FACILITY DESCRIPTIONS AND UPDATED COST ESTIMATES FOR THE IN-DELTA PROJECT

Prepared by the CALFED Storage and Conveyance Refinement Team

June 20, 1997

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The *Facility Descriptions and Updated Cost Estimates for the In-Delta Storage 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 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 the In-Delta Storage Project. This project would function as an isolated storage facility for surplus Delta flows. A chain of three lakes, created by flooding existing Delta islands, would be connected by siphons, which would rely on gravity to transfer stored water between island storage facilities and to Clifton Court Forebay. The general location of the In-Delta Storage Project is shown on Figure 1.

This evaluation and others being performed by CALFED are intended to provide a facilities evaluation and cost estimates of representative storage and conveyance components. The objectives of the In-Delta Storage Project evaluation are (1) to provide a cost estimate for the project which represents costs 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 In-Delta Storage Project is a relatively new concept. The configuration of the In-Delta Storage Project as it is presented in this evaluation has not been previously studied in sufficient detail; thus, the cost estimates for this project were developed primarily by Bookman-Edmonston Engineering. The approach used to develop the cost estimate involved applying current unit costs to quantities for similar facilities found in previous reports including the 1990 California Department of Water Resources (DWR) report *North Delta Program Draft EIR/EIS* and the 1995 DWR report *Isolated Transfer Facility Cost Estimate.*

A preliminary evaluation of the environmental considerations associated with the In-Delta Storage Project is also 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 evaluation of environmental considerations was gathered from existing literature and databases.

PROJECT BACKGROUND

Reclamation of Delta marshlands began in the 1850s, and by the 1930s, nearly all of the Delta had been reclaimed into intensively farmed islands. Since then, there have been numerous studies on salinity intrusion control, water quality improvement, and overall management of the water resources in the Delta including various water storage and conveyance concepts.

The In-Delta Storage Project is a relatively new water storage and conveyance concept which could contribute to improved management of water resources of the Delta. Over the past several years, several studies have been completed for similar concepts which flood Delta islands to provide water storage. However, a review of the DWR and the U.S. Bureau of Reclamation (Reclamation) libraries and publications revealed no detailed previous investigations of in-Delta storage facilities.

The In-Delta Storage Project concept is a similar and smaller version of the Chain of Lakes Project, which was identified in a March 1997 CALFED technical studies report titled *Status Reports on Technical Studies for the Storage and Conveyance Refinement Process,* the February 1997 *Preliminary Working Draft CALFED Bay-Delta Program Storage and Conveyance Component Inventories,* and the May 1997 draft *Facility Descriptions and Updated Cost Estimates for the Chain of Lakes Project.* Delta storage and conveyance concepts have gained recognition and popularity through the CALFED process as a potential component of a long-term comprehensive plan that will restore the ecological health and improve water management of the Bay-Delta. This evaluation builds on that concept and will provide CALFED with a cost estimate and written description of the In-Delta Storage Project that will enable it to be compared to other projects, including the Chain of Lakes Project, for consideration as a component of a long-term CALFED solution strategy.

FACILITIES DESCRIPTION

This section provides an overview of the major features included in the proposed In-Delta Storage Project. The conceptual design of the In-Delta Storage Project is based on original work developed by CALFED staff and Bookman-Edmonston Engineering.

PROJECT LOCATION

The In-Delta Storage Project would be located in the Delta along the western border of San Joaquin County (see Figure 1). Figure 2 provides a detailed facilities location map of the In-Delta Storage Project.

PROJECT DESCRIPTION

The In-Delta Storage Project is a combined isolated storage and conveyance facility that would store surplus Delta flows and convey stored water to Clifton Court Forebay without re-releasing the stored water to Delta channels before it could be used by either the State Water Project (SWP) or the Central Valley Project (CVP). A chain of three Delta islands would be interconnected by siphons crossing beneath Delta channels and connecting the southern most island to Clifton Court Forebay. These "islands-lakes" would include Bacon Island at the northern end of the chain, followed in succession by Woodward Island and Victoria Island, which would be connected to the Clifton Court Forebay.

The siphons connecting the islands in the In-Delta Storage system would create a hydraulically isolated connection from the Delta island storage facilities to Clifton Court Forebay. One of the key design considerations was minimizing the number and size of siphons required to carry the 5,000 cubic-feet-per-second (cfs) design flow within the constraint of the maximum hydraulic gradient available between the upstream end of the system at Bacon Island and the downstream end of the system at Clifton Court Forebay. The maximum upstream water surface elevation at Bacon Island could not exceed 6 feet above mean sea level (MSL) for safety considerations related to levee stability and the requirements of DWR's Division of Safety and Dams. The minimum water surface elevation at the most downstream end of the system at Clifton Court Forebay could not fall below 2 feet below MSL because of potential export pump cavitation problems at Banks Pumping Plant. The result is a maximum total allowable hydraulic gradient of 8 feet from Bacon Island and Clifton Court Forebay. Further hydraulic analyses and studies are required to better define the appropriate size and number of siphons required for this project.

PRINCIPAL FACILITIES

This section provides an overview of the major features of the In-Delta Storage Project with a design conveyance capacity of 5,000 cfs between storage islands and to Clifton Court Forebay. Generally, the principal facilities include a 5,000 cfs intake pump station on Bacon and Victoria Islands, a siphon connection between Bacon and Woodward Islands, a siphon connection between Woodward and Victoria Islands, and a siphon connection with a radial gate control structure between Victoria Island and Clifton Court Forebay. Table 1 provides a summary of the physical characteristics of the major features associated with the In-Delta Storage Project.

