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DESIGN MEMORANDUM NO. 1 MARCH 1986

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

GENERAL DESIGN MEMORANDUM AND APPENDIX A AND FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

US Army Corps of Engineers
Sacramento District

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GENERAL DESIGN MEMORANDUM AND APPENDIX A AND FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL, CALIFORNIA

MARCH 1986

McDowell

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL, CALIFORNIA
GENERAL DESIGN MEMORANDUM--PROJECT DESIGN

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II	Channel Cross Sections (Sheet 1)
III	Construction Schedule (Sheet 1)
IV	Utility Locations (Sheets 1-5)

RELATED DOCUMENTS

Supplemental Environmental Impact Statement (attached)

GDM Appendices (attached)
A. Comments and Responses

GDM Appendices (separately bound)
B. Detailed Cost Estimates for the Selected Plan
C. Recreation
D. Dredged Material Disposal Areas
E. Salinity Studies
F. Sediment Engineering Investigations
G. Analysis of Bottom Sediments
H. Local Cooperation Agreement
I. Fish and Wildlife Mitigation
J. Pertinent Correspondence

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GENERAL DESIGN MEMORANDUM - NEW YORK SLOUGH (PITTSBURG) TO SACRAMENTO

Pertinent Data for
Selected Plan

1. GENERAL DATA

Name	Sacramento River Deep Water Ship Channel, California.
Authorization	"An Act Making Supplemental Appropriations for the Fiscal Year Ending September 30, 1985, and For Other Purposes." Public Law 99-88, August 15, 1985
Rivers	Sacramento River Cache Slough (lower)
Counties and State	Contra Costa, Solano, Yolo, and Sacramento, California
Purpose	Navigation, Recreation, and Wetland Enhancement

2. NAVIGATION DATA

Location	New York Slough (Pittsburg) to Sacramento, California
Dimensions	
Length	46.5 Miles
Controlling Depth	35 feet (below -2.0 NGVD)

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Bottom Width (one-way traffic)	
New York Slough (Pittsburg) to Channel Mile (CM) 15.0	350 feet
Channel Mile 15.0 to the Entrance to the Manmade Channel (CM 18.6)	300 feet
The Entrance to the Manmade Channel (CM 18.6) to Port of Sacramento	250 feet
Side Slopes	
New York Slough to Channel Mile 15.0	1V on 4H
Channel Mile 15.0 to Port of Sacramento	1V on 3H
Dredged Material	
Amount	21,500,000 cu. yds.
Disposal areas	4,464 acres
3. RECREATION	Deferred
4. FISH AND WILDLIFE DATA	
Mitigation-Wetlands/Uplands Development on Prospect Island	63 acres
Enhancement-Wetlands Development on lower Sherman Island	Under Investigation
5. LAND USE DATA	
Permanent Change	
Agricultural land converted to tidal mud-flat, tidal marsh and riparian habitat for mitigation	+63 Acres
Submerged land converted to wetland habitat for enhancement	Under Investigation
Tidal mudflat and tidal marsh (and riparian) habitat due to dredging along sides of channel	26.2 Acres

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Temporary Change Short term impact (1-2 years) as a result of dredged material disposal on upland habitats	4,464 acres
Temporary impact (7-10 years) as a result of dredging on wetland riparian habitats	25.8 acres

6. Economics (50 years at 8-1/8% and October 1985 price level)

First Costs	
Federal	$43,132,550
Non-Federal	$35,983,509
Total first cost	$79,116,059
Annual Costs	
Federal	$ 3,576,490
Non-Federal	$ 2,983,701
Total annual costs	$ 6,560,191
Annual Benefits	
Navigation	$10,620,000
Total benefits	$10,620,000
Net Benefits	$ 4,059,809
Benefit-Cost Ratio	1.6 to 1

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CHAPTER I - INTRODUCTION

1. **Project status**. - An investigation was conducted in response to resolutions by the House of Representatives Committee on Public Works, adopted on 10 July 1968 and 11 December 1969. The Board of Engineers for Rivers and Harbors (BERH) was requested to review reports pertinent to the Sacramento River Deep Water Ship Channel, California, and determine whether any modification of the existing navigation project is advisable, particularly to the channel from New York Slough to the Port of Sacramento.

A Feasibility Report and Environmental Impact Statement (EIS) for Navigation and Related Purposes were completed in July 1980. The final EIS was filed with EPA on May 8, 1981. The Office of the Chief of Engineers (OCE) approved the report on November 20, 1981. The Feasibility Report was transmitted to Congress for information on October 4, 1983.

The Sacramento River Deep Water Ship Channel, California, navigation project was authorized by "An Act Making Supplemental Appropriations for the Fiscal Year Ending September 30, 1985, and for Other Purposes," as contained in Public Law 99-88 dated August 15, 1985. The authorized project plan is based on the selected plan contained in the Feasibility Report.

2. **Purpose and scope**. - This design memorandum presents the selected plan for navigation channel modification between New York Slough (Pittsburg) and the Port of Sacramento considering economic feasibility, local sponsor affordability and environmental effects. Recreation development and social and economic impacts of the selected plan are also discussed. This design memorandum will be used as a basis for detailed design and for preparation of the contract plans and specifications for the project between New York Slough (Pittsburg) and Sacramento.

3. **Description of the Feasibility Report plan**.

a. Suisun Bay Channel. - The portion of the ship channel from Avon to New York Slough (Pittsburg) is authorized for deepening to 35 feet and widening up to 600 feet to provide two-way traffic as a unit of the San Francisco Bay to Stockton (John F. Baldwin and Stockton Ship Channels) navigation project. The feasibility plan provided that in the event that this channel is not deepened and widened under the San Francisco Bay to Stockton authorization, it would be improved as part of the project plan.

b. Sacramento River Deep Water Ship Channel. - The project area is shown on a general map in Figure I-1. The selected plan of improvement involved modifications to three portions of the project reach.

(1) New York Slough to Junction Point (Channel Mile 15.0). - This portion of the channel was planned to be deepened from 30 to 35 feet, and the width increased from 300 to 400 feet.

(2) Junction Point to Entrance to Manmade Channel (Channel Mile 18.6). - The width would remain 300 feet along this reach, and the depth would be increased from 30 to 35 feet.

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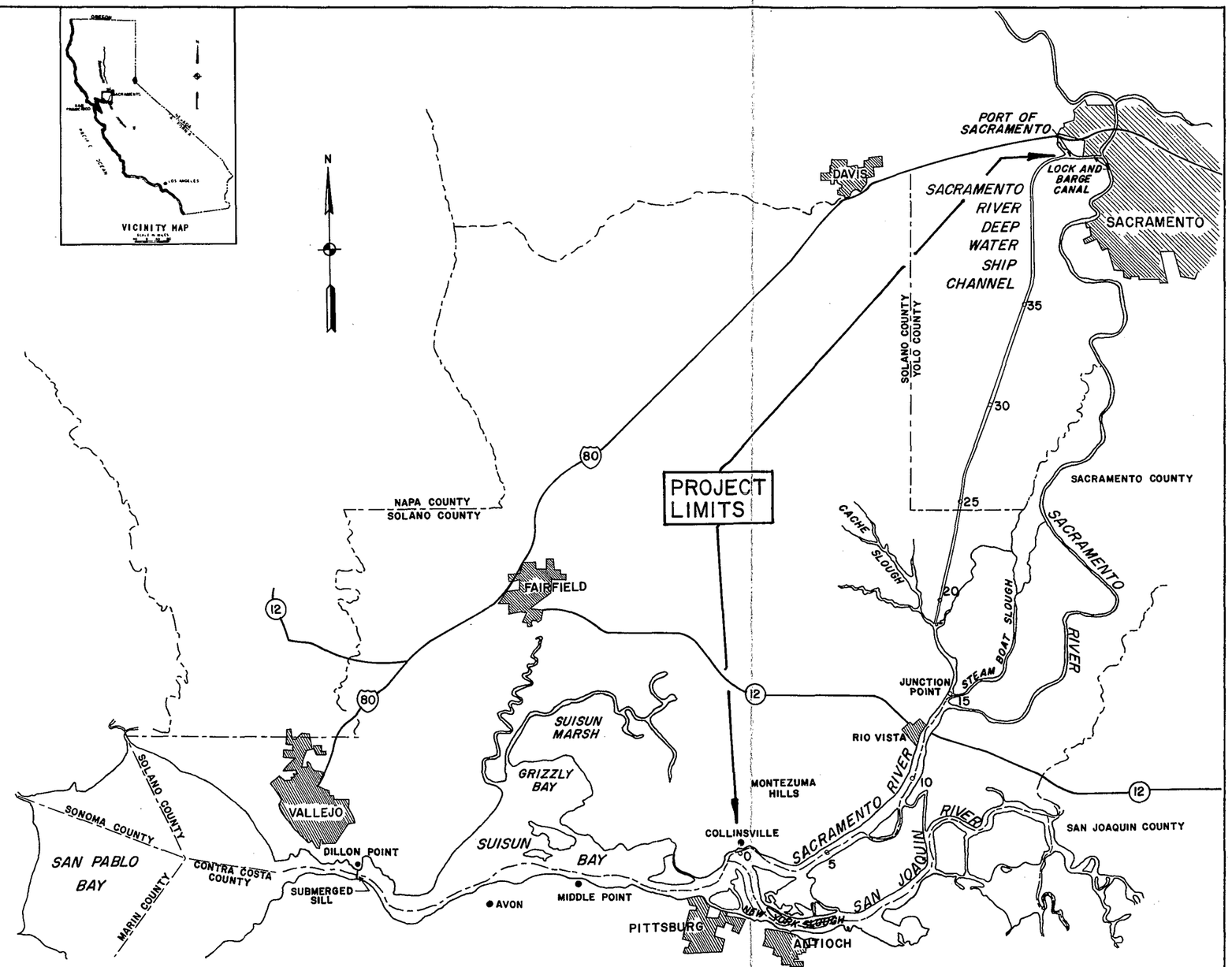

GENERAL MAP

SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL, CALIFORNIA

FIGURE I-1

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(3) Entrance to Manmade Channel to the Port of Sacramento. - This portion would be deepened from 30 to 35 feet, and the width increased from 200 to 250 feet.

Channel side slopes were planned to be 1 vertical on 4 horizontal in the reach between New York Slough and Channel Mile 18.6 and 1 vertical on 3 horizontal from Channel Mile 18.6 to the Port of Sacramento. Approximately 30 million cubic yards of dredged material was estimated to be excavated and pumped a maximum of 15,000 linear feet to 8 land disposal areas. Approximately 3,500 acres of land would be required for disposal.

Dredged material disposal sites required for construction of the feasibility report plan are shown on Figure I-2. Construction of dredged material retention dikes or bulkheads would be the responsibility of the local navigation project sponsor. All disposal sites would be diked and partitioned to eliminate rapid return of effluent and thereby maintain water quality standards established by the State Water Resources Control Board.

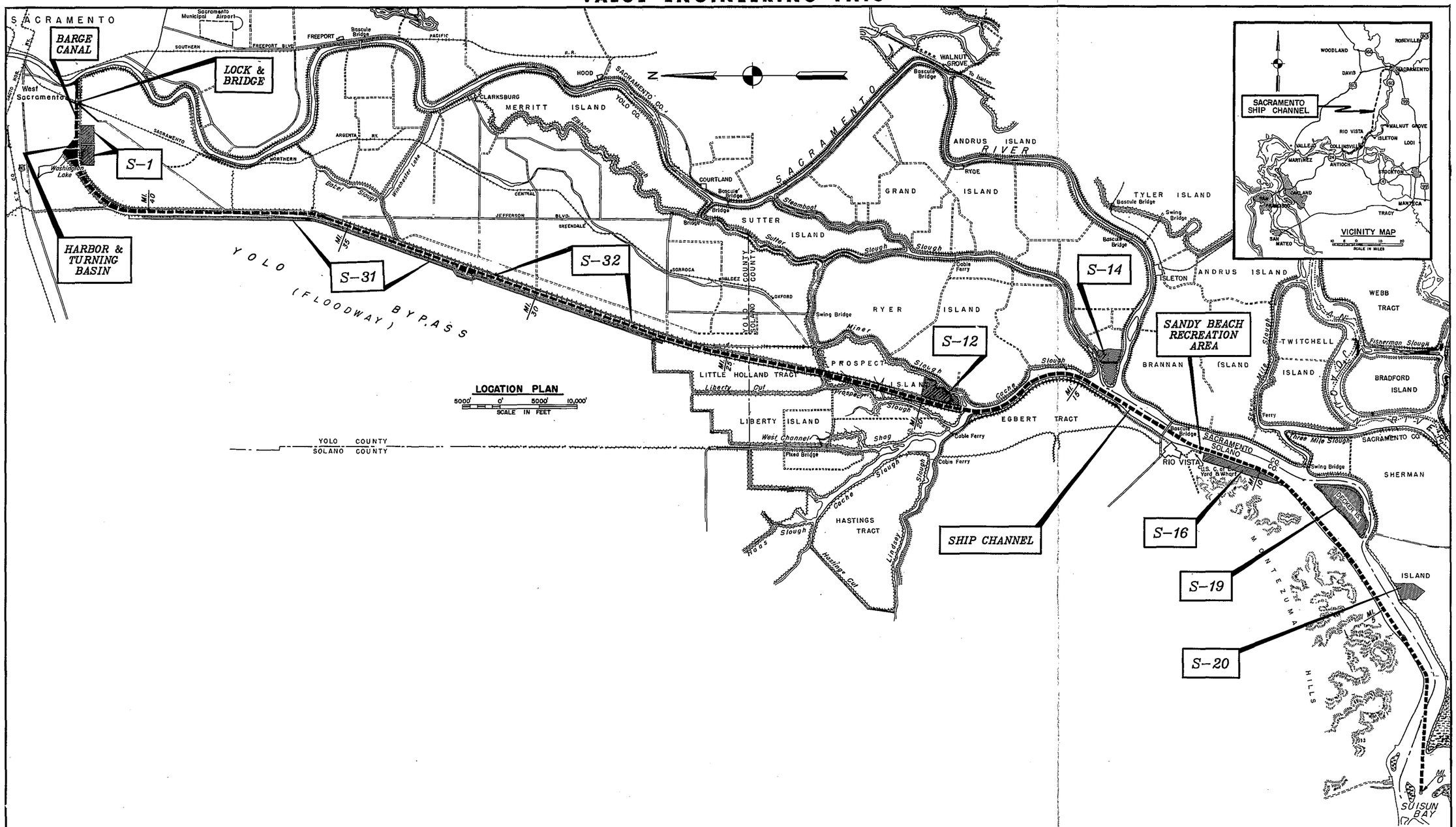
Recreation facilities were planned to be constructed at one dredged material disposal site where a potential local sponsor had expressed the willingness to cost-share in its development and operation and maintenance. The site is the Sandy Beach area located on the northern portion of the Corps maintenance dredging disposal site in Solano County south of Rio Vista. It is shown on Figure I-2. The facilities to be provided were day use and camping accommodations. The day-use facilities included picnic sites, parking, a swimming beach and restrooms. The camping accommodations would include restrooms and other support facilities. A boat launching area and support facilities were also to be provided.

Fish and wildlife mitigation was included in the feasibility plan to offset any losses due to the project. To offset the loss of wetland habitat, 45 acres of a former dredged material disposal area S-12, Prospect Island, was to be converted to a wetland habitat as recommended by the Fish and Wildlife Service. To compensate for the loss of upland habitat, a maximum of 156 acres on dredged material disposal areas would have been developed.

A mitigation feature included in the plan was a submerged sill or some other alternative feature to control potential salinity intrusion. The construction of this feature was predicated upon the results of post feasibility report studies and/or model tests.

4. **Requirements of local cooperation**. - The requirements of local cooperation as contained in the Chief of Engineer's 20 November 1981 report to the Secretary of the Army are given below. The Chief's report concurred with the recommendations of BERH (Items 1 through 8) and added a ninth requirement to conform to the Administration's July 15, 1981, proposed legislation on enhanced cost sharing.

The requirements of local cooperation for the authorized project have since been updated to reflect the present proposed legislation on cost sharing and requirements thereof. The draft local cooperation agreement for the authorized project is discussed further in Chapter X and is presented in Appendix H.



LEGEND

S-16 PROPOSED DISPOSAL AREA

FISH AND WILDLIFE AREA

SHIP CHANNEL

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: D. FORBES
CHECKED: J. VERES
SUBMITTED: Herman T. Gelt

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS
(1980 FEASABILITY REPORT)

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As contained in the Chief of Engineers November 20, 1981 report the Local interests will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way required for implementation and later maintenance of the project and for aids to navigation, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and later disposal of dredged material; and including necessary retaining dikes, bulkheads, and embankments therefor, or the costs of such retaining works, except for additions required solely for development of the recreation areas;

(2) Hold and save the United States free from damages due to construction and later maintenance of the project not including damages due to the failure of such levees, except damages due to the fault or negligence of the United States or its contractors;

(3) Accomplish without cost to the United States all alterations and relocations of highway bridges, buildings, utilities, and other structures and improvements made necessary by the project;

(4) Provide and maintain without cost to the United States adequate public terminals and transfer facilities open to all on equal terms;

(5) Provide and maintain without cost to the United States adequate depths in vessel berthing areas and local access channels serving the terminals;

(6) Share in the cost of fish and wildlife mitigation features, including lands, in the same ratio as the remaining costs of the navigation features;

(7) Provide a cash contribution for recreation equal to 50 percent of the final separable costs, including lands, allocated to this function;

(8) Bear all costs of operation, maintenance, and replacement of recreational facilities; and

(9) Agree to reimburse the Federal government for all expenditures for the construction of navigation features of the recommended plan, and all subsequent expenditures for maintenance and rehabilitation; except for expenditures assigned by the Secretary of the Army to governmental vessels in non-commercial service.

5. **Desires of local interests**. - The Port of Sacramento, Sacramento City Council and Chamber of Commerce, the West Sacramento District Chamber of Commerce, and the Sacramento Area Commerce and Trade Organization desire deepening the channel to stimulate industrial expansion, increase employment in the area, and maintain the competitive position of the Port of Sacramento. Many shippers and industries have expressed support for the project including Proctor and Gamble, Arco, Diamond International, and Union Oil, among others.

6. **Summary of selected plan**. - This paragraph contains a brief summary of the selected plan of improvement as developed from the feasibility plan and described later in Chapter IV, Selected Plan and Project Requirements. The alignment of the channel and disposal areas for the selected plan are shown on Plate I, Sheets 1-6.

a. Navigation. - The selected plan provides for deepening the existing one-way navigation channel between the mouth of New York Slough (Pittsburg) and the Port of Sacramento to 35 feet below mean lower low water (mllw) and widening the channel for ship maneuverability and safety. The widths have been further investigated since the feasibility plan, and the channel will be widened according to the tabulation below.

Reach	Selected Width as Reported in Feasibility Plan	Selected Width (ft)
New York Slough to Junction Pt. (CM15.0)	400	350
Junction Point (CM15.0) to Channel Mile 18.6	300	300
Channel Mile 18.6 to the Port of Sacramento	250	250

Material dredged from the channel will be placed in confined upland disposal areas.

