	LS	143	186	$20,000	$26,014	$26,014	1, page 44
Stop Log Lifting Beam	JOB	LS	143	186	$5,000	$6,503	$6,503	1, page 44
Electrical Work	JOB	LS	143	186	$30,000	$39,021	$39,021	1, page 44
Control Building (12 ' x 16 ')	JOB	LS	143	186	$26,000	$33,818	$33,818	1, page 44
Standby Generator	JOB	LS	143	186	$40,000	$52,028	$52,028	1, page 44
SUBTOTAL SPILLWAY							$23,873,892	
V. RESERVOIR								
Reservoir Clearing (Newville and Tehenn)	1,795	AC				$1,097	$1,969,115	2, item IV-a
Improvements	JOB	LS	137	176	$30,000	$38,540	$38,540	1, page 47
Construction Facilities	JOB	LS	137	176	$20,000	$25,693	$25,693	1, page 47
Excavate Overlook	48,400	CY	137	176	$14.00	$18.00	$871,200	1, page 47
Aggregate Base for Overlook	2,000	TON				$19.15	$38,300	2, item V-d
Asphalt Concrete for Overlook	511	TON				$58.92	$30,108	2, item v-e
Liquid Asphalt Prime and Seal	85	TON				$324.03	$27,543	2, av. item V- f&g
Landscaping Overlook	JOB	LS	137	176	$24,000	$30,832	$30,832	1, page 47
Visitor's Center	JOB	LS	137	176	$200,000	$256,934	$256,934	1, page 47
SUBTOTAL RESERVOIR							$3,288,265	
VI. OVERLOOK ACCESS ROAD								
Excavation	106,000	CY				$3.98	$421,880	2, item V-b1
Class II Aggregate Base	5,710	TON				$19.15	$109,347	2, item V-d
Asphalt Concrete	941	TON				$58.92	$55,444	2, item V-e
Liquid Asphalt Prime and Seal Coat	157	TON				$324	$50,873	2, av. item V-f&g

Table 2b
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

DESCRIPTION	QUANTITY	UNIT*	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Guard Rail	2,650	LF	160	237	$20.00	$30.00	$79,500	1, page 50
18 " CMP	180	LF				$44.78	$8,060	2, item V-j
24 " CMP	490	LF				$53.53	$26,230	2, item V-k
30 " CMP	200	LF	160	237	$45.00	$67.00	$13,400	1, page 50
Structure Excavation	350	CY	160	237	$12.00	$18.00	$6,300	1, page 50
Structure Backfill	270	CY	160	237	$20.00	$30.00	$8,100	1, page 50
SUBTOTAL OVERLOOK ACCESS ROAD							$779,133	
VII. ROAD RELOCATIONS								
Newville to Paskenta								
48 " CSP	140	LF	146	219	$60.00	$90.00	$12,600	1, page 51
26 " CSP	240	LF	146	219	$40.00	$60.00	$14,400	1, page 51
24 " CSP	160	LF	146	219	$30.00	$45.00	$7,200	1, page 51
18 " CSP	570	LF	146	219	$25.00	$38.00	$21,660	1, page 51
Structure Excavation	4,700	CY	146	219	$25.00	$38.00	$178,600	1, page 51
Structure Backfill	4,400	CY	146	219	$45.00	$68.00	$299,200	1, page 51
Roadway Excavation	1,033,000	CY				$3.98	$4,111,340	2, item V-b1
Aggregate Base	31,000	TON				$19.15	$593,650	2, item V-d
Asphalt Concrete	15,000	TON				$58.92	$883,800	2, item V-e
Down Drains	24	EA	146	219	$1,000	$1,500	$36,000	1, page 51
Fence	66,800	LF	146	219	$2.00	$3.00	$200,400	1, page 51
SUBTOTAL NEWVILLE TO PASKENTA ROAD							$6,358,850	
Cattle Crossings (6 total)								
11' - 5" x 73 " Multiple Steel Pipe	432	LF	146	219	$180	$270	$116,640	1, page 51
Structure Excavation	1,710	CY	146	219	$25.00	$38.00	$64,980	1, page 51
Structure Backfill	1,100	CY	146	219	$45.00	$68.00	$74,800	1, page 51
SUBTOTAL CATTLE CROSSINGS							$256,420	
Round Valley Road								
48 " CSP	300	LF	146	219	$60.00	$90.00	$27,000	1, page 51
24 " CSP	2,120	LF	146	219	$30.00	$45.00	$95,400	1, page 51
Roadway Excavation	233,000	CY	146	219		$3.98	$927,340	2, item V-b1
Structure Excavation	2,000	CY	146	219	$25.00	$38.00	$76,000	1, page 51
Structure Backfill	1,600	CY	146	219	$45.00	$68.00	$108,800	1, page 51
Aggregate Base	9,100	TON				$19.15	$174,265	2, item V-d
Asphalt Concrete	4,400	TON				$58.92	$259,248	2, item V-e
Down Drains	12	EA	146	219	$1,000	$1,500	$18,000	1, page 51
Fence	20,000	LF	146	219	$2.00	$3.00	$60,000	1,page 51
Compacted Embankment and Overhaul	211,000	CY				$1.36	$286,960	2, item V-c1
Bridge D/S of Newville Spillway	6,800	SF				$100	$680,000	3