Bacon Island

Bacon Island would be converted from its present uses to an island storage facility. The island would store a maximum of 117,700 acre-feet at a maximum water surface elevation of 6.0 feet above MSL. Much of the interior of Bacon Island is 15 feet below sea-level. Approximately 14 miles of levees would be reinforced to accommodate water storage on the island's interior. Bacon Island would be connected via siphon to Woodward Island.

The Bacon Island Storage facility would include a 5,000 cfs capacity low-lift pump station located on the eastern side of Bacon Island. The pump station would fill Bacon Island with flows from the Middle River. The pump station would be an indoor type, housing 11 pumping units, including one standby unit, and would have a total capacity of 7,570 horsepower.

The siphon connection to Woodward Island would require a 1,500-foot siphon crossing using two concrete box siphons with dimensions of 18' x 18' x 1,500'. The siphons would be constructed with 39-inch thick walls with reinforcing steel of 200 pounds-per-cubic-yard of concrete. The wall thickness is considered adequate to counteract the effects of bouyancy when the siphons are dewatered. The siphons would be constructed in place and would require the temporary relocation of the made-made Delta channel separating the Bacon and Woodward Islands. The invert elevation of the box siphons would be 40 feet below the existing channel bottom. The concrete box siphons would be covered with a 5-foot layer of rip-rap to protect against erosion. To convey 5,000 cfs through the siphons to Woodward Island, a head difference of about 2.3 feet would be required between Bacon and Woodward Islands.

Woodward Island

Woodward Island would have a maximum storage capacity of 20,400 acre-feet at a maximum water surface elevation of 6.0 feet above MSL. Approximately 9 miles of levees would have to be reinforced to allow storage on the island's interior. Woodward Island would be connected to Bacon Island upstream and Victoria Island downstream. The downstream connection to Victoria Island would require a 700-foot siphon crossing of Woodward Canal and North Victoria Canal. Siphon construction would be similar to that described for Bacon Island.

Two concrete box siphons would connect Woodward Island to Victoria Island. The siphons would have dimensions of 18' x 18' x 700'. To convey 5,000 cfs from Woodward Island to Victoria Island, a head difference of about 1.9 feet would be required between the two islands.

Because the siphon connections between Woodward Island and Bacon and Victoria Islands are ungaged, Woodward Island would be filled by gravity flows from the islands on either side of the siphons. As available Delta flows are pumped into either Bacon or Victoria Islands the water would flow freely through the siphons to equalize the water surface elevations of all three islands.

Victoria Island

Victoria Island would be the last island storage facility in the In-Delta Storage Project. Victoria Island would have a maximum storage capacity of 104,900 acre-feet at a maximum water surface elevation of 6 feet above MSL. Approximately 15 miles of levees would have to be reinforced to allow storage on the island's interior. Victoria Island would be connected to Woodward Island upstream and to Clifton Court Forebay downstream. The downstream connection to Clifton Court Forebay would be made through a 14,000-foot siphon system beneath Old River.

The downstream connection to Clifton Court Forebay would be made through two 18' x 18' x 1,400' concrete box siphons which would include radial gate control structures at the siphon outlets to Clifton Court Forebay. The head difference required between Victoria Island and Clifton Court Forebay to convey 5,000 cfs through the siphons connecting to the two water bodies would be about 2.2 feet.

An intake pumping station on Victoria Island would be located on the islands northeast side, across from Upper Jones Tract. The intake pumping station would pump available flows from the Middle River into the island for storage.

COST ESTIMATE

The In-Delta Storage Project is a relatively new project that has not been previously studied. Therefore no specific previous information describing or estimating the cost of the project exists.

There are, however, some studies with similar components from which comparative costs can be derived. The cost estimate for the In-Delta Storage Project was developed primarily by Bookman-Edmonston Engineering and was based on applicable portions of previous studies, experience, and engineering judgment. These previous studies include the 1990 DWR report *North Delta Program Draft EIR/EIS*, and the 1995 DWR report *Isolated Transfer Facility Cost Estimate.*

COST ESTIMATE METHODOLOGY

General

The cost estimates for the In-Delta Storage Project were determined by applying current unit costs to quantities developed by Bookman-Edmonston Engineering. Some of the costs used to update this cost estimate were determined by escalating the unit cost to October 1996 dollars using the Reclamation Construction Cost Trends (CCT) indices. Additional unit costs were developed by Bookman-Edmonston Engineering based on engineering and construction experience. The cost estimate does not include the cost of environmental documentation, environmental mitigation, operation and maintenance, power, and interest during construction.

Table 2 provides a detailed breakdown of the estimated costs of an In-Delta Storage Project. Cost items identified in previous cost estimates have been provided, along with the unit cost of the items or an indication that the estimated cost has been developed through a lump sum approach. The tables also include the Reclamation CCT index for the month and year in which the estimated cost was developed and for October 1996. These Reclamation cost indices are used to factor the previous cost estimate to October 1996 dollars. In some instances, only a unit cost has been provided, with no cost indices. In these cases, the unit cost has been taken from other sources. The far right-hand column of Table 2 provides the cost reference for each cost item.

Pumping Plants

The cost estimate for the Pumping Plants associated with the In-Delta Storage Project has been based on the cost and quantities from the September 1995 DWR Report, *Isolated Transfer Facility Cost Estimate*. These costs were originally priced in July 1995 dollars and have been updated to October 1996 dollars using the CCT indices described above.

Right-of-Way Costs

Right-of-way costs of $3,000 per acre were used based upon personal communication with Reclamation's Division of Land Resources staff in February 1997. The right-of-way necessary for the development of the In-Delta Storage Project would require 13,398 acres for the three Delta islands in the system. The resulting right-of-way cost is $40.2 million, which comprises approximately 10 percent of the total estimated capital cost of the project.

Contingencies and Other Costs

All contingencies and engineering, construction management, and administrative factors were determined by engineering judgement based on 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 25 percent to the estimated capital cost for the high end.