The feasibility report plan provided for the Suisun Bay channel between Avon and New York Slough to be deepened and widened under the Sacramento River Deep Water Ship Channel project if it were not improved as part of the San Francisco Bay to Stockton project.

A contract to deepen the channel to 35 feet and widen the channel to 350 feet under the San Francisco Bay to Stockton project was awarded in January 1986. However, prior to construction, the need for a two-way channel was not demonstrated. Therefore, the portion of the channel not needed for one-way traffic was reclassified to the "inactive" status. The two-way width will not be constructed until such time as the need is demonstrated and a project local sponsor is obtained. For these reasons, this reach will not be described further in this memorandum.

b. Recreation. - The feasibility plan described the potential development of recreation facilities at the Sandy Beach area located on the northern portion of the Corps disposal site S-16. Solano County has independently developed the site. Several local agencies have expressed interest in the future development of recreation facilities on disposal sites in Yolo, Solano and Sacramento Counties. At this time no local sponsors have come forward; thus, recreation development will be deferred.

c. Fish and wildlife mitigation. - Sixty-three acres of agricultural land on a former dredged material disposal site on Prospect Island is to be converted to a complex of wetland and riparian habitat as part of the selected plan. This mitigation feature will offset the loss or change of habitat in other portions of the project area due to the project.

d. Wetland enhancement. In the 1980 feasibility report, coordination with Federal and State fish and wildlife agencies had not revealed a suggested site or sites on which enhancement of wetlands should be

established through the use of dredged materials. The establishment of such wetlands at Federal cost (up to $400,000) was authorized by Section 150 of the 1976 Water Resources Development Act. Recently, several Federal and State fish and wildlife agencies have expressed interest in enhancing wetlands in the project area on lower Sherman Island. The site is located adjacent to the ship channel. No development is planned at this time since all the funding and environmental issues are not resolved. However, additional coordination and investigation will be undertaken with the interested agencies and organizations to determine, if the site could be beneficially utilized to provide a net enhancement of fish and wildlife values in the project area. Future development will be based on resolution of first the environmental issues and then any funding issues.

e. Salinity mitigation. - Post feasibility report studies and model tests have been conducted and are reported in detail in Chapter V, Summary of Technical Studies and in Appendix E, Salinity Studies. The studies and tests have not conclusively identified a definable potential salinity intrusion impact. A pre and post construction monitoring program will be conducted to better define potential impacts. If a measurable and significant salinity intrusion impact is defined, then mitigative measures such as a submerged sill or other alternatives will be instituted. Post-authorization studies and model tests will be conducted to evaluate mitigation alternatives. Mitigation measures are not anticipated at this time, therefore they are not described in this memorandum.

7. **Description of the project area**. - The Sacramento River Deep Water Ship Channel project is located in the Sacramento - San Joaquin Delta region of northern California. The study area for this memorandum extends from New York Slough (Pittsburg) to the Port of Sacramento, a distance of approximately 47 miles. The channel lies within Contra Costa, Solano, Sacramento, and Yolo Counties and serves the marine terminal facilities at the Port of Sacramento.

a. Solano County. - Solano County is centrally located between the San Francisco Bay area and the Sacramento metropolitan area. Because of this convenient location and abundance of land available for development, Solano County has experienced considerable population growth in recent years. From 1970 to 1980, its population grew 37% to 236,300, and the county's population growth rate through the year 2000 is projected to more than double that of the state.

From San Pablo Bay to the Sacramento Valley, Solano County covers a wide variety of terrain. Between Vallejo in the southwestern corner of the county and the central towns of Fairfield and Vacaville lie rolling hills. To the east of Vacaville are the flat, fertile farmlands of the Sacramento Valley and the communities of Dixon and Rio Vista. Along the south, the county is bordered by Suisun Bay, with its surrounding saltwater marshes, and the delta of the Sacramento and San Joaquin Rivers.

Solano County's economy is diverse, but is anchored by a large and relatively stable government sector. Mare Island Naval Shipyard in Vallejo is a major nuclear submarine repair base for the U.S. Navy and is the county's single largest employer. Travis Air Force Base in Fairfield and the California Medical Facility in Vacaville are also major government employers. The 27,000 employees in the government sector make up more than 35% of the non-farm workers in the county. Wholesale and retail trade, service industries, manufacturing, and agriculture are other major employment groups.

The long-range trend is for continued population and economic growth in the county.

b. Sacramento County. - Sacramento County is located near the center of California's Central Valley, 85 miles east of San Francisco and 95 miles west of the Lake Tahoe resort area. Due to its location, Sacramento has experienced a steady increase in population. From 1970 to 1980 its population grew 23% to 780,391, and the county's population is projected to be 1,186,600 by the year 2000.

c. Yolo County. - Yolo County lies in the southern Sacramento Valley between the Coast Range and the Sacramento River. About two-thirds of the county is covered with rich alluvial soil of the Sacramento Valley and Yolo Basin. From elevations of about 50 feet near the river, the land rises gradually westward to 3,057 feet in the hills of the north Coast Ranges.

d. Contra Costa County. - A small portion of the project lies in Contra Costa County so it is not described in detail here.

8. **Environmental setting and natural resources**. - Following is a summary of the environmental setting of the study area. A more detailed description of biological resources, water quality, land use, recreation and cultural resources is included in the Final Supplemental Environmental Impact Statement and the Appendicies to this memorandum.

a. Geology and soils. - The project area lies predominantly on the western flank of the Sacramento Valley in the northern portion of the Great Valley Geomorphic Province. The Great Valley is a large northwest trending asymmetrical geosyncline filled with a thick sequence of primarily continental and marine clastic sedimentary rocks of Jurassic to Recent age. The thickest sequence of sedimentary rocks found in the Great Valley occurs beneath the project area. These rocks rest on a basement probably composed of basaltic or ultramafic rocks. Exposures in the project area are limited to recent stream channel, fan, and basin deposits except for some Pleistocene alluvial sediments exposed in the area known as the Montezuma Hills. The project area is considered seismically active, the Midland fault zone being the dominant structural feature. This zone, active to at least Eocene time, is northwest striking and parallels the project from Cache Slough until it crosses the Sacramento River at the tip of Grand Island. The Calaveras and Hayward fault zones are located several miles to the south.

Both organic and mineral soils occur within the project area. Deep organic soils occur along the ship channel from Suisun Bay to Prospect Island. The source of these soils is the water-saturated layer of tule reed peat associated with the complex of sloughs and islands of the Sacramento-San Joaquin Delta. Mineral soils are found north of Prospect Island and in fill areas and natural levee deposits between Collinsville and the mouth of Cache Slough.

b. Climate. - The climate of the project area is the mild two-season Mediterranean type typical of California's Central Valley. Temperatures can exceed 100 degrees Fahrenheit in summer and occasionally fall below freezing during the winter months. Approximately 95 percent of the mean annual rainfall of 15 inches occurs from October through April. The prevailing wind is from the south and southwest with a velocity of at least 8 miles per hour (MPH) 50 percent of the observed time.

c. Hydrology.

(1) General. - Most of the water from the 64,000-square mile Central Valley watershed, or roughly one-third of the entire State of California, drains through the Sacramento - San Joaquin Delta. The water originates as runoff from winter rains in the valley and foothills and from spring snowmelt in the Sierra. Three-quarters of the total annual flow occurs between January and May, with January and February being the peak months. The main tributary rivers to the Delta include: the Sacramento, which produces 80 percent of the total runoff; the San Joaquin (15 percent); and other minor tributaries (5 percent). Before large scale water diversions began, the mean annual outflow from the Delta was more than 30 million acre-feet. The construction of many Federal, State and local water projects within the watershed has cut the flow to its present level of about 16 million acre-feet per year.

Besides diversion by upstream facilities, water is also removed from the Delta. Agricultural pumping and vegetative transpiration take up around 1.8 million acre-feet, and the Contra Costa Canal, South Bay Aqueduct, California Aqueduct, and Delta-Mendota Canal divert about 5 million acre-feet per year, although their design capabilities could produce much larger diversions.

(2) Water surface elevation. - Water elevations in the study area are influenced by hydrological and geological phenomena. Rapid melting of snow packs and rains in the tributary areas may greatly influence the water levels of the waterways in the study area. Another significant factor which influences the water levels is tidal action. The combination of heavy runoff and tidal action may produce flood stages.

(3) Tidal hydraulics. - Tidal action is an important factor in the development of any plan to improve the navigability of waterways in the study area. Tidal ranges for an average tide and low advective outflow are 4.5 feet at Collinsville, 4.75 feet at Junction Point, and 6.0 feet at the Port of Sacramento.

The closed end of the Sacramento River Deep Water Ship Channel and the constrictive geometry of the channel complicate the tidal hydraulics of the ship channel between Junction Point and the Port of Sacramento. The tidal amplitude increases as a result of a harmonic oscillation created by the closed end of the channel. The constrictive geometry increases the tidal effect. The average tidal range at the port is 6.0 feet; the average tide range for the river side of the lock is approximately 2.5 feet during periods of low flow.

d. Archeology and history. - Much of the prehistoric cultural record in the study area has been altered or destroyed by agricultural operations, industrial and urban developments, and water resources developments such as leveeing and dredged material disposal. The project area was first visited by Euro-Americans in 1776 during a Spanish exploration of San Francisco Bay. During the early nineteenth century, trappers frequented the area. After completing the Central Pacific Railroad, Chinese laborers reclaimed the Delta marshland by constructing levees. This resulted in agriculture being dominant in more recent history.

e. Vegetation. - Almost the entire length of the Sacramento River Deep Water Ship Channel is bordered by agricultural lands on the landsides of the levees. The agricultural vegetation includes row crops and orchards. Natural vegetation in the project area consists of stands of tidal marsh, freshwater marsh, riparian trees and brush, and grass.

f. Fish and wildlife. - Significant resident and anadromous fish populations occur in the ship channel and interconnecting rivers and sloughs. The waterways also provide important spawning and nursery areas for many commercial and sport fishes. Diverse and abundant species of reptiles, amphibians, birds, and mammals inhabit the complex habitats created by the combination of open waters, tidal marshland, riparian vegetation, valley grassland, and agricultural land. The area is an important wintering ground for waterfowl using the Pacific Flyway.

g. Planktonic and benthonic organisms. - Phytoplankton and zooplankton, the base of the aquatic food chain, exist in very high concentrations in the Delta. Mysid shrimp, an abundant and very important zooplankton species in the Delta, is the chief food of young fish, especially striped bass. The Delta also has a large and varied population of benthic organisms with more than 138 species identified in the system.

h. Rare, threatened, or endangered plants and animals. - Presently within the project study area, the Federal register lists one endangered mammal, one threatened insect, and two candidate faunal species (one small mammal and one bird). Also, a Federally listed threatened plant (and California rare plant) and a rare and endemic beetle are within the project area. A list of these species and a discussion on the project in relation to these species is presented in the Final Supplemental Environmental Impact Statement which is attached.

i. Air quality. - The study area is primarily within the boundaries of the Sacramento Valley Air Basin. Major pollution problems within the basin are photochemical smog (oxidents) and particulate matter. Most of the directly emitted particulate matter is the result of stationary sources including agricultural burning. Mobile sources, including motor vehicles, ships, boats, and airplanes, emit most of the oxidents.

j. Water quality. - The waters of the ship channel are used for commercial navigation, water supply, fishing, recreation, and disposal of irrigation return flows. These uses have different quality requirements. In 1975, the Central Valley Regional Water Control Board adopted a Basin plan which included water quality objectives for the deep water channel and in August 1978 adopted a similar plan for the Delta. Intermittent water quality data collected between 1963 and 1972 indicated that, except for salinity, the water quality in the channel meets or exceeds the objectives. Salinity measurements indicated that total dissolved solids often exceed the 500 parts per million (ppm) objective between Mile 35 and the Port of Sacramento. This was due primarily to saltwater ballast discharge from ships at the port.

k. Sediment quality. - Since deepening the ship channel involves dredging sediment and depositing it in dredged material disposal (DMD) sites, sediment samples were analyzed at various locations along the channel. The analyses recorded concentrations of zinc slightly above standards which is thought to originate from irrigation leaching of Central Valley soils which are high in zinc. A more detailed review of the sampling results may be found in Appendix G, and in the Final Supplemental Environmental Impact Statement.

l. Dredged material disposal sites. - Fifteen sites have been identified as dredged material disposal sites along the Sacramento Ship Channel. These sites range from 98 to 663 acres and are required for placement of 21.5 million cubic yards (cy) of material which will be dredged in the channel deepening. Placement of dredged material will be controlled so as to minimize placement of material on seasonal marshland or on riparian woodland. Most of these DMD sites would be returned to their prior uses.

9. **Existing navigation channels and proposed improvements**. - In the interest of commercial navigation, extensive improvements in the waterways have been accomplished by the Federal government, as discussed in the following subparagraphs.

a. Sacramento River. - The Sacramento River Deep Water Ship Channel Project is a modification of, and a supplement to, the Sacramento River Shallow Draft Navigation Project which was adopted by the River and Harbor Act of March 3, 1899, as modified by Acts of 1912, 1927 and 1935. The Shallow Draft Project provided for a channel 10 feet deep at mean lower low water, 150 to 200 feet wide from the mouth of the river to the "M" Street Bridge (Capitol Ave.) Sacramento; thence 6 feet deep to Colusa, 5 feet to Chico Landing; and such depths as practicable to Red Bluff (all depths being at mean lower low water). The existing Sacramento River Deep Water Ship Channel Project was authorized by the River and Harbor Act (Public Law 525, 79th Congress, 2nd Session) approved July 24, 1946. The principal features of the project as authorized by Public Law 525 include the Deep Water Ship Channel, Harbor and Barge Canal. The harbor consists of a turning basin of the same depth as the ship channel (30 feet), 1,000 feet wide and 1,200 feet long at Washington Lake. The barge canal, 11 feet deep and 120 feet wide with lock and drawbridge, connects the harbor and Sacramento River. The Deep Water Ship Channel is 30 feet deep and 200 to 300 feet wide from deep water in Suisun Bay to Washington Lake, including flood control intercepting works and drainage culverts. The project has been in operation for oceangoing vessels since June 1963. Local interests were required to furnish all lands, easements, rights-of-way, and dredged material disposal areas for the initial work and subsequent maintenance; make all necessary utility changes; and construct, operate, and maintain an adequate public terminal with necessary utilities, rail and highway connections at the harbor. The Sacramento-Yolo Port District provided the local requirements.

b. Suisun Bay Channel. - The original project was authorized by the River and Harbor Act of 2 March 1919. It provides for a channel 300 feet wide from Martinez to Antioch, California, 24 feet deep across the lower shoal near Bulls Head Point, thence 20 feet deep across Point Edith and Middle Ground Shoals, and thence 18 feet deep through New York Slough. The original project was completed in 1920 at a cost of $130,000; about one half, or $65,000, was contributed by local interests. The existing project was authorized by the River and Harbor Act of 21 January 1927 as modified by the Acts of 1930, 1935 and 1960. The existing project provides for a channel 300 feet wide and 35 feet deep to Avon and 300 feet wide and 30 feet deep to the mouth of New York Slough, a distance of 13 miles, and for a channel 250 feet wide and 20 feet deep south of Seal Islands from the main channel at Point Edith, Mile 3, to the main channel again at Port Chicago, Mile 6. The 30-foot channel was completed in 1934 at a Federal cost of $142,027. Under the authority of the San Francisco to Stockton, California (John F. Baldwin and Stockton Ship Channels) navigation project authorized by the River and Harbor Act of 1965 as contained in Public Law 89-298, the channel is authorized to be deepened from the existing depths of 35 and 30 feet to 45 feet between Martinez and approximately Chipps Island and to 45 feet from Chipps Island to New York Slough. The authorization provides for widening the existing channel bottom to 600 feet upstream to Middle Point, east of the piers at the Concord Naval Weapons Station at Port Chicago, and to 400 feet upstream to the mouth of New York Slough. Since the deepening of the channel to 45 feet from Avon to Chipps Island was contingent upon development of a

refinery near Chipps Island or development of other heavy industry requiring deep-draft vessels, these improvements were deauthorized. The current proposed improvements consist of a 35-foot deep channel 350 feet wide from Avon to New York Slough. The channel between Martinez and Avon was deepened to 35 feet under the authority of Section 107 of the 1960 River and Harbor Act (Public Law 86-845) subsequent to authorization of the San Francisco Bay to Stockton project. The deepening of the existing channel to 35 feet from Avon to New York Slough began in January 1986 as part of the San Francisco Bay to Stockton project and all work is expected to be completed by mid-1987.

c. Downstream Channels.

(1) San Pablo Bay. - The existing project was adopted or modified by the River and Harbors Acts of 1911, 1917, 1927, 1938 and 1945. It provides for a channel 600 feet wide, 35 feet deep and approximately 8 miles across Pinole Shoal. Recent authorization for the Pinole Shoal channel, which is within the limits of the San Pablo Bay and Mare Island project, allows its present 600-foot bottom width to be widened an additional 45 feet and the channel lengthened by approximately 9 miles to connect the naturally deep waters of San Pablo Bay and Carquinez Strait. The maneuvering area near the Union Oil Company wharf at Oleum would be deepened to 45 feet and enlarged to accommodate larger tankers. Also, a 45-foot deep and 600-foot to 800-foot wide channel is planned to be excavated through the shoal areas of upper Carquinez Strait near the Martinez-Benicia bridges. A maneuvering area south of the main channel in the vicinity of the Shell and Lyon (Tosco) Oil Company piers at Martinez would be deepened to 45 feet. The channel would taper to approximately 300 feet wide at the Interstate 680 highway bridge and the Southern Pacific Railroad Bridge to utilize the existing navigation openings through these bridges. The primary users of the channels are commercial ships traveling between Suisun Bay and Central San Francisco Bay.

(2) West Richmond Channel. - Authorization under the Act of October 27, 1965 provides for deepening of the existing Long Wharf maneuvering basin to 45 feet and the construction of the West Richmond channel, 600 feet wide, 3 miles long and 45 feet deep through the west navigation opening of the Richmond-San Rafael Bridge. The primary users of this channel will be commercial ships traveling between San Francisco Bay and upstream ports.

(3) San Francisco Bar. - The San Francisco Harbor project extends from the Pacific Ocean offshore approach channel (through San Francisco Bar) to the San Francisco Airport. The original project was adopted by various Congressional Acts from 1868 to 1922, and provided for channel dredging and rock removal. The project was modified to existing dimensions by Rivers and Harbors Acts of 1927, 1939, 1935, 1937 and 1965 which provided for dredging a channel 2,000 feet wide and 55 feet deep through San Francisco Bar for a length of 4 miles. Construction of the authorized plan is completed. The San Francisco Bar or Main Ship Channel is the only deepwater ocean entrance to San Francisco Bay and is used by all ocean-going shippers in the Bay Area.

d. Flood control. - Flood protection measures in the study area have been developed as part of the Sacramento River Flood Control Project. This project is a joint Federal-State-local interest venture which includes an extensive

system of levees, overflow weirs, leveed and unleveed bypass channels, and bank protection works. This project provides flood protection from Collinsville to near Chico along the Sacramento River. In most cases, levees are located adjacent to the channels and were constructed with borrow from the channels. The levees are subject to damage by flood flows, wind and tidal action, and vessel wavewash.