Table 2b
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX JAN. 81	USBR INDEX OCT. 96	UNIT COST JAN. 81	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
SUBTOTAL ROUND VALLEY ROAD							$2,713,013	
Chrome to Burrows Gap Road								
60 " CSP	250	LF	146	219	$70.00	$105	$26,250	1, page 52
24 " CSP	920	LF	146	219	$30.00	$45.00	$41,400	1, page 52
Roadway Excavation	202,000	CY				$3.98	$803,960	2, item V-b1
Structure Excavation	1,600	CY	146	219	$25.00	$38.00	$60,800	1, page 52
Structure Backfill	1,800	CY	146	219	$45.00	$68.00	$122,400	1, page 52
Aggregate Base	9,100	TON				$19.15	$174,265	2, item V-d
Asphalt Concrete	5,300	TON				$58.92	$312,276	2, item V-e
Fence	53,000	LF	146	219	$2.00	$3.00	$159,000	1, page 52
Bridge over Stony Creek Diversion	6,800	SF				$100	$680,000	3
SUBTOTAL CHROME TO BURROWS GAP ROAD							$2,380,351	
SUBTOTAL ROAD RELOCATIONS							$11,708,634	
VIII. SADDLE DAMS								
Mobilization	JOB	LS	132	159	$86,000	$103,591	$103,591	1, page 54
Clear and Grub	88	AC	132	159	$4,000	$4,818	$423,984	1. page 54
Foundation Excavation	2,572,300	CY				$3.23	$8,308,529	2, item I-d
Drill Grout Holes	79,470	LF				$18.70	$1,486,089	2, item I-g
Grout Connections	1,470	EA	132	159	$50.00	$60.00	$88,200	
Grouting	1,970	CY	132	159	$280	$337	$663,890	
Grout Pipe	6,620	LF	132	159	$8.00	$10.00	$66,200	
Borrow - Impervious Material	5,194,600	CY				$3.22	$16,726,612	2, item I-e
Filter and Drain Material	782,860	CY				$8.54	$6,685,624	2, item I- i&j
Riprap	195,420	CY				$31.64	$6,183,089	2, item I-n
Riprap Bedding	97,710	CY				$1.79	$174,901	2, item I-m
Placed Impervious	4,723,700	CY				$0.95	$4,487,515	2, item I-f
Instrumentation	JOB	LS	132	176	$50,000	$66,667	$66,667	1, page 54
SUBTOTAL CONVEYANCE FACILITIES							$45,464,891	