PRELIMINARY COST FINDINGS

Costs of the In-Delta Storage Project and supporting facilities have been developed to an October 1996 basis as described above. Table 3 summarizes estimated costs of the major items

D-005022

associated with the In-Delta Storage Project. The total estimated capital cost is estimated to be about $385 million with a resulting calculated cost range between $350 and $480 million.

ENVIRONMENTAL DOCUMENTATION

[NOTE: The environmental considerations section needs to be reevaluated by DWR to ensure consistency with the information presented in the previous section.]

This portion of the report provides a summary of environmental considerations related to the proposal for developing a proposed In-Delta Storage Project. Under this proposal, Webb Tract and Bacon Island would be used as year-round water supply reservoirs. Bouldin Island and Holland Tract would be dedicated to wetland and wildlife habitat uses. Fish, wildlife, plant, and cultural resources that could be affected by the In-Delta Storage 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

Using Bouldin Island and Holland Tract for wetland and wildlife purposes will have a positive effect on wildlife species. Diverting and storing water on Webb Tract and Bacon Island could result in increased water temperature and reduced water quality in the Delta. Reversed flows would also occur when water is being diverted. In addition to problems associated with reversed flows, migrating fish could be impacted by increased predation and entrainment at the diversion fish screens.

Fish, Amphibians, Reptiles, and Invertebrates

The In-Delta Storage Project would be located adjacent to several waterways that support both anadromous and resident game and non-game fish. Permanent residents or fish dependant on the

Delta as a migration corridor or nursery include striped bass, chinook salmon, steelhead trout, American shad, sturgeon, catfish, largemouth bass, winter-run chinook salmon, delta smelt, Sacramento splittail, and numerous other marine and freshwater species.

Depending on outflow regimes and water year hydrology, the Delta supports several types of habitats including estuary, freshwater, and marine water environments. The Delta supports about 90 species of fish. Increased flows of water into the central Delta, to be used for island storage, would draw migrating fish into the area. This longer route between the Bay Area and the upper reaches of the rivers would expose the fish to increased predation, higher temperatures, and more agricultural water diversions. More complex channel configurations and increased reversed flows through the central Delta increase the migrating fish's difficulty in finding their way to the sea or into the main river channels to move upstream.

General Wildlife

Lands within the area of the In-Delta Storage Project are highly cultivated and support a diverse wildlife. Important groups of wildlife dependant on the Delta environment are waterfowl and other migratory birds, game birds such as pheasant and quail, furbearers, and numerous nongame birds and mammals. The Delta is particularly important to waterfowl migrating via the Pacific Flyway. The principal attraction for waterfowl is winter flooded agricultural fields, mainly cereal crops, which provide food and extensive seasonal wetlands. Small mammals find suitable habitat in the Delta and upland areas. Vegetated levees, remnants of riparian forest, and undeveloped islands provide habitat for numerous small mammals. Small mammal species include muskrat, mink, river otter, beaver, raccoon, gray fox, and skunks. A variety of non-game wildlife such as songbirds, hawks, owl, reptiles, and amphibians can also be found in the area.

Sensitive and Listed Fish and Wildlife Species

Listed wildlife species that have been recorded in or around the area that would be directly affected by the In-Delta Storage Project include Swainson's hawk and California black rail (State threatened [ST]), and San Joaquin kit fox (federal endangered [FE], ST). Other listed species that could potentially be affected by the proposal include American peregrine falcon (FE), Aleutian Canada goose (FT), bald eagle (FT, SE), giant garter snake (ST), winter-run chinook salmon (FE), delta smelt (FT), longhorn fairy shrimp (FE), vernal pool fairy shrimp (FT), vernal pool tadpole shrimp (FE), valley elderberry longhorn beetle (FT) and Delta green ground beetle (FT).

Wildlife species that are either candidates for State or federal listing or considered "species of special concern" by the California Department of Fish and Game (CDFG) that have been known to occur in or near the area affected by the proposed In-Delta Storage Project include the great blue heron and the western pond turtle (federal candidate, CDFG species of special concern).

Bald eagle, peregrine falcon, yellow-billed cuckoo, and Aleutian Canada goose have been observed in the Delta, but none are confined exclusively to the area.

Sightings of San Joaquin kit fox have been made in the foothills south and west of the Clifton Court Forebay. It is unlikely that the In-Delta Storage Project will have a direct effect on this species.

Although there have been limited sightings of the giant garter snake in the project area, suitable habitat consisting of marsh and streambed vegetation is widespread in the area. Areas of suitable habitat include vegetated levees, vegetated islands and mid-channel berms, and vegetated irrigation canals and drains within agricultural lands. Virtually all islands and channels contain some suitable habitat for this species.

VEGETATION

Because of the intensive nature of farming activities on the islands, only about 1 percent of the lands in the project area are riparian. The majority of the riparian habitat in the project area can be found on Holland and Webb Tracts. Riparian habitat types in the area consist of cottonwood-willow woodland and willow scrub. The riparian habitat found here is generally young (less than five years) and can be found in small linear strips along ditches or at the toes of the perimeter levees that have not been regularly maintained. Maintenance policies of the local reclamation districts do not allow mature woody vegetation on the upper interior levee slopes or on exterior levee faces because of the need to inspect the levees for seepage and structural defects.

Annual grasslands occur primarily on the broad, gentle interior slopes of the perimeter levees and account for approximately 7 percent of the lands within the project area. Levees may be grazed but are not cultivated. A portion of the grasslands are upland habitat which occurs on remnant knolls or sand hills on Webb and Holland Tracts.

Less than 2 percent of the lands affected by the In-Delta Storage Project are occupied by structures, paved roads, or scarified and compacted soil. The largest portion of scarified and compacted soil is a site for processing and storing pulp byproduct used as a soil amendment on Holland Tract.