The Central Valley Project (CVP) of the U.S. Bureau of Reclamation is a multi-purpose development and is also authorized to make releases for navigation. Principal storage units in the Sacramento Basin are Shasta Lake on the upper Sacramento River, Folsom Lake on the American River and Auburn Dam which is planned for construction on the American River upstream from Folsom Lake.

10. **Transportation facilities and services**. - Because of its locational advantages in relation to other areas in the western United States, Sacramento is in the unique position to provide multi-modal transportation facilities capable of handling shipments by surface, air, or water. These transportation facilities, combined with the fact that Sacramento is located near the center of California's great Central Valley, make it an ideal base for certain industrial activities including manufacturing, processing, warehousing, and marketing. Sacramento's transportation advantage is also improved by its important role as a regional distribution point to other shipping centers of the Pacific Basin as well as to other parts of the United States.

The Sacramento area is located at the junction of two mainline transcontinental railroads, the Southern Pacific and Santa Fe Railroad Company and the Union Pacific System. Due to recent mergers in the railroad industry, the Southern Pacific and the Atchison, Topeka and Santa Fe Railroads are now one railroad called the Southern Pacific and Santa Fe Railroad Company. In addition, the Union Pacific System emerged from the merger of the Union Pacific, Missouri Pacific, and Western Pacific Railroads. The Sacramento Northern, a short-line carrier, which is a subsidiary of the Union Pacific System, offers rail service to Sacramento Valley markets. Both the Southern Pacific and Santa Fe Railroad Company and the Union Pacific System have large rail yards in the Sacramento area. One of the largest switching yards west of Chicago is located within the Sacramento area and is operated by the Southern Pacific and Santa Fe Railroad Company. The yard has a daily capacity of 9,000 rail cars. The Port of Sacramento has a 200-car holding yard.

Four major freeway systems bisect the area. Interstate 80 and U.S. 50 are major east-west directional arterial highways. Interstate 5 and U.S. 99 are major north-south highways. These routes, together with other converging freeways, lend ready access to markets throughout the 11 western states. Interstate 80 and 5 are immediately adjacent to the Port of Sacramento. Forty-one regularly scheduled truck lines and some 500 contract carriers service the Sacramento area.

The Sacramento Metropolitan Airport is located 12 miles north of the downtown core area and is surrounded by agricultural land. The airport is a modern facility with up-to-date navigation and safety equipment. The land

area encompasses 3,700 acres, 600 of which are utilized for structural improvements. Several major carriers (United, PSA, Western, Air California, American, Republic and Frontier) and four commuter carriers serve the airport. There are also a number of smaller public and private airports within the study area and numerous unpaved airstrips. In addition, there are three major military airfields in the area: Travis at Fairfield and McClellan and Mather at Sacramento.

Deep draft navigation improvements in the area include the existing Sacramento River and Suisun Bay Deep Water Ship channels. These channels currently provide deep water access to the Port of Sacramento for fully loaded ships up to about 18,000 deadweight tons (dwt). Larger ships must be partially loaded and/or await higher tides before using the channels. Between 120 and 130 deep-draft vessels use these channels annually to transport primarily bulk commodities to and from the Sacramento Valley region. Also, within the study area is a shallow draft channel in the Sacramento River which provides a 10-foot depth at mllw between deep water at Junction Point (Mile 15.0) and Sacramento. This channel is currently used mostly by small craft with drafts less than 10 feet. Due to lack of use by commercial vessels, the shallow draft channel authorized depth has not been maintained since 1973.

11. **Vessel traffic**. - During the period since the opening of the Port of Sacramento in 1963 to 1983, 2,650 deep draft vessels moved through the port and carried 30 million tons of cargo. In considering the deepening of the existing channel to Sacramento, the characteristics of the existing vessel fleet utilizing the channel were reviewed.

a. Dry bulk carriers. - Bulk carriers calling at the Port of Sacramento range in size from about 15,000 to 60,000 dwt with design drafts from 29 to 42 feet. However, shippers prefer to use vessels in the 18-20,000 dwt range due to the limited depth of the existing channel. These vessels can be fully loaded at the port and can then proceed directly to their destination. It is becoming increasingly difficult to charter ships in this size range since most of these vessels have been replaced by larger ships. Therefore, shippers must charter larger vessels (20-60,000 dwt) which need to be "topped-off" at other west coast ports or operated at less than their design drafts. This practice increases shipping costs. Table II-1 shows the principal characteristics of typical dry bulk carriers which loaded grain at the Port of Sacramento during the 1976-83 period. Most of the grain loaded at the port is backhaul traffic for bulk vessels which transport steel products and automobiles to the west coast. The bulk vessel which calls at the Port of Sacramento on a regular basis to load rice for Puerto Rico is the integrated tug-barge (ITB) California Rice Transport. This vessel is 656 feet long, has a beam of 85 feet and a maximum loaded draft of 31.5 feet. It has a cargo capacity of about 32,500 short tons and makes seven trips per year between Sacramento and San Juan, Puerto Rico. The ITB normally loads about 18,000 tons of milled rice at Sacramento and then proceeds to the Pacific Northwest to top-off with aluminum and lumber destined for east coast markets. On the return voyage to the west coast the vessel carries about 30,000 tons of phosphate rock from Jacksonville, Florida, to the Port of Stockton.

Dry bulk fertilizer arriving at the Port of Sacramento from Norway and Belgium is transported in medium-size bulk vessels between 24,000 and 30,000

TABLE II-1
SAMPLE OF VESSELS LOADING GRAIN AT THE PORT OF SACRAMENTO
1976-83

Vessel	Year Built	DWT	Length	Beam	Design Draft	Sailing Draft	Cargo	Tons Loaded	Destination
Pan Pacific	1966	25,040	585' 8"	75' 1"	34' 1"	30' 6"	rice	20,235	South Korea
Pacglory	1974	22,593	539' 2"	75' 2"	32' 4"	30' 6"	corn	21,041	Japan
On Lee	1970	35,657	655' 5"	91' 5"	36' 10"	31' 5"	wheat	30,166	People's Republic of China
Ace Pioneer	1976	16,588	557' 10"	86' 0"	29' 10"	30' 6"	wheat	16,421	Japan
Pan Western	1967	52,225	700' 0"	96' 2"	41' 10"	30' 0"	rice	33,075	South Korea
Asia Prosperity	1974	26,900	581' 4"	75' 0"	34' 3"	31' 0"	rice	23,681	Bangladesh
Sheaf Royal	1972	38,711	656' 0"	88' 9"	36' 7"	28' 0"	rice	27,305	Syria
Sunny Pioneer	1975	20,203	518' 4"	76' 11"	31' 3"	30' 4"	wheat	18,682	Japan
Lynton Grange	1976	26,600	600' 6"	74' 8"	34' 5"	30' 6"	wheat	23,422	Bangladesh
Causeway	1976	60,740	736' 3"	106' 0"	41' 4"	29 2"	rice	39,225	Bangladesh
Amazonas	1975	25,604	591' 7"	75' 1"	33' 6"	29' 10"	wheat	20,944	Brazil
Kate N.L.	1965	34,602	604' 9"	85' 9"	36' 3"	28' 9"	wheat	24,182	India
Kyrakatingo	1967	52,733	716' 9"	102' 2"	39' 5"	30' 10"	wheat	37,449	People's Republic of China
Andros City	1967	39,796	623' 4"	90' 9"	37' 3"	29' 8"	rice	29,848	Italy
Hasselt	1974	30,668	623' 4"	75' 6"	35' 1"	30' 0"	wheat	24,556	Soviet Union
Alkaios	1975	19,030	506' 0"	74' 10"	30' 2"	30' 4"	corn	19,711	Japan
Atlantic Heritage	1969	29,168	593' 2"	91' 3"	35' 1"	28' 9"	rice	22,046	Italy
Santa Catalina Maru	1972	22,697	544' 5"	75' 1"	34' 0"	30' 4"	wheat	16,204	Japan
Lago Maihue	1970	16,061	474' 6"	67' 10"	30' 4"	31' 0"	wheat	16,017	Chile
Pacific Defender	1968	20,520	520' 0"	74' 3"	30' 1"	31' 2"	rice	19,996	Indonesia
Kavo Alkyon	1961	16,230	534' 4"	66' 7"	30' 10"	30' 4"	rice	16,436	Spain
Kavo Xifias	1961	40,347	669' 11"	90' 7"	38' 7"	30' 5"	rice	29,423	Italy
Larry L	1970	27,306	597' 1"	75' 2"	34' 11"	30' 5"	wheat	21,600	Soviet Union
Kyuko Maru	1978	51,658	655' 11"	105' 8"	40' 9"	30' 10"	wheat	36,904	People's Republic of China
Maria Voyazides	1971	29,202	593' 2"	75' 11"	35' 0"	30' 3"	rice	24,595	Bangladesh
Georgina Glory	1962	27,593	577' 0"	75' 0"	36' 1"	31' 0"	wheat	21,934	Soviet Union
Pavel Rybin	1975	23,625	555' 11"	80' 10"	32' 6"	31' 2"	wheat	21,197	Soviet Union
Gospic	1977	37,836	615' 9"	93' 2"	35' 2"	30' 6"	rice	32,554	Indonesia
Maritime Investor	1976	41,035	602' 3"	90' 8"	39' 4"	29' 7"	rice	29,994	Italy
Atlantic Charity	1970	28,793	591' 7"	75' 2"	34' 11"	31' 4"	wheat	24,953	Jordan
Rayni Kotari	1974	23,307	539' 3"	75' 2"	33' 1"	32' 0"	rice	22,360	South Korea
Lily Village	1976	26,600	600' 7"	72' 7"	34' 5"	32' 0"	rice	23,862	South Korea
Hai Soo	1975	30,697	585' 3"	88' 3"	35' 0"	31' 10"	rice	27,012	South Korea
Bogasari Dua	1977	33,747	655' 3"	86' 4"	33' 0"	31' 6"	wheat	33,073	Indonesia
Flores	1968	27,738	607' 6"	79' 3"	32' 19"	31' 7"	wheat	27,698	Indonesia

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Table II-2

Sample of Vessels Unloading Fertilizer

VESSEL	DWT	LENGTH	BEAM	DESIGN DRAFT	INBOUND DRAFT
Star Daranger	27,890	564' 0"	85' 2"	34' 2"	30' 4"
Star Atlantic	29,709	564' 0"	85' 2"	35' 4"	31' 0"
Star Columbia	27,890	564' 0"	85' 2"	34' 2"	29' 6"
Star Heranger	27,890	564' 0"	85' 2"	34' 2"	29' 6"
N.R. Crump	28,939	593' 10"	95' 11"	34' 4"	27' 8"
Temple Inn	24,090	534' 4"	75' 2"	34' 2"	29' 6"
Cape Antibes	24,090	534' 4"	75' 2"	34' 2"	22' 9"
Star Luzon	29,709	564' 0"	85' 2"	35' 4"	22' 0"
Star Malaysia	29,486	564' 0"	85' 2"	35' 4"	26' 0"
Star Indonesia	29,709	564' 0"	85' 2"	35' 4"	26' 6"

dwt. These vessels have design drafts from 34 to 35.5 feet and must stop at the Port of San Diego to discharge cargo before calling at Sacramento. The vessels shown in Table II-2 are typical of the specially strengthened bulk carriers used in this trade. A special requirement of these vessels is that they must be able to sail with two holds empty since cargo is discharged at more than one west coast port. These vessels carry lumber and other forest products from the Pacific Northwest on their return trips to Europe. The anhydrous ammonia which began arriving at Union Chemical's fertilizer terminal located on the channel in May 1978 is being transported in the first U.S. flag liquid ammonia carrier, the S.S. Cornucopia. This vessel is 623 feet long with a beam of 90 feet and has a maximum draft of 31.8 feet. Cargo capacity is 23,000 short tons (32,000 cubic meters) with a full load displacement of 37,500 long tons. Cargo gear includes four independent insulated tanks which can carry the liquid ammonia at -28°F.

Bulk vessels carrying logs from the Port of Sacramento range in size from about 16,000 to 20,000 dwt with loaded departure drafts of 29 to 31.8 feet. Larger vessels between 20,000 and 60,000 dwt are also used for log shipments but must be partially loaded because of draft limitations. Most of the log vessels calling at the port transport a considerable amount of cargo on deck to achieve sufficient volume. To facilitate this, the heavy-lift cranes on board the vessels are mounted on pillars to provide space for deck cargo and to swing clear of a full deck load. Ballast from 2,000 to 4,000 long tons is common on log carrying vessels to balance the logs stowed on deck. The largest log vessel to call at the Port of Sacramento has been the Eastern Grace (March 1982) with a deadweight capacity of 58,581 tons. The principal characteristics of typical vessels being used to transport logs from the Port of Sacramento are outlined in Table II-3.

Table II-3
Sample of Vessels Loading Logs

VESSEL	DWT	LENGTH	BEAM	DESIGN DRAFT	SAILING DRAFT	TONS LOADED
Natasha	29,623	574' 7"	85' 5"	33' 9"	30' 8"	20,609
Eastern Cherry	19,418	512' 4"	74' 4"	31' 3"	30' 5"	15,064
Asia Botan	18,820	508' 8"	75' 0"	29' 4"	30' 6"	14,512
Shinyu Maru	20,009	502' 0"	77' 6"	30' 11"	30' 6"	15,804
Sunny Wealth	18,546	469' 10"	75' 0"	30' 0"	29' 2"	13,244
Toshin Maru	16,549	465' 9"	71' 7"	29' 10"	30' 2"	13,769
Maritime Queen	19,297	512' 4"	74' 4"	31' 3"	31' 0"	14,603
Asia Beauty	25,401	576' 11"	83' 5"	31' 2"	31' 6"	20,684
Pacific Trader	20,000	555' 10"	75' 0"	33' 8"	31' 1"	17,236
Midas Rhine	19,125	627' 6"	75' 0"	30' 1	30' 2"	13,467
Sacramento	16,549	465' 9"	71' 7"	29' 10"	31' 6"	14,306
Jupiter	19,480	684' 9"	102' 0"	32' 1"	31' 2"	13,227
Eastern Lily	18,244	479' 2"	75' 0"	30' 1"	29' 2"	12,371
Korean Crystal	17,249	480' 4"	74' 4"	29' 4"	30' 2"	11,734
Van Hawk	24,323	541' 11"	80' 10"	31' 2"	31' 6"	17,852
Mammouth Fir	32,646	597' 1"	88' 9"	35' 5"	29' 6"	6,671
Ocean Log	16,961	475' 10"	75' 1"	28' 6"	27' 8"	11,227
Seine Maru	40,543	602' 7"	90' 7"	39' 6"	24' 6"	7,217
Eastern Grace	58,581	742' 8"	102' 2"	40' 8"	25' 2"	3,798
Diamond Star	16,482	465' 8"	71' 7"	29' 10"	31' 2"	11,990

b. Wood chip vessels. - Bulk wood chip vessels were built specifically to supply the paper and fiberboard industry in Japan with pulpwood in the form of wood chips. The vessels are unique from conventional bulk vessels because of the low density of the cargo carried. Wood chips stow at one-half to one-third the density of other bulk commodities such as grain and phosphate rock. Wood chip vessels are therefore considerably deeper and slightly wider beamed than conventional vessels. Even at that, a typical wood chip vessel does not have sufficient volumetric capacity to stow more than about 70 percent of its deadweight capacity. Growth of the wood chip trade has resulted in the construction of 76 wood chip vessels aggregating over 2.5 million dwt. Table II-4 shows the wood chip vessels which called at the Port of Sacramento during the 1976-83 period. Most of the wood chips moving through the port are being transported by vessels in the 41-43,000 dwt range. These vessels have hold capacities of 2.9-3.0 million cubic feet and carry between 27,500 and 32,000 tons of wood chips. The stowage factors on the wood chips are generally 90 to 105 cubic feet per ton depending on the moisture content of the chips. The sailing drafts of these vessels range from 29 to 30 feet, and they represent the maximum size wood chip vessels that can presently load at the port with the existing channel dimensions.

The largest wood chip vessels in the world fleet are used to transport wood chips from Australia, South Africa, and the Pacific Northwest to Japan. Therefore, vessel dimensions, especially beam, are not limited by the Panama Canal. The dimensions of these vessels are presented in Table II-5. The largest existing wood chip vessel is the 57,897 dwt Eden Maru, with a 4.2 million cubic foot hold capacity, a length of 736.5 feet, and a beam of 115 feet. It is primarily used to transport eucalyptus chips from Australia to Japan but has also called at Coos Bay, Oregon, and Longview, Washington, for loading. It is expected that wood chip vessels in the 46-58,000 dwt range will call at the Port of Sacramento in the future if a deeper channel is provided. Based on a detailed review of actual loadings of the large wood chip vessels at ports in the Pacific Northwest and information provided by vessel operators, it is estimated that wood chip vessels in the 46-58,000 dwt range could fully load at the Port of Sacramento without requiring drafts greater than about 32 feet. A channel depth of 35 feet below mllw would carry all vessels with few tidal delays.

12. **Traffic densities**. - Table II-6 presents a summary of vessel calls at the Port of Sacramento between initiation of activities in 1963 and 1983. While it is evident that the number of calls have moderated somewhat in recent years, the number of vessel calls have increased dramatically at the port. The decrease in vessel calls at the port in 1982 and 1983 are the result of the worldwide recession and the Payment-In-Kind program. Vessel calls are projected to increase in the late 1980's as agricultural constraints are relaxed and the economic situation continues to improve. Table II-7 presents a summary of vessel calls by design draft at the port in 1983. The loaded drafts of the vessels at the port may have been less than the design draft, meaning that they were light (less than fully loaded). Thirty-six percent of the vessels calling at the Port of Sacramento in 1983 had design drafts of 36 to 38 feet. Twenty-three percent of the vessels had drafts of 34 to 35 feet.