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 79	USBR INDEX OCT. 96	UNIT COST OCT. 79	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
IX. THOMES CREEK DIVERSION FACILITIES								
Diversion Structure	JOB	LS	121	207	$7,940,000	$13,583,306	$13,583,306	4, page 4-13
Intake Structure	JOB	LS	122	213	$1,150,000	$2,007,787	$2,007,787	4, page 4-13
Canal and Roads	JOB	LS	120	199	$21,740,000	$36,052,167	$36,052,167	4, page 4-13
SUBTOTAL THOMES CREEK DIVERSION FACILITIES							$51,643,260	

Table 2b
ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR PROJECT (3.08 MAF)

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX APR. 80	USBR INDEX OCT. 96	UNIT COST APR. 80	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
X. CONVEYANCE FACILITIES								
Tehama Colusa Canal Turnout	JOB	LS				$1,543,000	$1,543,000	3
Sour Grass Canal	JOB	LS	127	199	$13,220,222	$20,715,151	$20,715,151	4- page 9-17
Sour Grass Pumping-Generating Plant								
Q=5,000 cfs, TDH = 115 ft., HP = 86,983	JOB	LS				$121,911,000	$121,911,000	3
Black Butte Canal , factored by $(5,000/10,000)^{3/8}$	JOB	LS	127	199	$15,453,000	$24,213,756	$24,213,756	4- page 9-17
Black Butte Pumping-Generating Plant								
Q=5,000 cfs, TDH = 144 ft., HP =108,918	JOB	LS				$139,522,000	$139,522,000	3
Tehenn Canal, factored by $(5,000/3,000)^{3/8}$	JOB	LS	127	199	$47,658,000	$74,676,709	$74,676,709	4- page 5-19
Tehenn Reservoir	JOB	LS	127	176	$29,010,000	$40,202,835	$40,202,835	4- page 5-19
Tehenn Pumping-Generating Plant								
Q=5,000 cfs, TDH = 190 ft., HP = 143,711	JOB	LS				$164,770,000	$164,770,000	3
Newville Pumping-Generating Plant								
Q=5,000 cfs, TDH = 380 ft., HP = 287,422	JOB	LS				$249,744,000	$249,744,000	3
SUBTOTAL CONVEYANCE FACILITIES							$837,298,451	
SUB TOTAL FOR THOMES-NEWVILLE							$1,198,600,000	
CONTINGENCIES @ 20%							$239,700,000	
ESTIMATED CONSTRUCTION COST							$1,438,300,000	
ENG., LEGAL, AND ADM. @ 35%							$503,400,000	
ESTIMATED CAPITAL COST FOR THOMES-NEWVILLE							$1,941,700,000	
ESTIMATED CAPITAL COST RANGE FOR THOMES-NEWVILLE								
LOW (-10%)							$1,748,000,000	
HIGH (+15%)							$2,233,000,000	

Footnotes:

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

Cost Reference:

1. California Department of Water Resources, *SWP Future Supply Program, Thomes-Newville Plan*, September 1981.
2. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates*, December 1990.
3. Cost developed by Bookman-Edmonston Engineering.
4. California Department of Water Resources, *Thomes-Newville and Glenn Reservoir Plans - Engineering Feasibility*, November 1980.
5. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.

Table 3
SUMMARY OF ESTIMATED CAPITAL COSTS
THOMES-NEWVILLE RESERVOIR

Cost Item	Estimated Costs ($Millions) 1.84 MAF	3.08 MAF
Land	30.5	36.0
Dam	99.0	150.4
Outlet Works	38.1	38.1
Spillway	19.5	23.9
Reservoir	3.0	3.3
Overlook Access Road	0.8	0.8
Road Relocations	11.7	11.7
Saddle Dams	1.7	45.5
Thomes Creek Diversion Facilities	54.9	51.6
Conveyance Facilities	804.3	837.3
SUBTOTAL	1061.6	1198.6
Contingencies (20%)	212.3	239.7
ESTIMATED CONSTRUCTION COST	1273.9	1438.3
Engineering, Legal, and Project Administration (35%)	445.9	503.4
ESTIMATED TOTAL CAPITAL COST	1,719.8	1,941.7
Capital Cost Range (minus 10% - plus 15%)	$1,548 - $1,948	$1,748 - $2,233