Sensitive and Listed Plant Species

A federal candidate/State listed rare plant, Mason's lilaeopsis, has been known to occur in or around the area that could be affected by the In-Delta Storage Project. An additional species, Antioch dunes evening-primrose (federal endangered), could also be impacted if found in the area.

Sensitive plant species or plants that are candidates for federal or State listing that could possibly be found in the project area include Suisun marsh aster, caper-fruited tropidocarpum, Delta tule pea, heartscale, and valley spearscale.

Additional plants listed by the California Native Plant Society as being rare, threatened, or endangered in California and elsewhere that could also be affected by the In-Delta Storage Project include marsh skullcap, California hisbiscus, Delta mudwort, and bristly sedge.

A special-status habitat that may be found along or near the area of the proposed project is the coastal and valley freshwater marsh. Also, there are four significant natural areas within or adjacent to the area affected by the In-Delta Storage Project: Middle River islands, White Slough, Old River islands, and Webb Tract marsh.

Wetlands

From information gathered from the U.S. Fish and Wildlife Service's National Wetland Inventory map, wetland types that would be affected on Webb and Bacon Islands are as follows:

Webb Island: Approximately 90 percent farmed wetlands, 2 percent emergent deep marsh, 5 percent open water ponds, and 3 percent drainage ditches.

Bacon Island: 95 percent farmed wetlands, 2 percent emergent deep marsh, and three drainage ditches (3 percent).

Three special-status wetland habitats, northern hardpan vernal pool, alkali meadow, and coastal and valley freshwater marsh, could be affected by the In-Delta Storage Project.

CULTURAL RESOURCES

No prehistoric sites of any kind have been found in the islands of the proposed project. It is possible that there may be one or two non-significant historic sites on these tracts.

On Bouldin and Bacon Islands, 19 sites represent the farming operations of George Shima (The Potato King). The sites include trash scatters, foundations, equipment, and boarding houses for an Asian labor camp dating to the early part of the century. Singly, these sites are not significant; but collectively they could be eligible to be listed as an Historic District on the National Register of Historic Places.

D-005028

BIBLIOGRAPHY

CALFED, 1997, *Facility Descriptions and Updated Cost Estimate for the Chain of Lakes Project.*

CALFED, 1997, *Preliminary Working Draft CALFED Bay-Delta Program Storage and Conveyance Component Inventories.*

CALFED, 1997, *Status Reports on Technical Studies for the Storage and Conveyance Refinement Process.*

California Department of Fish and Game, Natural Diversity Data Base," Update Version: 8/96, State of California.

California Department of Water Resources, August 1974, *Draft Environmental Impact Report - Peripheral Canal Project*, State of California.

California Department of Water Resources, 1990, *North Delta Program Draft EIR/EIS*, State of California.

California Department of Water Resources, September 1990, *Los Banos Grandes Facilities Feasibility Report, Appendix A: Designs and Cost Estimates*, State of California.

California Department of Water Resources, November 1993, *Program Environmental Impact Report - State Drought Water Bank*, State of California.

California Department of Water Resources, 1995, *Isolated Transfer Facility Cost Estimate*, State of California.

U.S. Fish and Wildlife Service, National Wetlands Inventory Program.

U.S. Fish and Wildlife Service, September 1995, *Environmental Effects of Yield Increase Options, Technical Appendix #9 to the Final Least-Cost CVP Yield Increase Plan.*

U.S. Fish and Wildlife Service, September 1995, *Environmental Effects of Yield Increase Options, Technical Appendix #9A to the Final Least-Cost CVP Yield Increase Plan.*

U.S. Geological Survey, National Aerial Photography Program.

U.S. Geological Survey Topographic Maps, Bouldin Island and Woodward Island.

Table 1
SUMMARY OF PHYSICAL CHARACTERISTICS
IN-DELTA STORAGE PROJECT

Bacon Island	
Maximum Water Surface Elevation (MSL)	6.0
Maximum Water Storage Capacity (Acre-feet)	117,700
Operating Water Surface Elevation (MSL)	6.0
Operating Storage Capacity (Acre-feet)	117,700
Siphons	
Length (feet)	1,500
Number of Boxes - Dimensions	2 - 18' x 18'
Intake Pumping Station	
Total Capacity (cfs)	5,000
Total Horsepower (HP)	7,570
Woodward Island	
Maximum Water Surface Elevation (MSL)	6.0
Maximum Water Storage Capacity (Acre-feet)	20,400
Operating Water Surface Elevation (MSL)	3.7
Operating Storage Capacity (Acre-feet)	18,600
Siphons	
Length (feet)	700
Number of Boxes - Dimensions	2 - 18' x 18'
Victoria Island	
Maximum Water Surface Elevation (MSL)	6.0
Maximum Water Storage Capacity (Acre-feet)	104,900
Operating Water Surface Elevation (MSL)	1.8
Operating Storage Capacity (Acre-feet)	84,100
Siphons	
Length (feet)	1,400
Number of Boxes - Dimensions	2 - 18' x 18'