Table II-4

Sample of Vessels Loading Wood Chips at the Port of Sacramento
1976 - 1983

Vessel	Year Built	DWT	Length	Beam	Design Draft
Alphine Rose	1969	42,124	649' 1"	99' 0"	36' 2"
Chuetsusan Maru	1967	28,209	577' 5"	84' 2"	35' 1"
Dai Honshu Maru	1974	43,272	599' 1"	91' 5"	42' 0"
Dairun Maru	1973	42,322	638' 10"	99' 11"	36' 1"
Eastern World	1973	37,911	643' 1"	96' 9"	35' 7"
Eaton Gloria	1975	42,174	639' 10"	98' 7"	36' 2"
Ehine Maru	1970	28,991	642' 11"	96' 6"	29' 8"
Golden Grampus	1975	37,300	643' 0"	96' 7"	35' 6"
Grand Zodiac	1975	31,304	570' 10"	91' 3"	32' 9"
Honshu Gloria	1975	41,962	639' 9"	98' 6"	37' 8"
Honshu Maru	1967	22,109	534' 10	77' 11"	31" 11"
Hourai Maru	1972	25,918	575' 2"	77' 4"	32' 11"
Jugo Maru	1968	22,194	534' 8"	77' 10"	31' 10"
Jugo Maru No. 2	1972	31,178	599' 1"	91' 4"	32' 11"
Kasugai Maru	1970	42,623	646' 4"	98' 7"	36' 0"
Kathryn Maru	1968	26,597	578' 0"	82' 2"	32' 10"
Kenjyu Maru	1974	42,187	650' 10"	100' 6"	36' 3"
Madang	1973	23,804	564' 4"	82' 0"	30' 9"
New Independence	1976	41,203	643' 1"	100' 2"	36' 1"
Oji Gloria	1976	41,901	639' 10"	98' 5"	36' 1"
Oji Maru	1967	26,611	578' 1"	82' 1"	32' 10"
Oji Maru No.1	1972	41,875	638' 9"	99' 11"	36' 2"
Oriental Taio	1974	46,595	675' 1"	100' 2"	37' 3"
Pacific Venture	1976	41,000	643' 1"	100' 0"	36' 1"
Papyrus Maru	1972	24,318	577' 5"	77' 11"	31' 10"
Prince of Tokyo	1974	41,515	638' 10"	99' 11"	36' 1"
Sendai	1975	40,999	643' 0"	100' 2"	36' 2"
Taikai Maru	1971	28,848	643' 2"	97' 7"	39' 8"
Tonami Maru	1969	42,124	646' 4"	99' 0"	36' 1"
Universal Taio	1974	46,624	675' 0"	100' 0"	37' 2"
Valentura	1976	37,300	643' 1"	96' 7"	35' 1"
World Wood	1974	46,417	674' 0"	100' 1"	37' 3"

TABLE II-5

LARGEST WOOD CHIP CARRIERS IN THE EXISTING WORLD FLEET

VESSEL	YEAR BUILT	DWT	HOLD CAPACITY (1,000 CUBIC FEET)	LENGTH	BEAM	DESIGN DRAFT	PRINCIPAL TRADE ROUTE
Oriental Taio	1974	46,595	3,140	675'1"	100' 2"	37' 3"	Pacific N.W. - Japan
Mimosa Africana	1975	50,077	3,600	687'7"	110'10"	37'10"	Durban, S.A. - Japan
Eden Maru	1971	57,897	4,156	736'6"	115' 0"	37' 9"	Australia - Japan
Oriental Soveign	1975	47,152	3,500	685'8"	104'11"	36' 1"	Pacific N.W. - Japan
Meridian	1975	46,242	3,100	649'7"	105' 8"	36' 9"	Pacific N.W. - Japan
World Wood	1974	46,417	3,142	674'0"	100' 1"	37' 3"	Pacific N.W. - Japan
Empress of Eden	1975	58,028	4,110	791'4"	108' 4"	37'10"	Australia - Japan
Hokuetsu Venture	1976	46,439	3,100	649'7"	105' 9"	36' 8"	——
Pacific Taio	1974	57,172	4,128	736'6"	115' 0"	37' 9"	Australia - Japan
Kengo Maru	1972	47,948	3,314	712'0"	105'10"	35' 0"	——
Southern Cross	1973	47,909	3,314	712'0"	105' 9"	35' 1"	Pacific N.W. - Japan
Hachinohe Maru	1972	54,187	3,422	754'5"	110' 5"	44' 6"	Australia - Japan

TABLE II-6
HISTORICAL VESSEL CALLS
PORT OF SACRAMENTO

YEAR	CALLS	YEAR	CALLS	YEAR	CALLS
1963	14	1970	129	1977	118
1964	66	1971	137	1978	123
1965	108	1972	124	1979	129
1966	109	1973	173	1980	175
1967	168	1974	149	1981	159
1968	167	1975	145	1982	114
1969	132	1976	127	1983	99

TABLE II-7

VESSEL CALLS BY DESIGN DRAFT
PORT OF SACRAMENTO

1983

DRAFT	CALLS	PERCENT
28	9	9
28-29	2	2
30-31	20	20
32-33	9	9
34-35	23	23
36-37	27	27
38	9	9

The deepening of the existing channel would allow larger vessels to transport additional cargo more efficiently and cost effectively. The greatest gains in the scale economies of the larger ocean bulk carriers are to be obtained in sizes up to about 35,000 dwt. Above this size, the gains tend to become progressively less. Most of the vessels used in future bulk cargo trades will probably be in the 20,000 to 40,000-ton range. These medium-sized vessels have more flexibility in route and trade opportunities than their larger counterparts. Exceptions will undoubtedly occur for certain specific cargo trades where the length of haul and volume of annual movement justify using the larger vessels. Generally, the economics of moving dry bulk cargoes such as rice, grain, fertilizers, etc., is such that these cargoes must move in medium-sized vessels on more frequent schedules to meet the consumption patterns at the distant ports. Consequently, the deepening of the ship channel will improve the economic potential of the Port of Sacramento.

CHAPTER III - PRIOR INVESTIGATIONS

13. **Investigations**. - During the planning and engineering phases of the Sacramento River Deep Water Ship Channel project, numerous investigations, reports and studies were accomplished. A summary of the most pertinent reports completed prior and subsequent to authorization are included in this chapter.

a. Investigations Prior to Authorization. -

U.S. Army Corps of Engineers. Sacramento District, June 1945. Feasibility Report on the Sacramento River Deep Water Ship Channel Project.

U.S. Army Corps of Engineers. Sacramento District, July 1949. Sacramento River Deep Water Ship Channel Project. Basis of Design and Salinity Condition.

U.S. Army Corps of Engineers. Sacramento District, January 1954. Review of Project Economics (revised).

U.S. Army Corps of Engineers. Sacramento District, December 1956. Review of Project Benefits.

U.S. Army Corps of Engineers. Sacramento District, November 1960. Public Overlook Facilities Lock and Bridge.

U.S. Army Corps of Engineers. San Francisco District, January 1975. Sacramento River Deep Water Ship Channel Investigation, Analysis of Channel Bottom Sediments.

Seldomridge, J. S. and C. Smith-Madsen, November 1976. Cultural Resources Reconnaissance: Sacramento River Deep Water Ship Channel (Collinsville to Sacramento). U.S. Army Corps of Engineers, Sacramento District.

U.S. Army Corps of Engineers. Sacramento District, November 1979. Transcript of Public Meeting.

U.S. Army Corps of Engineers. Sacramento District, July 1980. Sacramento River Deep Water Ship Channel, California: Feasibility Report and Environmental Impact Statement for Navigation and Related Purposes.

U.S. Army Corps of Engineers. Sacramento District, September 1980. San Francisco Bay to Stockton, California (John F. Baldwin & Stockton Ship Channels): Interim General Design Memorandum and EIS, Avon to Stockton.

U.S. Army Corps of Engineers. Office of Chief Engineers, November 1981. Sacramento River Deep Water Ship Channel, California: Report of Chief of Engineers.

Giroux, H. D., May 1983. Sacramento Deep Water Ship Channel Air Quality Emissions Analysis. U.S. Army Corps of Engineers, Sacramento District.

U.S. Army Corps of Engineers. Hydrologic Engineering Center, May 1983. Evaluation of Previous Reports that Addressed Potential Maintenance Dredging Problems in the Sacramento Deep Water Ship Channel. Special Projects Memo No. 83-3.

Cedergren, H. R., July 1983. Seepage study of Sacramento River Deep Water Ship Channel Project. U.S. Army Corps of Engineers, Sacramento District.

U.S. Army Corps of Engineers. Hydrologic Engineering Center, July 1983. Measurement of the High-Flow Characteristics of the Sacramento Deep Water Ship Channel. Special Projects Memo No. 83-7.

U.S. Army Corps of Engineers. Hydrologic Engineering Center, May 1984. Measurement of the Low-Flow Characteristics of the Sacramento Deep Water Ship Channel. Special Projects Report No. 84-5.

U.S. Army Corps of Engineers. Hydrologic Engineering Center, September 1984. Sacramento River Sediment Trap: A Preliminary Feasibility Study. Special Projects Report No. 84-6.

U.S. Army Corps of Engineers. San Francisco District, October 1984. Repeatability Study; San Francisco Bay-Delta Hydraulic Model.

U.S. Army Corps of Engineers. San Francisco District, November 1984. Sacramento and Stockton Deep Water Ship Channels High Export Study; San Francisco Bay-Delta Hydraulic Model.

Werner, R. H., January 1985. Intensive Cultural Resource Survey & Literature Review for the Sacramento Deep Water Ship Channel project; Yolo and Solano County, California, U.S. Army Corps of Engineers, Sacramento District.

b. Investigations Subsequent to Authorization. -

U.S. Army Corps of Engineers, Sacramento District, August 1985. Sacramento River Deep Water Ship Channel, California: Draft General Design Memorandum and Supplemental Environmental Impact Statement.

14. **Description of selected plan**. - The selected plan of improvement calls for the deepening and widening of the ship channel between New York Slough and the Port of Sacramento. This channel is connected to the Avon to New York Slough portion of the Suisun Bay channel which is common to ship traffic to and from the Port of Stockton, as well as to and from the Port of Sacramento. The feasibility report plan contained a provision to include the Avon to New York Slough channel in the selected plan if it was not constructed under the San Francisco Bay to Stockton project. This reach is currently under construction and therefore will not be included as part of the selected plan. The selected plan is independent and not contingent upon any plan of improvement of navigation channels downstream of Avon under the John F. Baldwin Ship Channel project.

The selected project reach has been divided into three distinct reaches based on similar design characteristics. The reaches are summarized below. The alignment and disposal areas for the selected plan are shown on Plate I, Sheets 1-6. The channel dimensions for the plan are summarized in Table IV-1 with typical sections shown on Plate II.

TABLE IV-1
Existing and Selected Channel Dimensions
(in feet)

Channel Reach	Existing Dimensions		Selected Plan	
	Depth	Bottom Width	Depth	Bottom Width
Suisun Bay Channel Avon to New York Slough	30	300	35	350
Sacramento River Deep Water Ship Channel				
New York Slough to Junction Point (CM 15.0)	30	300	35	350
Junction Point (CM 15.0) to Entrance to Man-Made Channel (CM 18.6)	30	300	35	300
Entrance to Man-Made Channel (CM 18.6) to Port of Sacramento	30	200	35	250

Approximately 21.5 million cubic yards of material will be excavated during the deepening and widening of the Sacramento River Deep Water Ship Channel. This material will be placed in upland disposal areas that are located on lands along the existing channel. These disposal lands will be acquired, the retention dikes constructed and the disposal areas maintained by the local sponsor.

C-090595

C-090595

a. Suisun Bay Channel. - Construction on the reach from Avon to New York Slough began in January 1986 under the San Francisco Bay to Stockton project and is expected to be completed by mid-1987. This reach was authorized to provide two-way traffic; however, the portion of the channel not needed for one-way traffic was reclassified to inactive status due to a lack of current need. This reach is presently being constructed to provide for one-way traffic. If the need for two-way traffic is realized in the future, the two-way portion could be reactivated.

b. Sacramento River Deep Water Ship Channel. - The selected plan for the three reaches of the channel from New York Slough to the Port of Sacramento is described as follows. All three reaches would provide for one-way traffic. The location of disposal sites is shown on Plate I, Sheets 1-6. The capacity of each site, although, not necessarily the volume of material to be disposed and the approximate channel miles to be accommodated by each site are summarized on Table IV-2.

(1) New York Slough to Junction Point (CM 15.0). - The selected plan for this reach includes widening the straight portion of the reach from 300 feet to 350 feet. The depth will also be increased from 30 feet to 35 feet. Approximately 5 million cubic yards of material will be dredged in this reach and placed upon land disposal sites that are depicted on Plate I, Sheets 4-6. The disposal sites include areas in the Montezuma Hills at RM 3.0 and 4.0, Sherman Island, Decker Island, a Rio Vista site south of the bridge, Egbert Tract (2 miles north of Rio Vista) and a portion of Grand Island. The potential for the placement of dredged material on lower Sherman Island for the enhancement of wetlands exists. No disposal on lower Sherman Island is planned at this time, but possible enhancement will be investigated further with the Port of Sacramento and the interested fish and wildlife agencies prior to construction in this reach. No disposal will take place until the required environmental documentation is completed.

(2) Junction Point (CM 15.0) to entrance to the manmade channel. - This reach lies within a portion of Cache Slough. The selected plan is to maintain the existing bottom width of 300 feet but deepen it from 30 feet to 35 feet. The alignment of the channel through the curves will be made to avoid or minimize cutting of the channel banks on the outside of the curves. The outside of curves in this reach will remain at the present locations while the inside of the curves will be transitioned to provide the width at the greater depth. The total estimated quantity of dredged material in this reach is 300,000 cubic yards which will be placed on land disposal sites located on Grand Island and landward of the Yolo-Bypass levees on Egbert Tract.

(3) Entrance to the manmade channel (CM 18.6) to the Port of Sacramento. - The manmade portion of the Sacramento River Deep Water Ship Channel will be widened from 200 feet to 250 feet and deepened from 30 feet to 35 feet. There is an estimated 16.2 million cubic yards of dredged material to be removed in this reach. The disposal sites to be used are located on the berms adjacent to the project levee, on Prospect Island, and landward of the berms and levees at Channel Miles 24.0, 31.0, 33.0, 38.0, and 42.0.

TABLE IV-2
Summary of Dredged Material
Disposal Sites

Site Designation	Location	Usable Area (Acres)	Capacity (10^6cy)	Approximate Channel Miles dredged between
S-1	Port of Sacramento Lt. Bk.	158	1.8	42 - Port
S-4	Chan Mi 38 Lt. Bk.	137	1.1	40 - 41
S-7	Chan Mi 33 Lt. Bk	228	1.8	31 - 34
S-9	Chan Mi 31 Lt. Bk.	173	1.4	28 - 30
S-11	Chan Mi 24 Lt. Bk.	640	4.3	21 - 24
S-12	Prospect Isl. Lt. Bk	241	1.4	17 - 21
S-13	Egbert Tract	570	4.5	12 - 14
S-14	Grand Isl.	196	1.6	14 - 17
S-16	Rio Vista	149	.7	11 - 12
S-19	Decker Isl	590	4.8	6 - 11
S-20	Chan Mi 5 Lt. Bk.	98	.2	5 - 6
S-21	Chan Mi 5 Rt. Bk	160	1.6	4 - 5
S-31	West Bank Manmade	663	2.8	25 - 41 2/
S-32	East Bank Manmade	265	1.1	25 - 41 2/
S-35	Chan. Mi 3 Rt. Bk.	196	1.6	0 - 4
Totals		4,464	30.7	

1/ Dredged Material disposal areas #31 and #32 located intermittently along portion of the channel.

C-090597

C-090597

c. Recreation. - There are no planned recreation facilities at the present time due to the lack of local sponsors. Therefore, recreation will be deferred. However, future participation in recreation development by several counties could occur as evidenced by the letters of interest located in Appendix C. The areas under consideration for recreation development are summarized below.

(1) Sandy Beach, Solano County. - Solano County has independently developed 30 acres of the Sandy Beach area which is located at the Corps-owned disposal site (S-16) immediately south of Rio Vista. The site is leased to the County and is developed with day-use and camping facilities. The site will not be impacted by the project. Solano County has expressed interest in expansion into the disposal site area. However, the remaining area is needed for the channel improvement and present and future maintenance dredging. The site is presently just large enough to satisfy the capacity and water quality requirements for disposal. Any future recreation development would have to be compatible with the primary use as a disposal site. This site will be reevaluated in the future if there is local interest.

(2) Sacramento County. - Sacramento County has expressed interest in developing recreation facilities on the Grand Island disposal site (S-14). They have proposed development schemes for a 60-acre facility and a 10-acre facility. This area is government-owned and is used as a dredged material disposal site for maintenance dredging. The existing acreage is used to meet water quality requirements and accommodate the continuing ship channel operation and maintenance disposal capacity needs. The 60-acre recreation facility is not being considered at this time due to the need for disposal activities, and interest in the 10-acre recreation facility was withdrawn by local interests. This site will be reevaluated if local agencies show future interest in this site.

(3) Yolo County. - Plans for small recreation areas that would utilize dredged material after disposal were developed in cooperation with the East Yolo Community Services District. No proposal was made since the District was unable to sponsor the development.

d. Salinity mitigation plans. - The channel deepening impacts to salinity have been evaluated by both physical and mathematical modeling. The modeling has not been able to conclusively determine an impact on which mitigation measures could be based. A detailed description of the studies and the results can be found in Chapter V and in Appendix E. A monitoring program has been developed in cooperation with the State Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (USBR) to determine the potential impacts of the channel deepening on salinity. The monitoring program will be conducted by the Corps of Engineers in coordination with DWR and USBR and will begin prior to construction and continue after construction until adequate data is obtained to assess the magnitude of impacts, if any. In the interim, further coordination and studies will be undertaken to determine an appropriate and environmentally acceptable mitigation plan. If an impact is defined, then mitigative measures will be instituted.

e. Fish and wildlife mitigation. - In accordance with recommendations of the U.S. Fish and Wildlife Service, 63 acres on the southern tip of Prospect Island will be developed as a wetland and riparian upland habitat area. The development will serve to fully mitigate for project caused fish and wildlife habitat losses. Dredged material will be placed in the area and the existing groundline contoured to provide open water, tidal mudflat, tidal marsh and riparian habitat. Suitable native and introduced species of aquatic and terrestrial vegetation will be planted. A monitoring program will be conducted to ensure that the area is developed and maintained at the recommended habitat values.

f. Cultural resources mitigation. - The present project design will not affect any eligible sites or sites in the National Register. Therefore, no mitigation will be required. The State Historic Preservation Office (SHPO) has concurred with this finding.

Should dredged disposal site S-1 be expanded in the future to include a prehistoric site designated as Yol-42, it will be necessary to determine whether Yol-42 is eligible for the National Register. Two archeological investigators were unable to adequately evaluate the site's significance based on surface remains alone; therefore, after consultation with the SHPO, limited subsurface testing for a determination of eligibility could be required. If Yol-42 is determined ineligible for the National Register, no mitigation would be required. If Yol-42 is determined eligible and could not be preserved by project redesign, it would be necessary to notify the SHPO and the Advisory Council on Historic Preservation (ACHP) and enter into a memorandum of agreement for mitigation of the site. Correspondence pertaining to cultural resources is contained in Appendix J.

g. Cost estimate. - The estimated first and annual costs for the selected plan are based on 1 October 1985 price levels, and annual costs are based upon an 8-1/8 percent interest rate and a 50-year amortization period. A complete summary and basis for the first and annual costs are contained in Chapter VII and detailed estimates are contained in Appendix B.

15. **Construction schedule**. - The entire project reach from New York Slough to the Port of Sacramento will be divided into four reaches for construction. The three mile portion of the channel from New York Slough to Collinsville (Channel Mile 0.0) will not require improvement since the existing natural channel is sufficiently deep and wide.