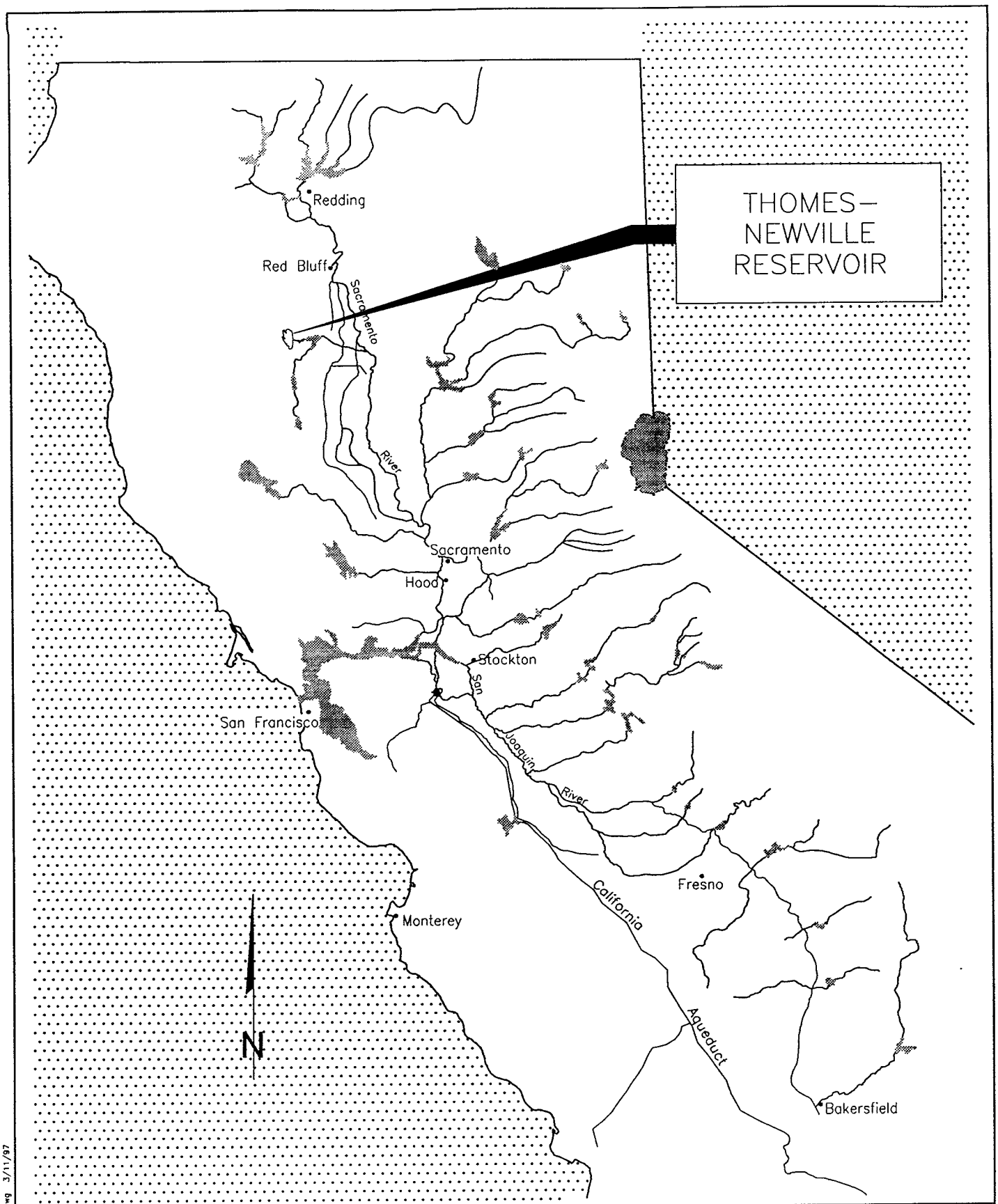

Figure 1
Project Location Map
Thomes–Newville Reservoir

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