Table 2
ESTIMATED COSTS
IN-DELTA STORAGE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
I. BACON ISLAND								
Land Acquisition	5,066	AC				$3,000	$15,198,000	
Reinforce Levees								
Riprap	914,600	TON	163	181	$15.00	$16.70	$15,273,820	2, page 439
Bedding (6" thick)	258,500	TON	163	181	$14.00	$15.60	$4,032,600	2, page 439
Geotextile (bedding)	5,818,200	SF	163	181	$0.25	$0.28	$1,629,096	2, page 439
Embankment	297,100	CY	163	181	$7.00	$7.80	$2,317,380	2, page 439
Pump Station (5,000 cfs)	JOB	LS				$30,574,000	$30,574,000	1
Bacon-Woodward Siphon (1500')[b]								
Temporary River Alignment								
Excavation	75,615	CY	181	181	$2.50	$2.50	$189,038	5, page 7
Levees (using excavation)	75,615	CY	181	181	$3.00	$3.00	$226,845	5, page 7
Cofferdam Sheetpiling	226,200	SF	202	207	$28.00	$28.70	$6,491,940	5, page 7
Cofferdam Gravel Fill	22,200	CY	202	207	$21.00	$21.50	$477,300	5, page 7
Backfill	75,615	CY	181	181	$4.00	$4.00	$302,460	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	255,000	CY	181	181	$6.00	$6.00	$1,530,000	5, page 7
Concrete	27,000	CY	198	213	$275	$296	$7,992,000	5, page 7
Reinforcing Steel	5,311,500	LBS	198	213	$0.60	$0.65	$3,452,475	5, page 7
Backfill	133,500	CY	181	181	$4.00	$4.00	$534,000	5, page 7
Riprap	40,500	TON	181	181	$27.00	$27.00	$1,093,500	5, page 7
Access Roads	0.26	MI	231	237	$500,000	$513,000	$133,380	5, page 7
Inlet and Outlet Transition								
Excavation	51,400	CY	181	181	$2.25	$2.25	$115,650	5, page 7
Concrete Slab	1,370	CY	198	213	$225	$242	$331,540	5, page 7
Concrete Walls	1,090	CY	198	213	$350	$377	$410,930	5, page 7
Reinforcing Steel	490,000	LBS	198	213	$0.60	$0.65	$318,500	5, page 7
Backfill	11,500	CY	181	181	$4.00	$4.00	$46,000	5, page 7
Miscellaneous @ 20%							$4,749,612	
SUBTOTAL BACON ISLAND							$97,522,565	
II. WOODWARD ISLAND								
Land Acquisition	1,565	AC				$3,000	$4,695,000	3
Reinforce Levees								
Riprap	561,600	TON	163	181	$15.00	$16.70	$9,378,720	2, page 439

Table 2
ESTIMATED COSTS
IN-DELTA STORAGE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Bedding (6" thick)	158,800	TON	163	181	$14.00	$15.60	$2,477,280	2, page 439
Geotextile (bedding)	3,572,400	SF	163	181	$0.25	$0.28	$1,000,272	2, page 439
Embankment	182,500	CY	163	181	$7.00	$7.80	$1,423,500	2, page 439
Woodward-Victoria Siphon(700')[b]								
Temporary River Alignment								
Excavation	35,287	CY	181	181	$2.50	$2.50	$88,218	5, page 7
Levees (using excavation)	35,287	CY	181	181	$3.00	$3.00	$105,861	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	35,287	CY	181	181	$4.00	$4.00	$141,148	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	119,000	CY	181	181	$6.00	$6.00	$714,000	5, page 7
Concrete	12,600	CY	198	213	$275	$296	$3,729,600	5, page 7
Reinforcing Steel	2,478,700	LBS	198	213	$0.60	$0.65	$1,611,155	5, page 7
Backfill	62,300	CY	181	181	$4.00	$4.00	$249,200	5, page 7
Riprap	18,900	TON	181	181	$27.00	$27.00	$510,300	5, page 7
Access Roads	0.12	MI	231	237	$500,000	$513,000	$61,560	5, page 7
Inlet and Outlet Transition								
Excavation	51,400	CY	181	181	$2.25	$2.25	$115,650	5, page 7
Concrete Slab	1,370	CY	198	213	$225	$242	$331,540	5, page 7
Concrete Walls	1,090	CY	198	213	$350	$377	$410,930	5, page 7
Reinforcing Steel	490,000	LBS	198	213	$0.60	$0.65	$318,500	5, page 7
Backfill	11,500	CY	181	181	$4.00	$4.00	$46,000	5, page 7
Miscellaneous @ 20%							$2,636,464	
SUBTOTAL WOODWARD ISLAND							$34,793,558	
III. VICTORIA ISLAND								
Land Acquisition	6,767	AC				$3,000	$20,301,000	3
Reinforce Levees								
Riprap	973,500	TON	163	181	$15.00	$16.70	$16,257,450	2, page 439
Bedding (6" thick)	275,200	TON	163	181	$14.00	$15.60	$4,293,120	2, page 439
Geotextile (bedding)	6,192,500	SF	163	181	$0.25	$0.28	$1,733,900	2, page 439
Embankment	316,200	CY	163	181	$7.00	$7.80	$2,466,360	2, page 439
Elevated Roadway (Highway 4)								
Riprap	570,200	TON	163	181	$15.00	$16.70	$9,522,340	2, page 439
Bedding (6" thick)	161,200	TON	163	181	$14.00	$15.60	$2,514,720	2, page 439