The four reaches are broken down as follows:

(1) Channel Mile 35.0 to the Port of Sacramento
(2) Collinsville (Channel Mile 0.0) to Junction Point (Channel Mile 15.0)
(3) Junction Point (Channel Mile 15.0) to Channel Mile 27.0
(4) Channel Mile 27.0 to Channel Mile 35.0

The construction was previously planned to be accomplished by four contracts. Each contract would deepen and widen the channel to the selected plan dimensions. The total construction time was estimated at seven years, including a contract for the development of the mitigation lands on Prospect Island. Due to the greater financial role the local sponsor must assume in contributing toward project construction costs under present cost sharing requirements, the local sponsor has requested that the construction contracts be modified and the construction period extended to enable them to financially participate in the project. In order to facilitate the local sponsor's needs and improve the channel economically, the construction has been broken down into seven dredging contracts and one contract for the mitigation land development. Once the channel is constructed to the project depth along the entire length, shipping benefits to the Port of Sacramento would begin to occur; thus, the contracts have been sequenced so that the channel will be deepened first and then widened. The construction period will total nine years, including a contract to develop the mitigation lands on Prospect Island. All the construction will be accomplished by contract. The sponsor has the responsibility for the acquisition of all lands, relocations of utilities, and preparation of dredged material disposal areas. The contracts are scheduled in the following order:

CONTRACT 1 - Channel Mile 35.0 to the Port of Sacramento (deepen)
CONTRACT 2 - Channel Mile 0.0 to 15.0 (deepen and widen)
CONTRACT 3 - Channel Mile 15.0 to 27.0 (deepen)
CONTRACT 4 - Channel Mile 27.0 to 35.0 (deepen)
CONTRACT 4A - Mitigation Development on Prospect Island
CONTRACT 5 - Channel Mile 35.0 to the Port of Sacramento (widen)
CONTRACT 6 - Channel Mile 15.0 to 27.0 (widen)
CONTRACT 7 - Channel Mile 27.0 to 35.5 (widen)

Construction of Contract 1 will begin at the Port of Sacramento and continue downstream to Channel Mile 35.0. The channel will be deepened to the 35-foot project depth and the curves will be widened to the project width of 250 feet. This reach is planned to be constructed first due to the early availability of the dredged material disposal sites. Contract 2 between Channel Mile 0.0 and 15.0 will deepen and widen the channel to the project depth and width. This will complete the reach between Channel Mile 0.0 and Channel Mile 15.0 which is considered by the pilots to be the most difficult to navigate. Thus, safety will be enhanced at the earliest opportunity. Contract 3 between Channel Mile 15.0 and 27.0 will deepen the channel to the project depth and widen the curves to the project width of 250 feet. Contract 4 between Channel Mile 27.0 and 35.0 will also deepen and widen in the curves. The Prospect Island mitigation development is then scheduled to be constructed. Subsequently, the straight portions of the channel between Channel Mile 15.0 and the Port of Sacramento will be widened to the project width of 250 feet by Contracts 5, 6 and 7. The length of the construction contracts will be approximately one to two years. A detailed construction schedule appears on Plate III.

Construction of all of the contracts are dependent upon the level of funding for each year throughout the length of the project. The above tabulation and Plate III summarize the proposed construction schedule.

16. **Project requirements**.

a. Dredged material disposal areas. - After potential disposal sites were reviewed with Federal and State fish and wildlife agencies, the Port of Sacramento and others, 15 sites were selected as acceptable disposal areas based on the established disposal criteria. All sites are land sites with a total capacity of approximately 31 million cubic yards, 9 million cubic yards more than anticipated for initial dredging. Final selection of sites to be used during construction will be made from these acceptable areas during preparation of plans and specifications. All sites will be diked to contain the dredged material, and interior cross dikes will be used to partition the sites to maintain effluent water quality at or above the standards established by the EPA and the State of California Water Resources Control Board. Table IV-2 summarizes the selected disposal sites and Plate I, Sheets 1-6, show the locations of these sites along with the channel alignment.

b. Right-of-way. - The Port of Sacramento will be responsible for acquiring all of the necessary rights-of-way and easements for dike construction, fish and wildlife mitigation facilities and dredged material disposal. Permanent easement or fee purchase will be necessary for rights-of-entry for the fish and wildlife mitigation area. Temporary disposal easements are necessary for the 4464 acres for the dredged material disposal sites. Selection of areas to be used during construction will be finalized during the preparation of plans and specifications.

c. Relocations. - Relocations of utilities and other improvements are the responsibility of the Port of Sacramento. There are several improvements crossing the ship channel that will require relocation prior to deepening or realigning the channel. These improvements include four gas lines and one submerged cable. Of these five improvements, all are owned and operated by Pacific Gas and Electric. The four gas lines are within the reach from Channel Mile 0.0 to the Rio Vista Bridge (CM 13.0). The submerged cable is located in the Cache Slough reach. The Port of Sacramento will be responsible for the relocation of utilities and improvements necessary for the development and use of the disposal areas. A complete listing of the known relocations is shown in Table IV-3.

TABLE IV-3

LIST OF RELOCATIONS

MILE	DESCRIPTION	OWNER
5.00	2-26" pipelines	Pacific Gas and Electric
7.00	2-12 3/4" gas lines	Pacific Gas and Electric
12.10	Natural gas line	Pacific Gas and Electric
12.50	2-10 3/4" gas lines	Pacific Gas and Electric
17.90	4000-V submerged cable	Pacific Gas and Electric

d. Effects of construction on navigation. - The effect of project construction and maintenance on large vessels navigating the waterway will be minimal since vessel sailings are scheduled. The contractor will coordinate with the Port of Sacramento in order to determine when the larger vessels will be using the waterway. The dredge discharge line can be disconnected in 30 minutes or less to allow vessel passage. Smaller vessels will be able to maneuver around the dredge. The discharge lines will be marked for safety and will not affect small craft navigation. The dredging operation will not be affected by small craft navigation.

e. Maintenance and operation.

(1) Channels. - Maintenance dredging of the channel is a Federal responsibility. The maintenance dredging will be accomplished by contracts and the dredged material will be placed on sites currently being used for maintenance disposal or sites provided by the Port of Sacramento.

(2) Navigation aids. - The initital installation and relocation of the navigation aids and the subsequent maintenance are the responsibility of the U.S. Coast Guard. The initial installation and relocation cost due to improvement of the channel has been estimated to be $550,000.

(3) Bank protection. - Maintenance of wavewash protection within the limits of the Sacramento River Deep Water Ship Channel project has divided responsibility. The Federal government has been responsible for bank protection upstream from Channel Mile 18.6 (the manmade portion of the channel). Bank protection downstream of Channel Mile 18.6 has been maintained by state and local interests because of the flood control use of the natural channels. Reclamation Districts along the ship channel are responsible for the maintenance of the bank protection within their District. The proposed enlargement will not affect the bank protection significantly. Therefore, there will be no change in the responsibilities for maintenance.

(4) Retention dikes. - In accordance with local cooperation requirements, retention dikes, bulkheads, and embankments required for maintenance dredging are the responsibility of the local sponsor.

(5) Levees. - Local interests will continue to be responsible for maintenance of all existing flood-control levees and assume responsibility for the maintenance of new or reconstructed flood-control levees (of which none are contemplated).

(6) Berthing areas and terminals. - The Sacramento-Yolo Port District will maintain and operate at non-federal expense adequate public berthing areas and terminal facilities to be served by the deepened channel. Dredging of the berthing area to the 35 foot depth (below - 2.0 NGVD) will be accomplished during the first dredging contract. The Sacramento-Yolo Port District will reimburse the Government for all costs of this work.

(7) Recreation Areas. - Maintenance and operation of any recreation facilities constructed as part of the project in the future will be the responsibility of the local agencies which participate in development of the areas as required by Public-Law 89-72.

(8) Fish and wildlife mitigation areas. - Maintenance and operation of fish and wildlife mitigation developments is a Federal responsibility. The Corps will be responsible for operation and maintenance. A post-construction monitoring program will be conducted by the Corps of Engineers to aid in the operation and maintenance of the area. The Port District will be required to cost share the operation and maintenance costs as specified in Chapter X, Local Cooperation and Appendix H, Local Cooperation Agreement.

17. **Departures from the Feasibility Report plan**. - The following paragraphs describe the departures from the project Feasibility Report and provide the rationale for the departures.

The following tabulation compares the feasibility report plan to the selected plan channel dimensions.

Channel Reach	Feasibility Plan		Selected Plan	
	Depth (ft)	Width (ft)	Depth (ft)	Width (ft)
Sacramento Deep Water Ship Channel				
New York Slough to Junction Point (CM 15.0)	35	400	35	350
Junction Point to Entrance to Manmade Channel (CM 18.6)	35	300	35	300
Entrance to Manmade Channel (CM 18.6) to the Port of Sacramento	35	250	35	250

a. New York Slough to Junction Point (CM 15.0). - The project Feasibility Report included a 400-foot wide channel from New York Slough (Pittsburg) to Junction Point (CM 15.0) to allow for ship maneuverability and rapid shoaling. A reevaluation of the conditions in the channel affecting navigation and the needs of the channel have resulted in the selection of a 350-foot wide channel. This width is consistent with the downstream channel which is presently being constructed to the 350-foot width at this time under the San Francisco Bay to Stockton Project. This channel width is both economically and environmentally more desirable than widening to 400 feet. Therefore, the New York Slough to Junction Point reach has been revised.

b. Recreation. - The Feasibility Report described one dredged material disposal area to be modified as a recreation site, i.e., Sandy Beach in Solano County (S-16). However, this site has already been developed by Solano County at their expense. Other sites were investigated for recreation potential, but no recreation is included due to a lack of non-Federal sponsors. Sacramento, Solano and Yolo Counties have expressed interest in trying to develop recreation sites as part of the project. If an acceptable plan is developed, recreation development could be added at a later date. Until then, recreation development will be deferred.

c. Fish and wildlife mitigation. - Due to changes in disposal sites and project requirements, the fish and wildlife impacts were reevaluated. The feasibility report plan included development of 45 acres of wetland habitat on Prospect Island and 156 acres of upland habitat on selected dredged material disposal areas. The current plan developed with the fish and wildlife agencies requires development of 63 acres of wetland and riparian upland habitat on Prospect Island to mitigate project impacts on fish and wildlife.

d. Salinity mitigation measures. - There are essentially no significant changes from the Feasibility Report plan. However, explanation of differences and similarities is required here for purposes of clarity. The Feasibility Report stated that "effects of channel deepening on salinity distributions would be monitored before, during, and after the channel deepening. If salinity distributions increased to unacceptable levels above preproject conditions as a result of channel deepening, a submerged sill or acceptable alternative would be constructed in Carquinez Strait to restrict the landward flow of more saline bottom currents." The Feasibility Report plan also provided for mitigation for salinity intrusion predicated on the results of additional model studies conducted at the Bay-Delta Model. An acceptable mitigative measure would be implemented concurrent with channel deepening activities if additional studies indicate that such a measure is warranted.

These additional model studies have been completed and indicate no significant adverse salinity impacts associated with the project except a possible impact to the firm yield of the SWP and the CVP. This potential firm yield impact is small and not clearly definable at this time. Therefore, based on the results of the additional studies referred to in the Feasibility Report, no salinity mitigation measure will be implemented concurrent with project construction. Instead, a salinity monitoring program coordinated with DWR and USBR will be conducted by the Corps prior to, during, and after project construction. If this monitoring program detects a measurable or significant impact to the firm yield due to increased salinity due to channel deepening, appropriate mitigative measures will be incorporated into the project. Additional model studies will be undertaken during the monitoring period to develop and assess alternate mitigation measures including those proposed in the past. This will enable a faster implementation of mitigation measures should they be necessary. These provisions are consistent with the Feasibility Report plan.

18. **Funding**. - Traditional cost-sharing has required that the Federal Government bear costs for construction of the navigation channel, fish and wildlife facilities, engineering, design, supervision and administration and navigation aids. The non-federal requirements include all lands and damages, relocations and preparation of dredged material disposal areas.

The cost-sharing agreement for the project has changed since the Feasibility Report plan. Non-federal interests are now required to provide a greater share of the project costs. The non-federal interest, the Sacramento-Yolo Port District, will be responsible to provide 25% of the total costs of construction of the general navigation facilities assigned to commercial navigation. They will also be required as in the past to provide all lands and damages, relocations, and preparation of the dredged disposal

areas. Federal costs will be limited to 75% of the total costs of construction of the general navigation facilities.

19. **Wetlands enhancement**. - The Feasibility Report plan described the potential for establishment of wetlands at Federal expense under the authorization of Section 150 of the 1976 Water Resources Development Act. At that time, it was proposed that Donlon Island be developed if it were not developed under the San Francisco Bay to Stockton project. No other additional sites were recommended at the time.

The Donlon Island site has since been developed. Several fish and wildlife agencies have only recently proposed the use of lower Sherman Island for enhancement. This feature is not included in the selected plan but will be investigated further prior to construction in the adjacent channel.

CHAPTER V - SUMMARY OF TECHNICAL STUDIES

20. **General**. - Technical studies were conducted to determine the physical and environmental effects of the selected plan. This chapter summarizes the studies conducted, methods used and conclusions. Details and references cited are given in Appendices E-G.

21. **Salinity studies**. - The possibility of increased salinity intrusion into the Delta is a major concern regarding the proposed project. The salinity concentrations in the Delta affect agricultural uses, Municipal and Industrial water supplies, and fish and wildlife needs. Because of this, the State of California has established salinity standards for the State Water Project (SWP) and Central Valley Project (CVP). Both the USBR and the State of California Department of Water Resources (DWR) have expressed concern that the deepening of Sacramento ship channel might require the water projects to release greater amounts of water to meet these standards. However, greater releases could impact the firm yield of the projects, thus reducing the water available for contracting. Therefore, studies were conducted as part of the feasibility studies to determine the effect of channel deepening on salinity and investigate measures to mitigate any increases in salinity, if necessary. As part of those studies, a submerged sill (underwater rock barrier) in Carquinez Strait was tested to determine its effectiveness as a mitigation measure. Tests were also conducted to determine whether future construction of the State's proposed Peripheral Canal would change the conclusions drawn from studies done without the Peripheral Canal. The results are presented in the July 1980 Feasibility Report and Environmental Impact Statement. A summary of these earlier salinity studies, as well as the more recent salinity studies, is given in this section.

a. Salinity studies during feasibility investigation.

(1) Studies performed. - Salinity studies conducted at the San Francisco Bay-Delta Model in 1978 were part of a joint effort to address the impacts of deepening the Stockton Ship Channel alone and the Sacramento River Deep Water and Stockton Ship Channels together from 30 to 35 feet. Both dynamic and steady-state tests were conducted at this hydraulic model of the bay and Delta system. Steady-state tests' main advantage is that, unlike dynamic tests, conditions are held constant, introducing less variance and allowing the effects of smaller changes to be detected. However, the effects detected are theoretical and cannot be compared to historical data as was the intent of dynamic tests. Both types of tests require considerable skilled subjective evaluation to interprete the results.

(2) Model tests. - The method used to determine if salinity intrusion results from channel deepening was a comparison of tests depicting before-and-after project conditions on a hydraulic model. Both base tests, before project, and plan tests, after project, were conducted at the Model with various hydrologic conditions intended to simulate actual conditions. The following paragraphs describe the testing conditions. Channel bathymetry for the tests is given in Table V-1.

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Table V-1
Channel Dimensions - Model Tests

Channel or Facility	Base		Plan	
	Depth	Width	Depth	Width
San Francisco Bar Channel	55	2000	55	2000
West Richmond Channel	*	600	*	600
Southampton Shoal Channel	35	600	35	600
Richmond Long Wharf	35	Irregular	35	Irregular
Pinole Shoal Channel	38**	600	38**	600
Carquinez Strait Channel and	45	700-800	45	700-800
Oleum, Port Costa and Martinez Maneuvering Areas	35*	Irregular	35*	Irregular
Suisun Bay Channel				
Martinez to Avon	35	300	35	300
Avon to Point Edith	30	300	35	600
Point Edith to Middle Point	30	300	35	600
Middle Point to Pittsburg	30	300	35	400
Stockton Ship Channel				
Pittsburg to Antioch via New York Slough	30	400	35	400
Antioch to Prisoners Pt.	35*	400	35*	400
Prisoners Pt. to Stockton	30	225	35	250
Sacramento Ship Channel				
Pittsburg to Mile 3.5	30	300	35	400
Sacramento River 3.5 to 15.0	30	300	35	400
Cache Slough 15.0 to 18.6	30	300	35	300
Manmade Channel 18.6 to 43.0	30	225	35	250

* Existing depth is naturally 35 feet or greater.
** Depth based on July 1981 Hydrosurvey, 35-feet depth channel was deepened to 38 feet (mean lower low water).

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(a) Base tests. - Base tests included the existing 1980 channel geometry and inflow and tidal conditions identical to the plan test conditions. Two dynamic salinity tests and two steady state salinity tests were conducted. These tests are described in Appendix E. The results of the four base tests were used for comparison with plan results.

(b) Plan tests. - Plan tests included several channel geometry, inflow and tidal conditions. Six dynamic salinity tests and six steady state salinity tests were conducted. Two of the dynamic and three of the steady state tests depicted the deepening of the Stockton Channel alone. Four of the dynamic and three of the steady state tests depicted the deepening of both the Stockton and Sacramento channels. In addition, a velocity test and a steady state test were performed on a submerged sill located in Carquinez Strait. These tests are described in Appendix E.

(3) Model Test Results. - The results of these tests showed that changes in salinity due to deepening the Stockton Ship Channel alone and the Stockton Ship Channel combined with the Sacramento River Deep Water Ship Channel deepening were smaller than the Model could accurately predict. The tests also revealed the Peripheral Canal would have no significant effect on test results and confirmed the effectiveness of the submerged sill as a mitigation measure. The water agencies were concerned the Bay Model could not measure relatively small increases in salinity which could require as much as 400 cubic feet per second (cfs) of additional Delta outflow to counteract the increases. Accordingly, salinity model tests were recommended.

As a result, the Corps agreed to address these concerns during post feasibility report studies. Specifically, the Corps agreed to determine the capability of the Model to detect small changes in salinity; to improve the capability, if possible; and to conduct additional tests to determine any salinity intrusion effects of the channel deepening work.

b. Post-feasibility report salinity studies.

(1) San Francisco Bay Delta Model. - The model was upgraded during the post-feasibility report studies. Substantial improvements in the model's operational equipment and capability have taken place since 1980. The current model description, instrumentation and operation procedures are described in Appendix E, Salinity Studies. To enhance model capability, the Corps designed, procured, and installed a minicomputer-based control system to automate model operations and to record and process data. The Corps also added state-of-the-art equipment to control water surface elevations and current velocities and to measure electrical conductivity for salinity determination. Automated salinity sensors and computerized data collection and analysis resulted in the following improvements:

- More data can be processed and analyzed in a shorter time. Data can be collected every tidal cycle whereas previous data was obtained only every 5 to 10 cycles.
- Human errors associated with data collection, recording and sample testing are minimized.
- Immediate examination of the data and on-the-spot adjustments are possible during model operation.
- Improvements in flow additions and channel depletions have been developed.

(2) Repeatability Studies and Results. - The Waterways Experiment Station was tasked to develop a repeatability testing program to define the capability of the improved model. The program is contained in Attachment A in Appendix E, Salinity Studies.

The approach adopted was to test a worst-case flow condition. If no impact was detected under this condition, it would be reasonable to assume no impact would occur during actual dry periods. To maximize the detection of small salinity differences, steady-state tests were run to reduce model noise to a minimum. The steady-state flow conditions and test approach were coordinated with the USBR and State DWR and their concurrence was obtained prior to testing. The preliminary test results were discussed with both agencies throughout the testing program.