CALFED BAY-DELTA PROGRAM

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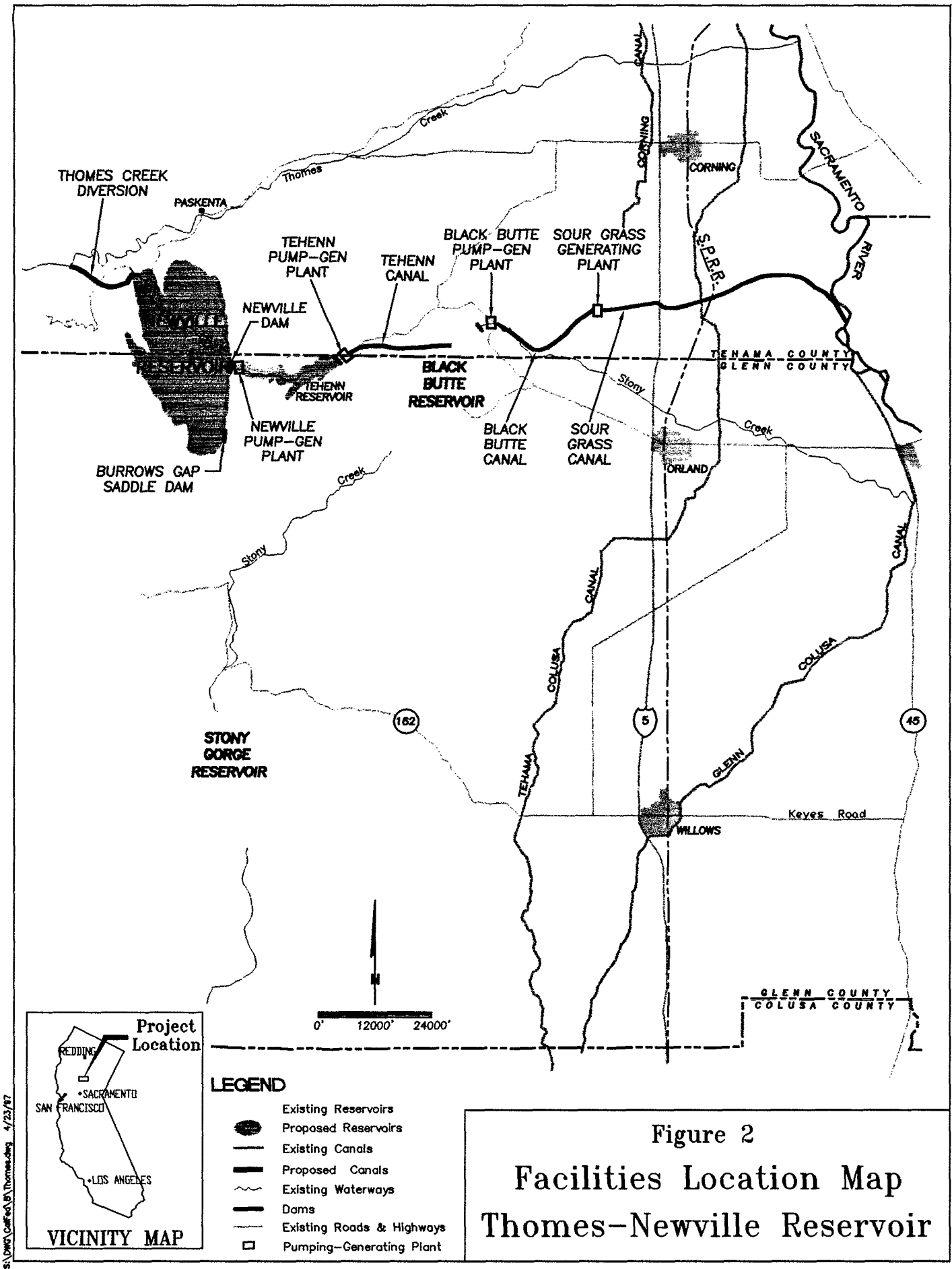