D—005032

Table 2
ESTIMATED COSTS
IN-DELTA STORAGE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
Geotextile (bedding)	3,627,500	SF	163	181	$0.25	$0.28	$1,015,700	2, page 439
Embankment	819,800	CY	163	181	$7.00	$7.80	$6,394,440	2, page 439
Foundation	740,100	CY	163	181	$9.80	$10.88	$8,053,923	1
Aggregate Base	14,980	TON				$19.15	$286,867	4, item v-d
Asphalt Concrete	6,810	TON				$58.92	$401,245	4, item v-e
Causeway Bridge	21,000	SF				$100	$2,100,000	1
Victoria-CCFB Siphon (1400')[b]								
Temporary River Alignment								
Excavation	70,574	CY	181	181	$2.50	$2.50	$176,435	5, page 7
Levees (using excavation)	70,574	CY	181	181	$3.00	$3.00	$211,722	5, page 7
Cofferdam Sheetpiling	150,800	SF	202	207	$28.00	$28.70	$4,327,960	5, page 7
Cofferdam Gravel Fill	14,800	CY	202	207	$21.00	$21.50	$318,200	5, page 7
Backfill	70,574	CY	181	181	$4.00	$4.00	$282,296	5, page 7
Dewatering	JOB	LS	202	207	$100,000	$102,500	$102,500	5, page 7
Siphon								
Excavation-Structural	238,000	CY	181	181	$6.00	$6.00	$1,428,000	5, page 7
Concrete	25,200	CY	198	213	$275	$296	$7,459,200	5, page 7
Reinforcing Steel	4,957,400	LBS	198	213	$0.60	$0.65	$3,222,310	5, page 7
Backfill	124,600	CY	181	181	$4.00	$4.00	$498,400	5, page 7
Riprap	37,800	TON	181	181	$27.00	$27	$1,020,600	5, page 7
Access Roads	0.24	MI	231	237	$500,000	$513,000	$123,120	5, page 7
Inlet and Outlet Transition								
Excavation	51,400	CY	181	181	$2.25	$2.25	$115,650	5, page 7
Concrete Slab	1,370	CY	198	213	$225	$242	$331,540	5, page 7
Concrete Walls	1,090	CY	198	213	$350	$377	$410,930	5, page 7
Reinforcing Steel	490,000	LBS	198	213	$0.60	$0.65	$318,500	5, page 7
Backfill	11,500	CY	181	181	$4.00	$4.00	$46,000	5, page 7
Radial Gates and Hoist Assemblies	2	EA				$145,000	$290,000	
Miscellaneous @ 20%							$4,136,673	
SUBTOTAL VICTORIA ISLAND							$100,161,100	
IV. SEEPAGE INTERCEPTION WELLS	JOB	LS				$5,174,000	$5,174,000	1

D-005034

Table 2
ESTIMATED COSTS
IN-DELTA STORAGE

DESCRIPTION	QUANTITY	UNIT[a]	USBR INDEX OCT. 90	USBR INDEX OCT. 96	UNIT COST OCT. 90	UNIT COST OCT. 96	TOTAL COST OCT. 96	COST REFERENCE
SUBTOTAL FOR IN-DELTA STORAGE							237,700,000	
CONTINGENCIES @ 20%							$47,500,000	
ESTIMATED CONSTRUCTION COST FOR IN-DELTA STORAGE							$285,200,000	
ENGR., LEGAL, AND ADMIN. @ 35%							$99,800,000	
ESTIMATED CAPITAL COST FOR IN-DELTA STORAGE							$385,000,000	
ESTIMATED CAPITAL COST RANGE								
LOW (-10 %)							$350,000,000	
HIGH (+25%)							$480,000,000	

Footnotes:

[a]SF=square foot; LS=lump sum; CY=cubic yard; AC=acre; CFS=cubic feet per second; HP=horsepower; LBS=pound; MI=mile; EA=each.

[b] The USBR index date for all siphons is September 95, not the October 1990 date shown above.

Cost References:

1. Cost developed by Bookman-Edmonston Engineering.
2. California Department of Water Resources, *North Delta Program Draft EIR, EIS*, November 1990.
3. U.S. Bureau of Reclamation, Land Resources Branch, Graham McMullen, February 1997.
4. California Department of Water Resources, *Los Banos Grandes Facilities Report, Appendix A: Designs and Cost Estimates, December 1990.*
5. California Department of Water Resources, *Isolated Transfer Facility Cost Estimate,* September 1995.

D—005034

Table 3
SUMMARY OF ESTIMATED COSTS
IN-DELTA STORAGE PROJECT

Cost Item	Estimated Costs ($Million)
Bacon Island	97.5
Woodward Island	34.8
Victoria Island	100.2
Seepage Interception Wells	5.2
SUBTOTAL	237.7
Contingencies (20%)	47.5
ESTIMATED CONSTRUCTION COST	285.2
Engineering, Legal, and Project Administration (35%)	99.8
ESTIMATED TOTAL CAPITAL COST	385.0
Capital Cost Range (minus 10% - plus 25%)	350 - 480