The purpose of the repeatability program was twofold. One objective was to establish limits for model noise. The results were to be compared to determine the effect, if any, the change in channel geometry has on model noise variance. The flow conditions tested were termed "net Delta outflow" (4,480 cfs) and "Delta export" flow conditions (5,000 cfs). The other objective was to develop a statistically rigorous procedure for making base-to-plan comparison of model results. Deepening of the Sacramento River Deep Water and Stockton Ship Channel was used as the plan condition to make the base-to-plan comparisons. The statistical theory associated with the plan is included in Appendix E, Salinity Studies.

The initial test program consisted of three series of tests: Base 1, Plan 1, and Plan 2. Each series included seven tests. A second program was later added, consisting of two base tests. The relationship between these test series is listed in Table V-2. The channel bathymetry used in the Base and Plan tests is given in Appendix E and channel dimensions used in the Base and Plan conditions are given in Table V-1. In September 1985, in conjunction with the San Francisco Bay to Stockton Deepening project, the widening of the Suisun Bay Channel between Avon to Pittsburg to enable two-way traffic was deferred until such time as the need for a two-way channel is apparent. Presently, this is estimated not to occur for 20 years or more. The channel width for this channel reach instead of being widened from 300 to 600 feet will only be widened to 350 feet. The model tests for the plan condition included the 600 foot wide channel in this reach. The physics of salinity intrusion relate to both the depth and width. Although depth is certainly the most significant factor affecting salinity instrusion, significant changes in width are also an important factor. Therefore, the potential impacts on the Bay-Delta system as predicted by the physical model tests will likely be less than shown by the following test results as long as the channel width is only 350 wide in the Suisun Bay reach.

The results of the tests are reported in the report entitled San Francisco Bay-Delta Model; Repeatability Model, dated October 1984. The majority of the main text is included in Appendix E, Salinity Studies. The tests showed model noise ranged from about 0.2 to 0.3 ppt in the ocean and lower bay to as low as 0.004 ppt (4 ppm) in the Delta. Typical Delta values ranged from 0.01 to 0.03 ppt (10 to 30 ppm). Overall, there appeared to be no significant difference in model noise for Base 1 and Plan 1 tests.

Table V-2

Flow Conditions

Series	Prototype Geometry	Net Delta* Outflow (cfs)	Delta Exports** (cfs)
Base 1	Existing 1980 Channel Conditions	4,480	5,000
Plan 1	Deepen Sacramento and Stockton Channels to 35'	4,480	5,000
Base 2	Existing 1980 Channel Conditions	5,400	11,000
Plan 2	Deepen Sacramento and Stockton Channels to 35'	5,400	11,000

* Water Net Delta Outflow depends on annual precipitation, upstream reservoir releases and local water demands.

** Delta exports depend on legal commitments for CVP and State Water Project (SWP).

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The Plan 1 and Base 1 tests were run until all stations were stabilized at steady state (lunar day 220) and run for at least an additional 50 lunar days. (A lunar day is about 24 hours and 50 minutes.) The salinity values are steady-state values for lunar days 220 to 269. Base and Plan differ only in the channel dimensions of the Sacramento and Stockton ship channels. The following tabulation shows where a statistically signficant change in salinity had been modeled. The locations of the stations used in the Plan 1 and Base 1 tests are shown in Table V-3 and on Figure V-1. The Plan 1 versus Base 1 tests results are shown in Table V-4.

The repeatability tests results significantly narrowed the area of concern by indicating a slight shifting of salinity intrusion patterns for critically dry flow conditions. The increase noted at station 21 - bottom only, though statistically significant, is only 3 percent and would not affect beneficial uses of water. A 20 ppm increase at Station 23 (Rio Vista) was not considered significant. Although a statistical change was noted, the magnitude was so small that the actual impact was considered negligible.

Model results also showed some statistically significant decrease in salinity in the same general vicinity, which indicates a slight shifting might occur in salinity distribution with no change in overall Delta salinity.

(3) High export steady-state tests. - The repeatability test series identified one localized area in the Sacramento River near Decker Island that could be affected. The next step was to identify the range of the impacts. The initial repeatability testing, Plan 2 condition (5,400 cfs net Delta outflow, 11,000 cfs exports) and the two additional Base 2 flow condition tests were compared to determine project impacts for that flow condition (low net Delta outflow, high export). The results at all salinity locations for Plan 2 vs Base 2 are shown in Table V-5. The salinity values are steady-state values for lunar days 220 to 269. Base 2 and Plan 2 differ only in the channel dimensions of the Sacramento River Deep Water and Stockton Ship Channels. The table also notes if a statistically significant change had been modeled. The locations of the stations in Table V-5 appear on Figure V-1.

The results indicate a general decrease in salinity throughout the Bay Delta System at the low flow, high export flow conditions. However, most all these small decreases are not statistically significant. Notably, the Sacramento River at Decker Island (Station 22) showed a statistically significant decrease at this low flow, high export flow condition. This same station showed a significant increase at low flow, low export flow conditions.

(4) Summary of physical model test results. - Physical model test results show no significant adverse salinity effects throughout the Sacramento-San Joaquin Delta under average or dry conditions. These tests for the worst case critically dry flow condition show only a minor salinity redistribution resulting in no change or slight decreases in salinity at several locations in the Delta with small increases along the Sacramento River near Decker Island. This potential increase would be very small and would occur very infrequently.

TABLE V-3

SALINITY STATIONS

Station	Location	Sampling Depths (Feet)		
1A	Pacific Ocean South Bar	5	18	32
1B	Pacific Ocean Ship Channel	5	25	50
1C	Pacific Ocean Bonita Channel	5	33	62
1	Golden Gate	5	75	150
2	West of Alameda Channel	5		48
2A	San Mateo Bridge, South Bay		24	
2B	Dumbarton Bridge, South Bay		22	
3	Tiburon, Central Bay	5		54
4	San Pablo Strait	5		68
5	Pinole Point, San Pablo Bay	5		33
6A	Dillon Point, Carquinez Strait	5	33	62
7	Martinez, Carquinez Strait	5		39
9	Port Chicago, Suisun Bay	5		26*
11A	Chipps Island, Suisun Bay	5		46*
13	Antioch, San Joaquin River	5		27*
15	Jersey Piont, San Joaquin River	5		43
16	Twitchell Is, San Joaquin River	5		42
17	Webb Reach, San Joaquin River	5		32
18	Prisoners Pt, San Joaquin River	5		32
20	Wards Cut, San Joaquin River		13*	
21	Sherman Is, Sacramento River	5		23*
22	Emmaton, Sacramento River	5		21*
23	Rio Vista, Sacramento River		14*	
24	Hamilton Landing, Cache Slough		15	
24B	Sacramento Ship Channel		13*	
25	Steamboat Slough		4	
26	Isleton, Sacramento River		6	
29	Columbia Cut, Middle River		12	
30	Quimby Island, Old River		12	
31	Dutch Slough near Taylor Slough		7	
33	Woodward Island, Old River		13	
34	Woodward Island, Middle River		10	
35	West Canal, Clifton Court Forebay		13	
37	Empire Cut at Turner Cut		8	
L	Franks Tract, False River		6	
M	Holland Tract, Old River		10	
O	Entrance to Contra Costa Canal		2	
S	Terminous, South Fork Mokelumne R.		9	

* Indicates probes which were adjusted in the Plan Tests with the Deepening of the channels by 5 feet.

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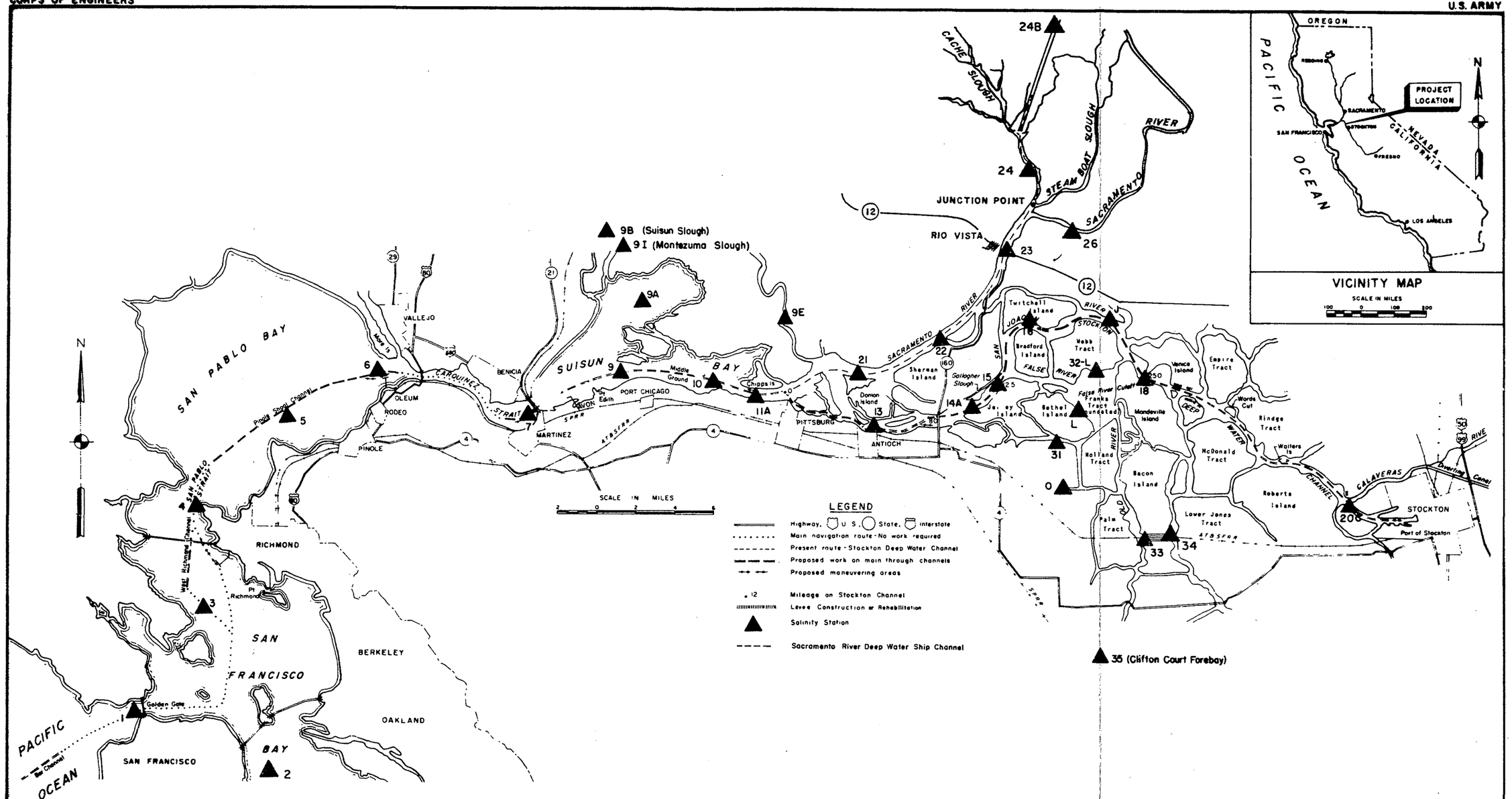

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CALIFORNIA

SALINITY STATIONS

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: B.S.
Drawn: T.W.B.
Date: AUGUST 1985

FIGURE V-1

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Table V-4

Low Net Delta Outflow, Low Export
Hypothesis Test Results - 90% Level of Significance

Station (See Footnote)	Salinity (ppt) Base 1	Salinity (ppt) Plan 1	Observed Diff., ppt	Statistical Changes in Salinity
1A+	32.29	32.53	+0.24	Increase
1A*	32.29	32.67	+0.38	Increase
1A-	32.45	32.71	+0.26	Increase
1B+	31.96	31.88	-0.08	No Change
1B*	32.37	32.57	+0.20	No Change
1B-	32.43	32.66	+0.23	Increase
1C+	32.28	32.52	+0.24	No Change
1C*	32.71	32.95	+0.24	No Change
1C-	32.78	32.99	+0.21	No Change
1+	31.98	32.10	+0.12	No Change
1=	31.82	32.10	+0.28	Increase
1*	31.94	31.99	+0.05	No Change
2+	31.08	31.33	+0.25	Increase
2-	31.24	31.52	+0.28	Increase
2A*	31.07	31.46	+0.39	Increase
2B*	31.32	31.53	+0.21	No Change
3+	30.84	31.13	+0.29	Increase
4+	27.95	28.18	+0.23	Increase
4-	29.67	29.73	+0.06	No Change
5+	27.68	28.03	+0.35	Increase
5-	28.10	28.68	+0.58	Increase
6A+	21.31	22.04	+0.73	Increase
6A*	22.54	23.06	+0.52	Increase
6A-	23.29	23.68	+0.39	Increase
7+	18.04	18.97	+0.93	Increase
7-	19.83	20.03	+0.20	No Change
9+	14.89	14.77	-0.12	No Change
9-	15.31	15.82	+0.51	Increase
11A+	8.41	8.42	+0.01	No Change
11A-	8.99	9.08	+0.09	No Change
13	4.50	4.49	-0.01	No Change
13-	4.72	4.66	-0.06	No Change
15+	1.63	1.53	-0.10	Increase
15-	1.71	1.66	-0.05	No Change
16+	0.77	0.68	-0.09	Decrease
16-	0.85	0.76	-0.09	Decrease
17+	0.30	0.26	-0.04	Decrease
17-	0.31	0.27	-0.04	Decrease
18+	0.28	0.26	-0.02	Decrease
18-	0.29	0.27	-0.02	Decrease
20*	0.30	0.29	-0.01	Decrease
21+	4.33	4.32	-0.01	No Change
21-	4.92	5.05	+0.13	Increase
22+	1.32	1.48	+0.16	Increase
22-	1.48	1.77	+0.29	Increase
23*	0.13	0.15	+0.02	Increase
24*	0.08	0.06	-0.02	Decrease
24B*	0.14	0.11	-0.03	Decrease
25*	0.07	0.05	-0.02	Decrease
26*	0.08	0.07	-0.01	Decrease
29*	0.30	0.30	0.00	No Change
30*	0.54	0.51	-0.03	Decrease
31*	1.06	0.98	-0.08	Decrease
33*	0.60	0.56	-0.04	Decrease
34*	0.39	0.39	0.00	No Change
35*	0.50	0.48	-0.02	Decrease
37*	0.31	0.29	-0.02	Decrease
L*	0.84	0.82	-0.02	No Change
M*	0.69	0.64	-0.05	Decrease
O*	0.67	0.63	-0.04	Decrease
S*	0.17	0.14	-0.03	Decrease

Footnote
+ - Measurements taken near the water surface.
* - Measurements taken at or near mid-depth.
- - Measurements taken near channel bottom.

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Table V-5
Low Net Delta Outflow, High Export
Hypothesis Test Results - 90% Level of Significance

Station (See Footnote)	Base 2 Ave Salinity Test 1	Base 2 Ave Salinity Test 2	Base Ave Salinity	Plan 2 Ave Salinity Range	Plan 2 Ave Salinity Ave	Std Dev	Difference	Statistically Significant Change in Salinity
1+	32.35	32.42	32.38	31.96-31.99	31.98	0.01	-0.40	Decrease
1=	32.53	32.39	32.46	32.15-32.60	32.35	0.14	-0.11	No Change
1*	32.69	32.62	32.66	32.25-32.67	32.42	0.16	-0.24	No Change
2+	31.28	31.17	31.22	30.59-30.89	30.69	0.10	-0.53	Decrease
2-	31.73	31.51	31.62	31.18-31.47	31.37	0.09	-0.25	Decrease
2A*	32.24	31.32	31.78	31.00-31.38	31.14	0.14	-0.64	Decrease
2B*	31.91	31.55	31.73	31.52-32.01	31.75	0.18	-0.02	No Change
3+	31.31	31.20	31.26	30.77-31.35	31.04	0.19	-0.22	No Change
3-	32.04	32.00	32.02	31.22-31.70	31.47	0.16	-0.55	Decrease
4+	28.24	27.79	28.02	26.78-27.88	27.29	0.35	-0.72	Decrease
4-	30.14	29.89	30.02	29.10-29.72	29.34	0.24	-0.68	Decrease
5+	27.60	27.38	27.49	26.67-27.16	26.86	0.16	-0.63	Decrease
5-	28.47	28.12	28.30	27.49-28.00	27.65	0.26	-0.65	Decrease
6A+	20.67	20.37	20.52	19.75-20.54	20.15	0.27	-0.37	No Change
6A-	23.23	22.96	23.10	22.40-22.87	22.62	0.14	-0.48	Decrease
6A*	22.43	22.17	22.30	21.69-22.17	21.89	0.15	-0.41	Decrease
7+	17.59	17.38	17.48	17.12-18.03	17.63	0.32	-0.15	No Change
7-	19.58	19.21	19.40	18.67-19.36	19.04	0.24	-0.36	No Change
9+	13.56	13.14	13.35	12.39-13.50	13.01	0.43	-0.34	No Change
9-	14.39	14.02	14.20	13.82-14.66	14.14	0.30	-0.06	No Change
11A+	6.82	6.27	6.54	5.88- 6.44	6.17	0.21	-0.37	No Change
11A-	7.51	7.10	7.30	6.81- 7.40	7.10	0.20	-0.20	No Change
13+	3.66	3.36	3.51	3.24- 3.61	3.43	0.12	-0.08	No Change
13-	3.72	3.42	3.57	3.32- 3.64	3.49	0.11	-0.08	No Change
15+	1.87	1.69	1.78	1.59- 1.89	1.74	0.11	-0.04	No Change
15-	2.01	1.80	1.90	1.77- 2.01	1.88	0.09	-0.02	No Change
16+	1.15	1.02	1.08	0.94- 1.08	1.01	0.06	-0.07	No Change
16-	1.20	1.06	1.13	1.01- 1.15	1.07	0.05	-0.06	No Change
17+	0.50	0.43	0.46	0.40- 0.51	0.45	0.04	-0.01	No Change
17-	0.53	0.46	0.50	0.42- 0.52	0.47	0.04	-0.03	No Change
18+	0.33	0.29	0.31	0.27- 0.32	0.29	0.02	-0.02	No Change
18-	0.35	0.31	0.33	0.28- 0.33	0.30	0.02	-0.03	No Change
20*	0.31	0.29	0.30	0.24- 0.29	0.27	0.02	-0.03	No Change
21+	2.80	2.55	2.68	2.41- 2.77	2.60	0.12	-0.08	No Change
21-	3.32	3.08	3.20	2.99- 3.21	3.11	0.09	-0.09	No Change
22+	0.70	0.61	0.66	0.54- 0.63	0.59	0.03	-0.07	No Change
22-	0.71	0.63	0.67	0.57- 0.65	0.60	0.03	-0.07	Decrease
23*	0.11	0.09	0.10	0.08- 0.09	0.09	0.00	-0.01	Decrease
24*	0.05	0.05	0.05	0.04- 0.06	0.05	0.01	0.00	No Change
24B*	0.09	0.10	0.10	0.09- 0.12	0.10	0.01	0.00	No Change
25*	0.06	0.09	0.08	0.05- 0.07	0.06	0.01	-0.02	Decrease
26*	0.07	0.08	0.08	0.06- 0.07	0.07	0.00	-0.01	Decrease
29*	0.36	0.34	0.35	0.29- 0.35	0.32	0.02	-0.03	No Change
30*	0.73	0.64	0.68	0.59- 0.70	0.65	0.04	-0.03	No Change
31*	1.55	1.39	1.47	1.29- 1.54	1.40	0.10	-0.07	No Change
33*	0.83	0.73	0.78	0.68- 0.80	0.74	0.05	-0.04	No Change
34*	0.37	0.34	0.36	0.30- 0.41	0.36	0.05	-0.00	No Change
35*	0.53	0.48	0.50	0.44- 0.50	0.48	0.02	-0.02	No Change
37*	0.30	0.26	0.28	0.23- 0.29	0.27	0.02	-0.01	No Change
L*	1.26	1.10	1.18	1.02- 1.27	1.13	0.10	-0.05	No Change
M*	1.06	0.95	1.00	0.88- 1.07	0.98	0.08	-0.02	No Change
O*	0.97	0.86	0.92	0.79- 0.95	0.88	0.06	-0.04	No Change
S*	0.15	0.13	0.14	0.11- 0.13	0.12	0.01	-0.02	Decrease

Footnote
+ - Measurements taken near the water surface.
* - Measurements taken near mid-depth.
- Measurements taken near the channel bottom.