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Figure 2

Facilities Location Map Thomes-Newville Reservoir

CALFED BAY-DELTA PROGRAM

D-005086

D-005086

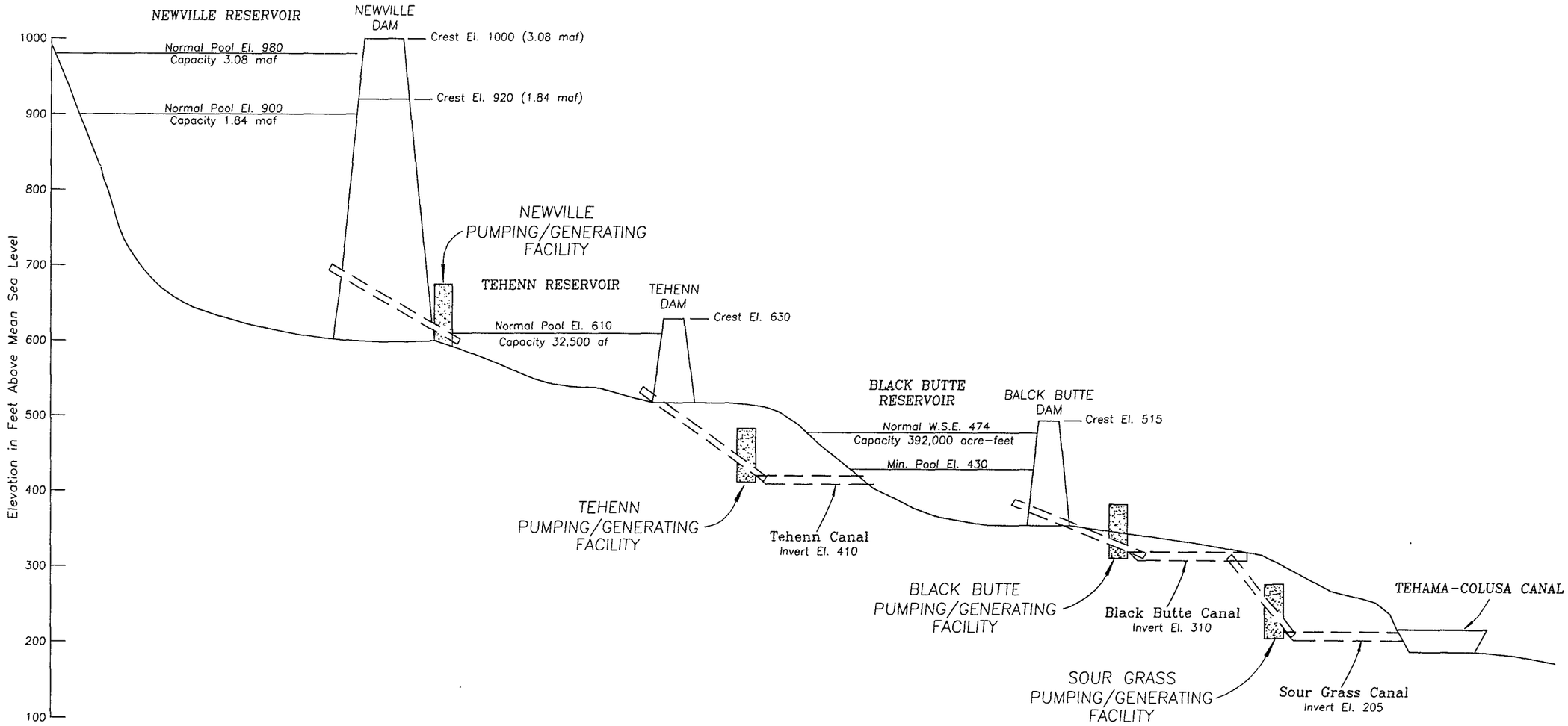

Figure 3

Thomes–Newville Reservoir Plan

Schematic Profile

Figure 4
AREA-CAPACITY CURVES
NEWVILLE RESERVOIR