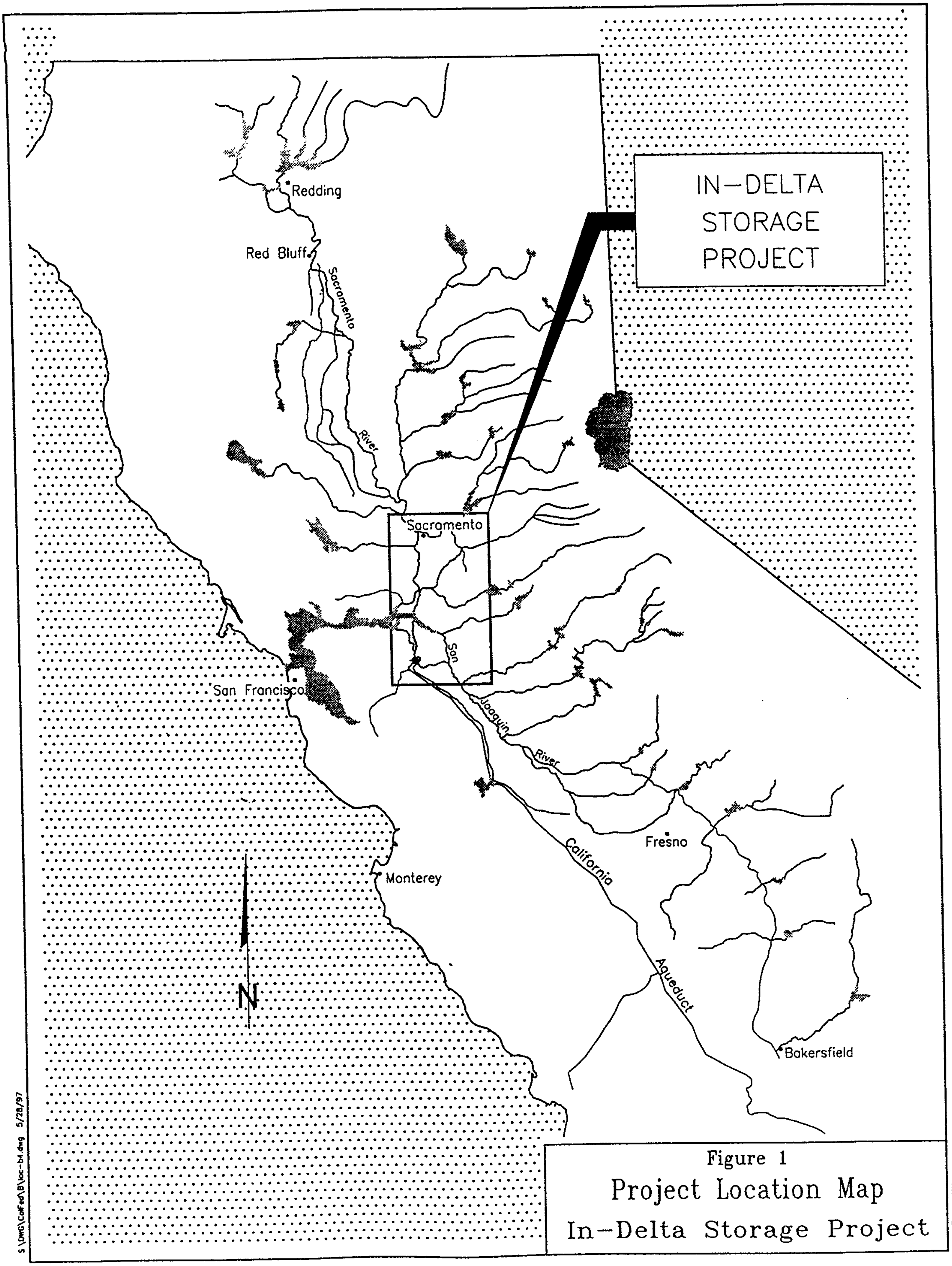


Figure 1
Project Location Map
In-Delta Storage Project

CALFED BAY-DELTA

D-005036

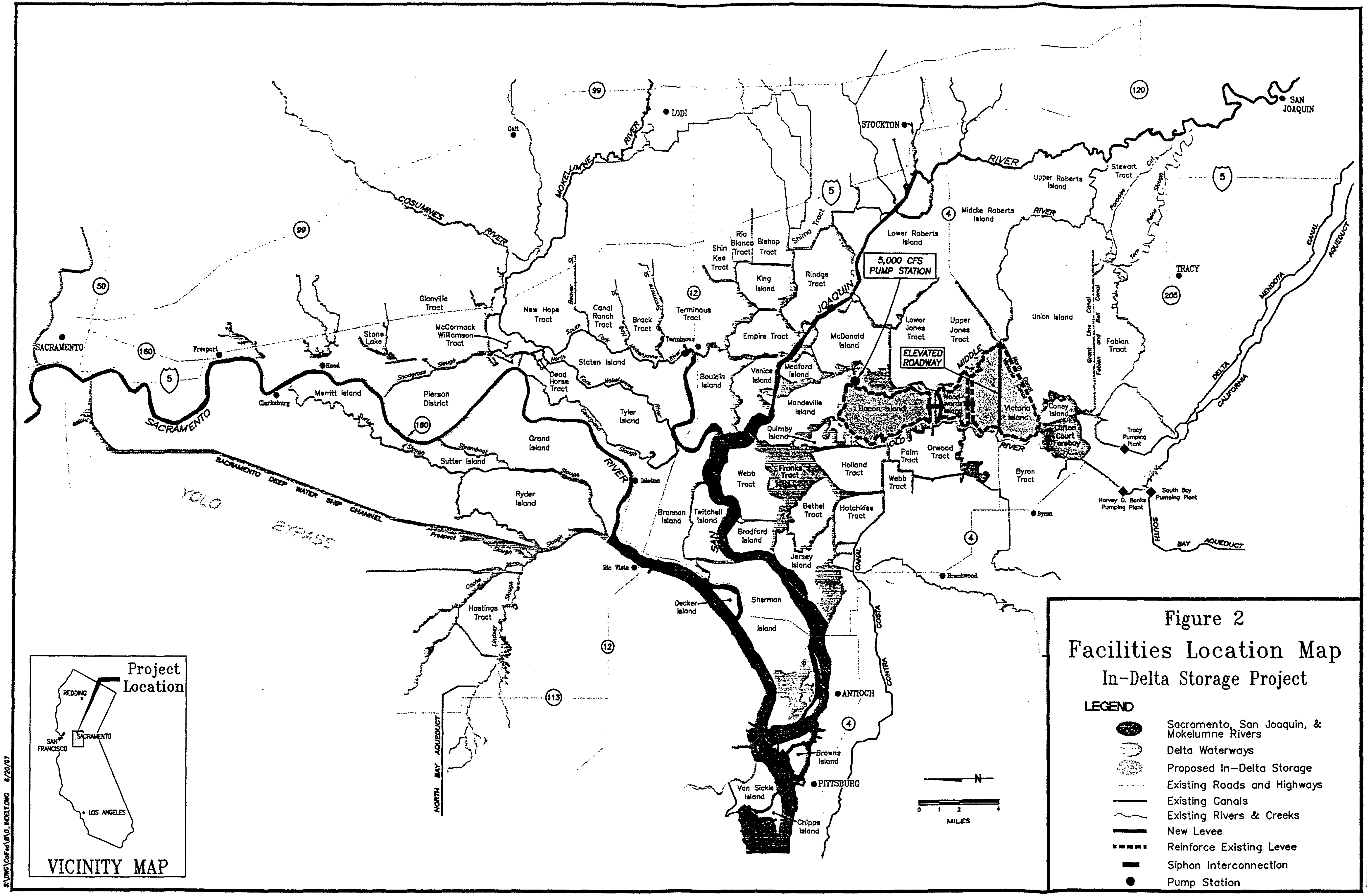


Figure 2
Facilities Location Map
In-Delta Storage Project

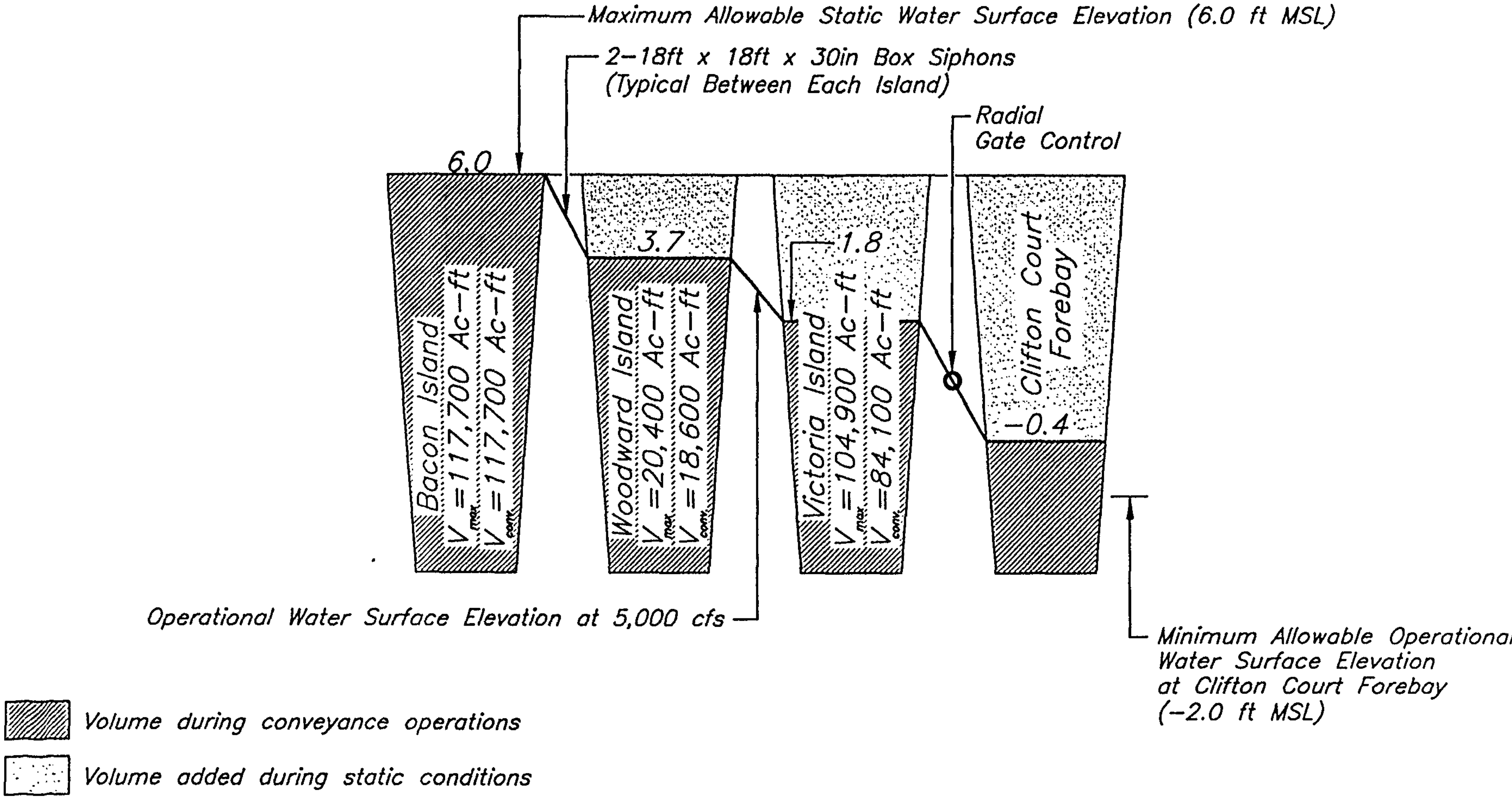
LEGEND

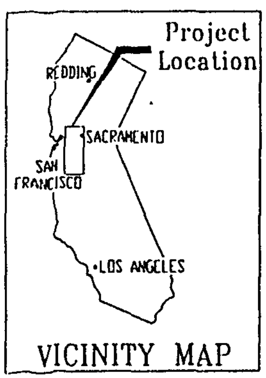
- Sacramento, San Joaquin, & Mokelumne Rivers
- Delta Waterways
- Proposed In-Delta Storage
- Existing Roads and Highways
- Existing Canals
- Existing Rivers & Creeks
- New Levee
- Reinforce Existing Levee
- Siphon Interconnection
- Pump Station

D-005037

T:\DWG\CalFed\Indelta dwg 6/20/97

D-005038





NOTES:

1. Levee elevations to be raised accordingly such that the static water surface elevation in all reservoirs is 6.0 feet MSL.
2. $V_{conv.}$ = Maximum storage capacity while conveying 5,000 cfs through the entire system.
3. V_{max} = Maximum static storage capacity of island.

Figure 3

In - Delta Storage

Hydraulic Gradient

CALFED BAY-DELTA PROGRAM

D-005038