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22. **State Department of Water Resources firm yield operations studies.**

a. General. - Results of the two series of Plan vs Base comparisons were coordinated with the DWR and the USBR. Both agencies indicated that a salinity increase in the Sacramento River at Emmaton may reduce the firm yield of the SWP and CVP. They suggested computer simulations be required to estimate reductions in firm yield. The DWR agreed to conduct the studies and the results are discussed below. The USBR was unable to do an independent study due to other work priorities but indicated they would review the DWR firm yield operations studies (computer simulations).

The Bay Delta model tests are the most reliable indicator of the deepening project impacts. However, these physical model tests provided data for only two steady-state flow conditions on which to base an estimate of project impacts. While these data points are critical ones, the State Water Operations computer simulation requires several dynamic flow conditions for input data which is generally not available. The State computer simulations were developed using assumed data for several varied dynamic conditions. These various assumptions were developed to cover the range of actual conditions that the DWR, USBR and the Corps, could expect to occur.

DWR conducted two separate firm yield analysis utilizing two different approaches. The first approach, Method 1, was an empirical approach to determine project impact by assuming various changes in the salinity outflow relationship at Emmaton based on the percentage impact change shown by the Base 1 vs. Plan 1 physical model test results. The second more theoretical approach, Method 2, was based on using a salinity gradient relationship between Collinsville and Emmaton as derived from steady state physical model test results for the base (Base 1) and channel deepening (Plan 1) cases. The first method was included in the draft GDM. The second method was developed after the first method was complete and in response to perceived inaccuracies related to the initial evaluation. The second method was not completed in time to include in the draft GDM. The following paragraphs describe the study assumptions, tests and analyses conducted by the DWR using both methods.

Given the complexity of the real world condition, the approach adopted by the agencies was to test worst case conditions. If these conditions showed no or negligible impact, then it could be assurred that there would be no impact. The disadvantage of this approach is that nothing specific is learned if it shows some impact. That is, the potential impact is not quantified. However, given this and considering the difficulties of developing appropriate input data, it was decided by DWR, the USBR and the Corps that this was the only rational approach. The results were examined closely for reasonableness and consistency as compared to the state-of-the-art physical model test results and the knowledge of the actual behavior of the Delta system.

b. Study assumptions. - There are several assumptions associated with the tests. Since the purpose of the tests was to evaluate differences between a plan (Sacramento River Deep Water and Stockton Ship Channels, 35 feet deep) vs. a base (1980 condition Sacramento River Deep Water and Stockton Ship Channels, 30 feet deep) condition, the most important assumptions are those which significantly affect those differences. A complete listing of assumptions is given for both methods in Appendix E. The major assumptions are discussed below.

(1) Firm yield. - The objective of the operations runs was to determine the effect (potential loss) on firm yield to the State Water Project (SWP) and the Central Valley Project (CVP). The water project firm yield is that amount of water which can be delivered to users during a critical dry period. This firm yield is based on iterative calculations of optimizing water deliveries during the historically driest period of record. In California, the period used to calculate the firm yield is from May 1928 through October 1935. The computed firm yield is used by DWR and USBR to determine the amount of water that each agency can sell on a long term basis.

(2) Water quality standards. - The water quality standard at a specific site may require the release of SWP and CVP water from upstream reservoirs. Since the channel deepening could potentially increase salinity at the Emmaton station (Sacramento River near Decker Island-Station 22) during low flow years, the only time an adverse project impact might occur is when the controlling station (in determining upstream water releases) is at the Emmaton station. The study assumes State Water Quality Control Board Decision 1485 (D-1485) water quality standards will be maintained throughout the critical dry period. A summary of those standards has been included in Appendix E. In addition, the recently negotiated "Coordinated Operation Agreement" between the USBR and the State requires the USBR to operate the CVP to meet Delta salinity standards.

(3) Study procedures. - Test results from physical model results were for only two steady-state (constant) flow conditions. The steady-state tests maximize the model's ability to detect differences but only evaluate theoretical flow conditions. Method 1 uses previously developed DWR and USBR empirical relationships which show that salinity at a station is a function of the current month's net Delta outflow, the previous month's net Delta outflow, and the previous several months' bulk volume[1/] flows passing that location. These relationships attempt to replicate dynamic flow conditions which the steady-state tests cannot simulate. Method 2 applies the steady state model results to solve the established salinity transport equations to derive before project and after project salinity-outflow relationsips at Emmaton. Both methods assumed the long term steady state impact identified by the first series (Plan 1 vs Base 1) of Bay-Delta Model results were equal to the dynamic project impact for the prototype. Since the salinity in the prototype is highly dependent on antecedent conditions (memory effect), both methods will overestimate project impacts. Therefore, project impacts resulting from these studies will identify only the maximum potential impact. The firm yield studies presented herein do not define the minimum potential impact.

(a). Method 1. - The first method modified the empirically derived salinity vs. outflow relationship developed for Emmaton by a percentage adjustment based on steady-state results to account for project effects. Several possible project impact curves for the Emmaton Station were developed using various extrapolations of steady-state Bay Delta model test results and are shown in Figure V-2. At the 4400 cfs net Delta outflow, the

1/ Bulk volume flow is the amount of water passing that location over a specified time period.

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physical model tests show a salinity change from 1.400 ppt (TDS) to 1.625 ppt - an increase of .225 ppt or about 16% above the base condition. For all curves there is no impact at a flow equivalent to the 5,400 cfs net Delta outflow run in the model tests. Physical model tests actually showed some salinity decrease at that flow condition, but this was not included in the analysis which represents another conservative assumption.

An initial assumption for Curve A was zero impact at flows of 5400 cfs and above, and a 16 percent impact at 4400 cfs net Delta outflow (NDO) since only two theoretical points were known. This curve assumed a linear increase for flows below 4400 cfs. Curve A, however, did not consider the differences between the net Delta outflow (which can be measured in the Bay Delta Model) and the net Delta outflow index used in the State operation studies. A 1982 USBR preliminary study[1/] showed differences between the Model's net Delta Outflow and net Delta Outflow Index. Generally, the Bay Delta model requires more Delta outflow than shown by the Delta outflow index (used in the computer operations runs) to achieve the same absolute salinity values. This difference varied at each location but was about 500 cfs at the Emmaton Station. Thus, the physical model tests' net Delta outflows of 5400 cfs and 4400 cfs translate into 4900 cfs and 3900 cfs, respectively, for comparable river flows.

Curve B is based on the same assumptions as Curve A except the 500 cfs outflow difference is accounted for in the curve. Curve B places no impact at 4900 cfs net Delta outflow (NDO) and a 16% impact at 3900 cfs net Delta outflow (NDO).

Curve C assumes a 16% impact for all flow conditions.

Curve D shows no impact for flows of 4900 cfs NDO and above and increases linearly to a maximum 16% impact at flows of 3900 cfs NDO and below.

Curve E also shows no impact for flows of 4900 cfs NDO and above. The project impact increases linearly from 0 ppm impacts at 4900 cfs to 225 ppm at 3900 cfs and lesser flows.

(b). Method 2. - The second approach developed by DWR is a theoretical approach to estimate project impacts on the firm yield of the CVP and SWP system based on a theoretically developed salinity gradient relationship between the Collinsville and Emmaton stations. Under Method 2, the Emmaton salinity standards are satisfied not directly at Emmaton but through Collinsville due to two major reasons. First, established regressional salinity versus outflows relationships used at all Delta stations are based on historically recorded data. However, the required historical salinity versus outflow data is non-existant. Secondly, the COE's physical model studies showed that no impact was found at Collinsville due to deepening the Ship Channel. For these reasons, it is felt that the historically derived regressional salinity versus outflow relationships at Collinsville are still valid. For these reasons, the Salinity versus outflow

1/ Preliminary Draft comparison of prototype Delta outflow salinity relationship in the Sacramento-San Joaquin Delta and the relationship measured estimated by the US Army Corps of Engineers San Francisco Bay Delta Model, USBR, July 1982.

PROJECT IMPACT CURVES FOR EMMATON

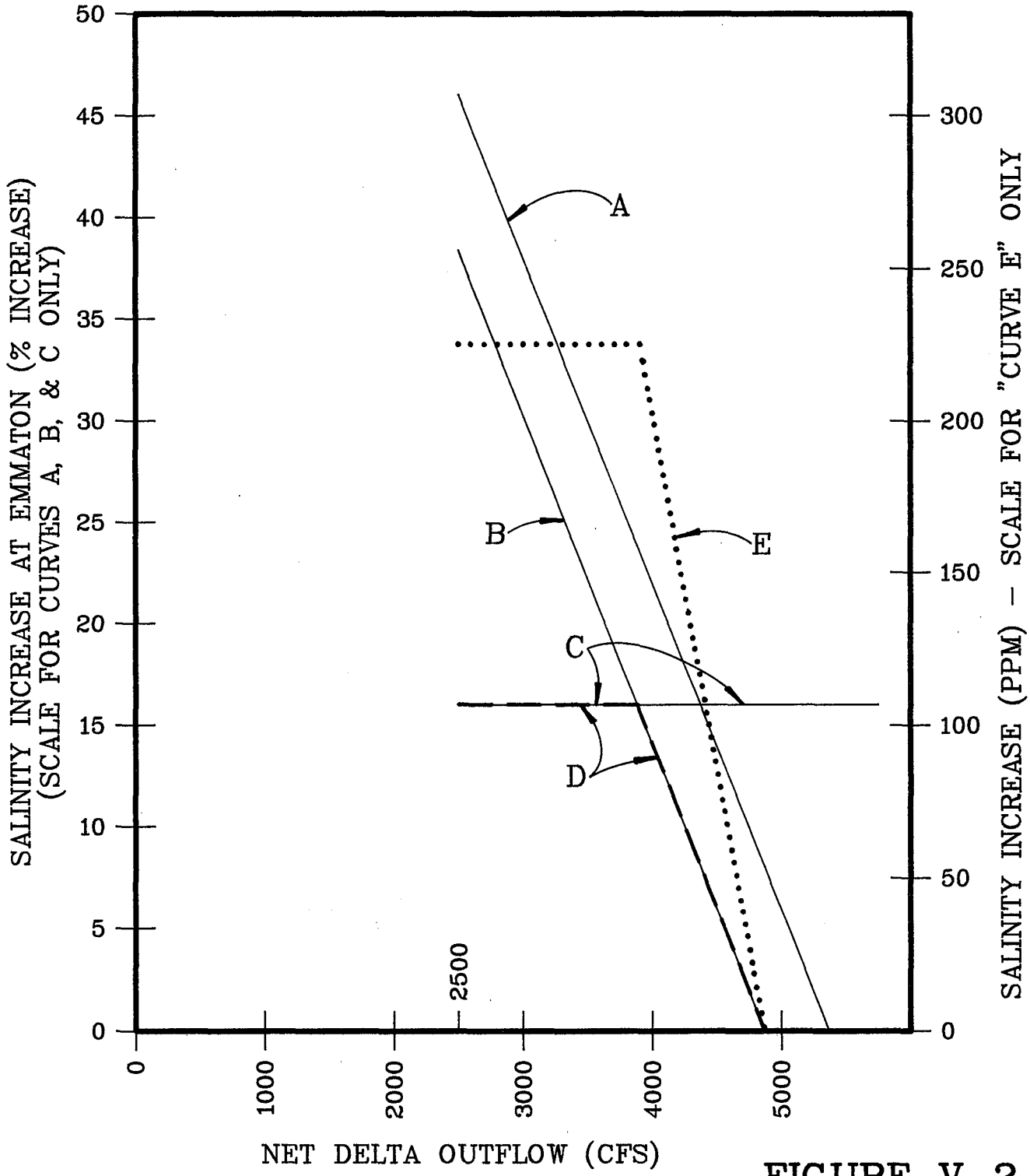

FIGURE V–2

relationships derived for Emmaton are transferred to Collinsville resulting in two standards at Collinsville, i.e., D-1485 Collinsville salinity standard and D-1485 Emmaton standard transferred to Collinsville. The transfer of the Emmaton standard to Collinsville is partly based on the Corp's physical model results by using two steady-state physical model results; base 1 (30 ft. depth) and plan 1 (35 ft. depth) runs with 4,480 cfs of Delta outflow. Base 2 and Plan 2 test results were not used. The Base 1 and Plan results were:

Station	Salinity (PPT) Base	Plan
Emmaton	1.40	1.62
Collinsville	4.63	4.68

Steady-State, one-dimensional, advection-diffusion equation for salinity transport can be written as,

$$\frac{\partial (QS)}{\partial X} - AE \frac{\partial^2 S}{\partial X^2} = 0$$

Where Q = flow rate
S = salinity
A = flow area
E = dispersion coefficient

Rewriting the equation in finite difference form between the Emmaton and Collinsville stations, the above equation can be reduced to,

$$Q \left(1 + \frac{2\ S_{22}}{S_{21} - S_{22}}\right) = \frac{2AE}{\Delta X} = K'$$

Where S_{22} = Salinity at Emmaton
S_{21} = Salinity at Collinsville
ΔX = distance between Emmaton and Collinsville

Assuming E remains constant for base and plan conditions respectively, the values of k' can be obtained using the physical model results.

k' = 8364 ft^3/Sec for base condition
k' = 9224 ft^3/Sec for plan condition

These k' values are then used to transfer Emmaton salinity standards to Collinsville for both base and plan conditions. The transfer is made using the following equation.

$$S_{21} = S_{22}\left(\frac{K' + Q}{K' - Q}\right)$$

The required outflow (Q) to maintain Collinsville salinity (S_{21}) can be computed for rearranging by the following regression equation and solving for Q.

$$S_{21} = \frac{e^{19.795875}}{Q^{0.510981}\ Q_{P_1}^{0.600025}\ V_{12}^{0.205131}}$$

Where e = natural logarithm base
Q = required outflow
Qp_1 = previous month outflow
V_{12} = previous 1 month cumulative outflow (volume)

The validity of the approach was tested by comparing it against historic data. The salinity at Emmaton (Station 22) and Collinsville (Station 21) were computed using the proposed method and plotted at various levels of Delta outflow (see Figure V-3). Also plotted in Figure V-3 are historic values of S-22 and S-21 recorded during the 1977 drought period.

c. Study Results. - The results from both approaches are summarized below.

(1). Method 1. - Project impacts on firm yield are shown on Table V-6 and are based on the extrapolated curves previously shown in Figure V-2. All of the scenarios described have serious flaws in regards to quantifying an impact. They do not acknowledge the fact that as the Delta outflow is reduced to zero, any impact due to deepening must also reduce to zero and the positive impacts of any redistribution of salinity levels is also not considered. Also, a review of historic river flows and salinities shows a considerable influence of previous months flows as well as current months flows on salinity. This dynamic, or carryover, effect is not fully recognized by the assumptions, as the physics of this effect is not fully understood. In addition, the steady-state Bay Model results used as input to this method could exaggerate the project impacts.

Table V-6

METHOD 1
Worst Case Analysis

Project impacts for various assumed curves
Impact on Project Yield with Interim Suisun Marsh Standards
Estimated Impact (TAF)1/

Scenario	SWP	CVP	Total
A	22	89	111
B	12	56	68
C	55	91	146
D	5	32	37

Impact on Project Yield with Permanent Suisun Marsh Standards

Estimated Impact (TAF)1/

Curve	SWP	CVP	Total
A	23	92	115
B	14	55	69
C	53	100	153
D	8	31	39
E	7	23	30

1/ Thousands of Acre-feet

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COLLINSVILLE VERSUS EMMATON SALINITY

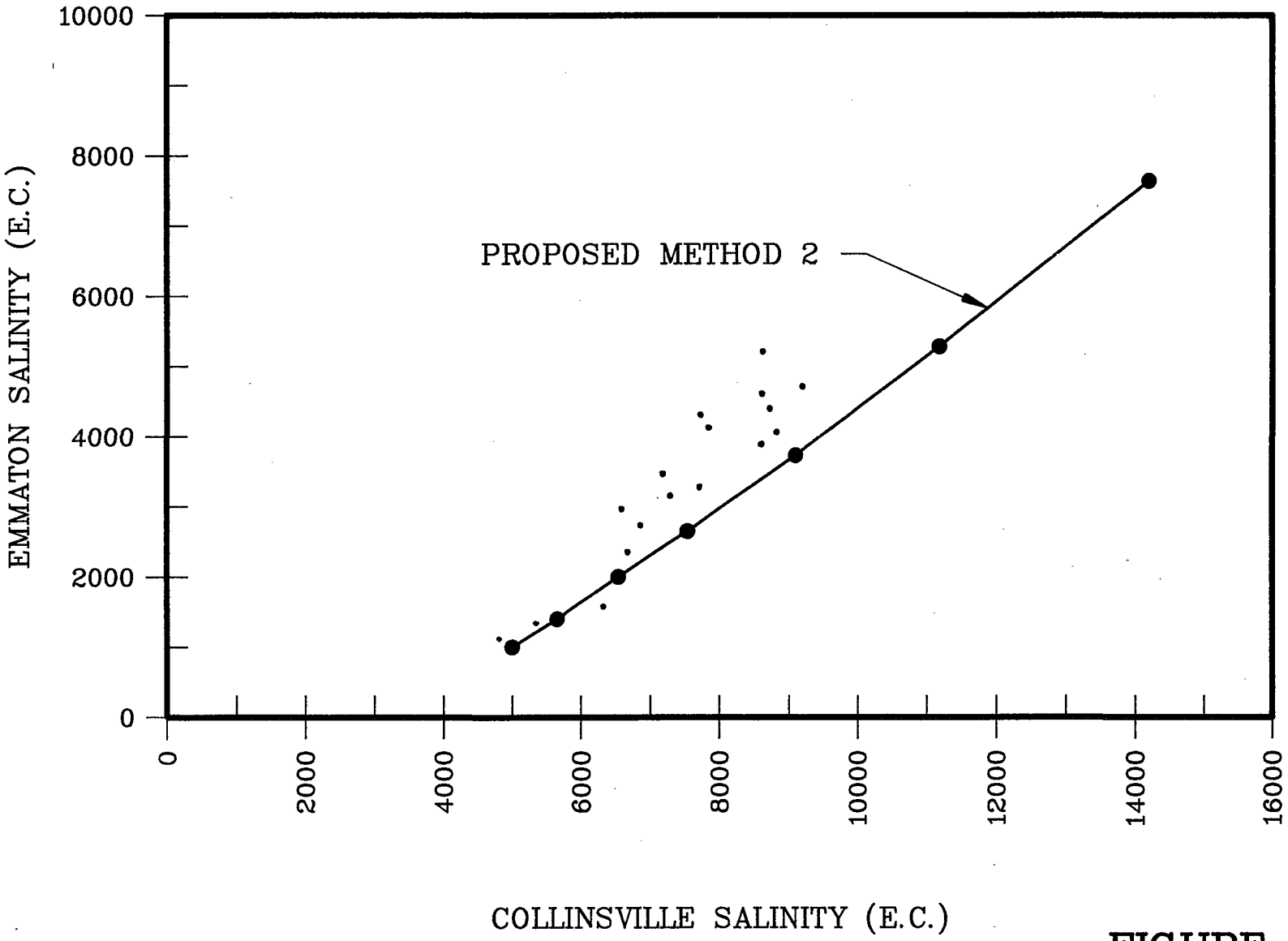

FIGURE V–3

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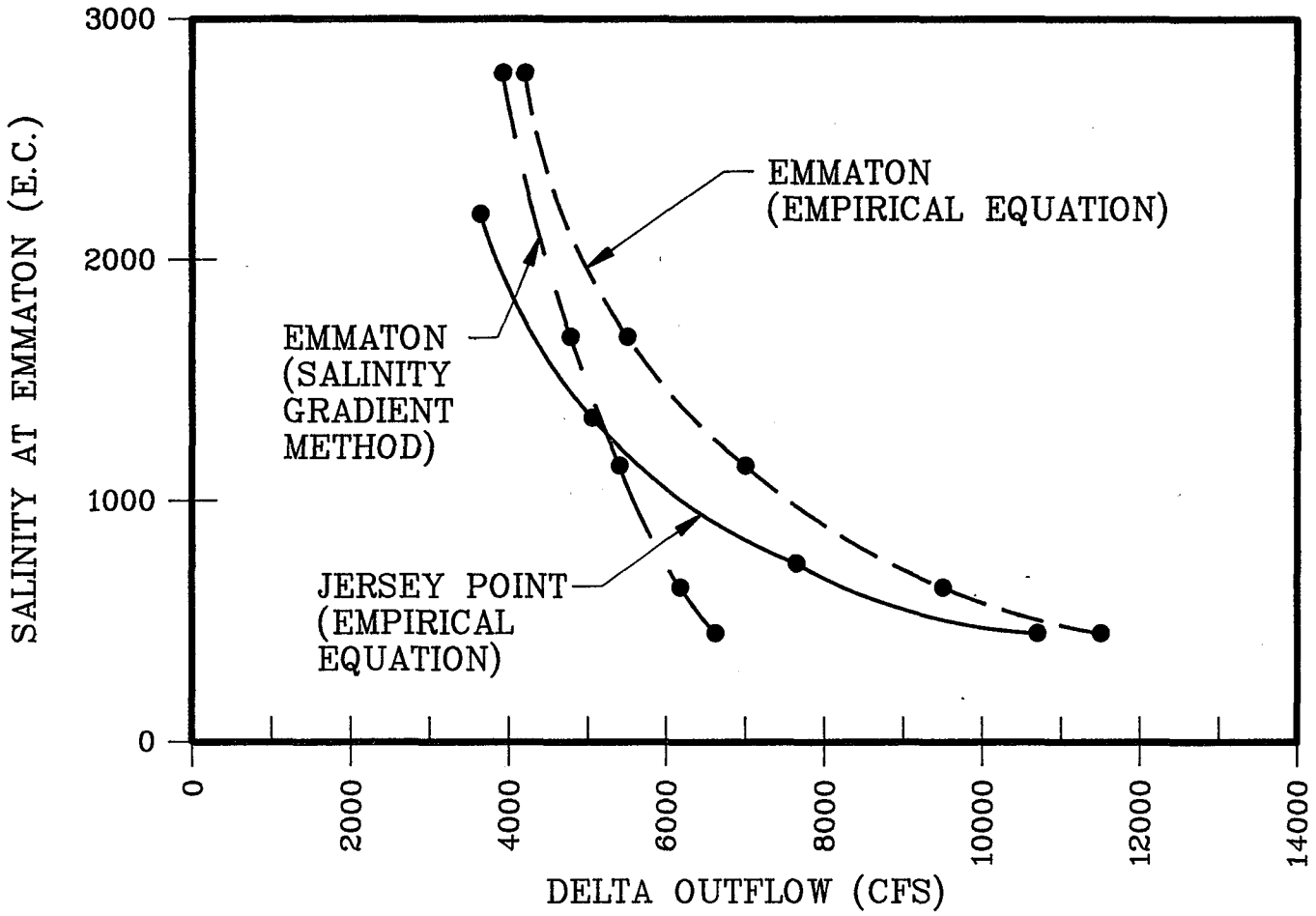
There are several interrelated reasons for this exaggeration. Curve B assumes the percentage impact increases to 43% at a 2,500 cfs NDO. Indeed, an examination of the detailed operations run data shows that the large impacts on firm yield are due to large percentage adjustments to salinity during critical dry years where flows drop to the 3000 cfs NDO range during the summer months. Data from the 1978 model tests presented in the Feasibility report (Plan D-1 1977 Hydrology dynamic test) show a 3 to 4 percent increase at Station 22 at higher salinities. This shows that the percentage impact decreases at higher salinities. Due to these considerations, both DWR and the Corps agree, impacts calculated for curves A, B and C are not a valid measure of even a worst case analysis of project salinity impacts.

(2) Method 2. - The salinity outflow relationship developed using the salinity transport equation and Bay Delta model results do not agree with the empirically derived regressional relationships developed for Collinsville and Emmaton. This is to be expected since the theoretical idealized equations can never duplicate the actual prototype. The Collinsville Station is situated in a location where it is influenced by both San Joaquin River flows and Sacramento River flows (the equation assumes otherwise). However, by running both the base and plan conditions (in which the salinity gradient equation is used to transfer the Emmation standard to Collinsville) the inconsistencies are minimized so that the differences can generally be attributed to potential impacts of the channel deepening.

DWR operation run results initially predicted a 15,000 acre-feet reduction in firm water yield. However, the detailed run showed the Jersey Point standard controlling more often for the base run than it did using the historically derived empirical equations. This inconsistency can be attributed to the differences between the salinity gradient relationships and the empirical relationships. The empirical salinity relationship at Emmaton and Collinsville were compared with the salinity gradient relationships. This is shown in Figure V-4. The new relationship reasonably agrees with historic data at the lower Delta outflows but diverges at the higher Delta outflows. Therefore, DWR reasoned that the inconsistencies between the different types of equations may be masking the project impacts by making them appear to be less than what actually will occur. However, the extent of this bias is unknown. Therefore, DWR conducted another series of base and plan runs deleting the Jersey Point standard. This forced the Emmaton stations to control much more often (where there is a potential project impact) resulting in a much greater firm yield difference. Since the Jersey Point standard controls more often in the actual prototype, the maximum impact of 59,000 acre feet (which assumed Jersey Point never controlled) is too high. Based on these two sets of evaluations, DWR estimates the maximum firm yield impact as about 35,000 acre-feet per year. See correspondence in Appendix J. Project impacts on the firm yield for the two sets of base and plan runs are given in Table V-7.

d. Analysis of firm yield studies. - DWR, USBR, and the Corps agree the second more theoretical method is a more reasonable approach to calculate potential reductions to the firm yield of the CVP and SWP system. Both methods estimate maximum potential impacts of about 35,000 acre-feet. Therefore, the maximum impact is minor, less than 1/2 percent of a combined firm yield of the CVP and SWP. However, since both used the worst case approach, the studies have not defined a minimum impact since underlying

COMPARISON OF EMPIRICAL EQUATION VS. SALINITY GRADIENT EQUATION



NOTES:

1. ALL CURVES ARE FOR STEADY STATE CONDITIONS.
2. EMPIRICAL EQUATION IS DERIVED FROM HISTORICAL SALINITY REGRESSIONAL RELATIONSHIPS.
3. SALINITY GRADIENT METHOD IS METHOD 2.

FIGURE V–4

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TABLE V-7

Method 2-DWR Firm Yield Studies

Study[1/] I.D.	Exports (TAF/Yr) CVP	SWP	End Storage (TAF)		Impact (TAF/Yr) CVP	SWP	Total
36A	3112	2310	1133	916	11	5	16
37A	3102	2308	1125	900			
Difference	10	2	8	16			
36C	3399	2430	1060	884	40	19	59
37C	3369	2414	997	868			
Difference	30	16	63	16			

1/ In the table, the prefix 36 and 37 denote base and plan conditions, respectively, while postfix A and C denote conditions with and without the Jersey Point Standards, respectively. Differences in End Storages (TAF) are converted to annual figures (TAF/Yr.) by dividing by factors of 6.3 and 5.8 for the SWP and the CVP, respectively.

assumptions in both methods maximize the calculated impact. For example, both methods use physical model steady state results as if they were derived for a dynamic flow condition. This conflicts with DWR empirical salinity-outflow equations which shows salinity is strongly correlated with prior months net Delta outflow and the previous months bulk volume flows passing at location. The inclusion of this "memory effect" in the firm yield studies would reduce (and may be even eliminate) the calculated firm yield impacts. In addition, the theoretically developed salinity-gradient relationship used to estimate project impact shows significant differences between the base and plan relationship for flows greater than 5,400 net Delta outflow. Hence, the method was attributing adverse project impacts to the prototype during average, dry and wet years. This conflicted with physical model test results which showed no project effects when flows exceed 5,400 net Delta outflow (a dry year flow). Although flows generally do not get very high during the historic dry period of record on which the firm yield is based, this effect, nevertheless, would overstate the actual impacts in the prototype.

In addition, channel dimensions tested at the Bay-Delta model for the plan condition are for a channel width of 600 foot wide (300 is the existing width) along 13 miles of the Suisun Bay Channel from Avon to Pittsburg. In September 1985, the Corps decided to construct only a width of 350 feet. A width reduction of 250 feet from the model test dimensions. Widening to 600 feet has been deferred for the foreseeable future (probably at least 20 years) until the navigation traffic justifies a two-way channel. Although the depth of the channel is the most important factor in the physics of salinity intrusion, large changes in width also significantly effect salinity intrusion. Therefore, the impacts on the Bay-Delta system as predicted in the physical model test contained herein will be less than shown as long as the 350 foot channel remains in the Suisun Bay Channel from Avon to Pittsburg.

e. Conclusion of salinity study results. - The results of a worst case analysis show a potential decrease in firm water yield because of the requirement to release water from storage to meet water quality standards. Based upon reasonable estimates to date, the maximum potential impact to the firm yield of the SWP and CVP could be as much as 35,000 acre-feet. Discussions with USBR and DWR indicate the minimum impact on the firm water yield cannot be defined at this time. Currently, the best analysis of current impacts is the physical model test at the Bay-Delta model. Further physical model tests, however, would not likely yield conclusive results of the project effect on firm water yield. The Corp's tests also show that the potential impact, if any, would only occur in critical dry years, which occur infrequently. Detailed analysis using state-of-the-art equipment has not been able to quantify actual project impacts, if any. A salinity monitoring program to be conducted prior to, during, and after completion of project construction has been established. This was determined to be the best method for conclusive definition of project impacts. If a significant and measurable increase in salinity is identified, the Corps will provide appropriate measures to mitigate for that increase.

23. **Salinity mitigation alternatives**. - If the monitoring program identifies an increase in salinity due to channel deepening, mitigation features would be constructed. These measures could consist of the submerged sill previously identified in feasibility studies or smaller temporary structures that would be employed during very dry years. Another alternative would be the use of CVP water for navigation purposes. Possible use of CVP water for navigation purposes is discussed in a November 30, 1984, letter from the District Engineer, Sacramento District Corps of Engineers, to the Regional Director, USBR, and USBR's letter reply dated February 8, 1985. Both letters are contained in Appendix J. If mitigation is needed, technical feasibility,environmental feasibility and economics will determine the best mitigation technique. Concurrent with the monitoring program, studies and/or modeling tests will be conducted to identify acceptable mitigative measures.

24. **Seepage studies**. - H. R. Cedergren, consultant under contract to the Corps, conducted a study to assess existing seepage conditions along the banks of the ship channel, evaluate the anticipated effect that a 5-foot deepening of the ship channel would have on existing seepage rates, and determine if any anticipated effects could be measured within an accuracy of other variables that affect seepage.

a. Methods. - The study included the following tasks: (1) site visits, (2) a literature review, (3) preparation of cross sections, (4) calculation of flow nets, (5) analysis of ground water seepage before and after dredging, and (6) prediction of effects.

(1) Site visits. - To obtain first-hand information about conditions along the channel, the consultant visited lands on both sides of the deep water channel by ground vehicle on April 5 and 6, 1983, and made both air and ground inspections by helicopter on April 7, 1983.

(2) Literature review. - The literature survey provided historical background on the design and construction of the ship channel, as well as valuable information on the geology, hydrology, hydraulics, topography, etc., of the area.

(3) Cross sections. - Cross sections were taken at 20 locations along the channel to depict the geometrical conditions and to determine the distances between the channel and the levees protecting developed lands along the channel.

(4) Flow nets. - Because of the presence of the Yolo Bypass along portions of the right side of the channel (looking downstream), and most other lands on this side being either undeveloped or at high elevations relative to water in the channel, flow net analyses concentrated on five locations along the left side of the channel (looking downstream). Only one flow net pair was constructed for a property on the right side.

These five locations selected represent the varying soil conditions along the channel. At each location, one flow net was constructed for "existing" or "before" conditions and another for conditions "after" dredging. Then the "relative" seepage quantities after dredging were compared with those before dredging.

b. Assumptions. - All flow nets for "existing" conditions were developed for sections with the bottom of the channel assumed to be completely covered with sediments or in-place materials having coefficients of permeability 1/100 of those of underlying sands that are presumed to exist under each cross section. Borings indicate that sandy formations occur at moderate depths below the lower permeability soils at most locations; however, the assumption that such formations are continuous is felt to be rather severe (in relation to possible increases caused by the dredging). In addition, all flow nets for the "after" dredging conditions were for the assumption that the sediments are completely removed from the channel bottom or that existing low-permeability formations are reduced in thickness by 5 feet. Both of these assumptions are also conservative; therefore, the actual influence of the dredging will probably be much less than is estimated from the flow nets. In addition, any increase in seepage would be short term since resedimentation after construction would tend to return seepage to pre-project conditions.

c. Conclusions. - The lands along the right side of the channel (looking downstream) are relatively high or are used for the Yolo Bypass, except for one short portion, RM 15.3 to RM 18.5, near Cache Slough. This portion is at a lower elevation and seepage could be increased by the dredging. Flow net analysis indicates a potential maximum increase of 8% in seepage after dredging. However, if this area is subject to flooding as part of the Yolo Bypass, this theoretical increase may be of no significance. Deepening should have no adverse effects along the right side of the channel.

The lands along the left side of the channel are high for the first 15 miles, then become progressively lower at the downstream end at Sherman Island (CM 3.7), where it is at Elev. -10. Portions (for example, at the Brannan Island Recreation Area and Decker Island) are at high levels and are not subject to seepage from the channel. The conservative assumption was made that the existing channel bottom is covered with a barrier of silt and which is partially or completely removed by the dredging. For this assumption, the flow nets indicate that at locations where the channel is relatively narrow, the seepage rates might be increased by 6% to 10%, and in areas where the natural waterways are wide and the channel is far away from

the protected lands the increases may be 1% to 3%. Table V-8, taken directly from the seepage report, summarizes the theoretical increases in seepage due to channel deepening on the basis of flow net analyses.

The assumptions made in the study are deliberately very conservative. The project impact would be so small as to be undetectable over most of the project reach. On the basis of this investigation, it is very unlikely that increases of several percent could be reliably measured by conventional monitoring methods; and unless the effects of other influencing factors can be clearly established, piezometric data could be inconclusive or misleading.

25. **Maintenance Dredging Studies**.

a. General.

A sediment engineering investigation was conducted to evaluate potential project impacts on maintenance dredging of the Ship Channel improvement. Presently, dredging is performed on an annual basis producing approximately 350,000 cubic yards of material for disposal. The study reach extended from the Collinsville tide gage at CM 0.00 upstream to CM 18.25 upstream which is the portion of the ship channel which requires maintenance dredging most frequently.

b. Previous Studies.

Two previous reports (HEC, 1974a and 1974b) summarize the procedures and results from a study to estimate the amount, frequency and location of maintenance dredging resulting from the proposed deepening of the Sacramento Deep Water Ship Channel from 30 to 35 feet (HEC, May 1983). Figure V-5 shows a sketch of the study area along with the locations of cross sections and sampling sites used in the HEC (1974a and 1974b) studies.

Computer program HEC-6, "Scour and Deposition in Rivers and Reservoirs" (HEC, 1977), was used during the 1974 study to locate and quantify dredging requirements in the channel. Discharge and sediment data from water years 1965 through 1969 were used.

Conclusions reached by the 1974 study were based on channel trap efficiency as the primary "gross estimator." These previous investigations compared trap efficiencies and deposited sediment volumes for hydraulic conditions before and after deepening. They concluded that "one would expect just about the same amount of maintenance dredging for either channel" (HEC, 1974b). Thus, maintenance dredging requirements should not change.

The 1974 studies were thorough but based on a limited data base and simplifying assumptions. However, these studies raised several important aspects which required further investigation:

(1) The effects of tidal changes were indirectly accounted for.

(2) Possible resuspension of deposited sediments as well as the effects of salinity on flocculation of sediments in transport.

Table V-8

Sacramento River Deep Water Ship Channel - Seepage Study

Flow Net Summary

Section No.	Mile	Flow net numbers Lt. side	Rt. Side	Distance from levee c/l to channel c/l FEET	Seepage factor, n_f Existing cond.	After 5' dredging	Maximum Increase	Land Elev. in back of levee	Comments
9-L	21.5	1-A		460.	0.39			Zero	Near d/s end of man-
		1-B		460		0.42	8%	Zero	made channel.
11-L	17.3	2-A		600	0.77			-8.0	At Cache Slough;
		2-B		600		0.84	10%	-8.0	fairly narrow.
11-R	17.3		3-A	440	0.79			-5.0	End of Yolo Bypass;
			3-B	440		0.86	8%	-5.0	Egbert Island
15-L	12.8	4-A		1750	0.70			-8.0	At Sacramento River;
		4-B		1750		0.73	4%	-8.0	very wide.
18-L	6.4	5-A		2240	0.73			-12.0	At Sacramento River;
		5-B		2240		0.76	3%	-12.0	very wide.
20-L	4.15	6-A		2300	0.55			-10.0	At Sacramento River;
		6-B		2300		0.56	2%	-10.0	very wide.

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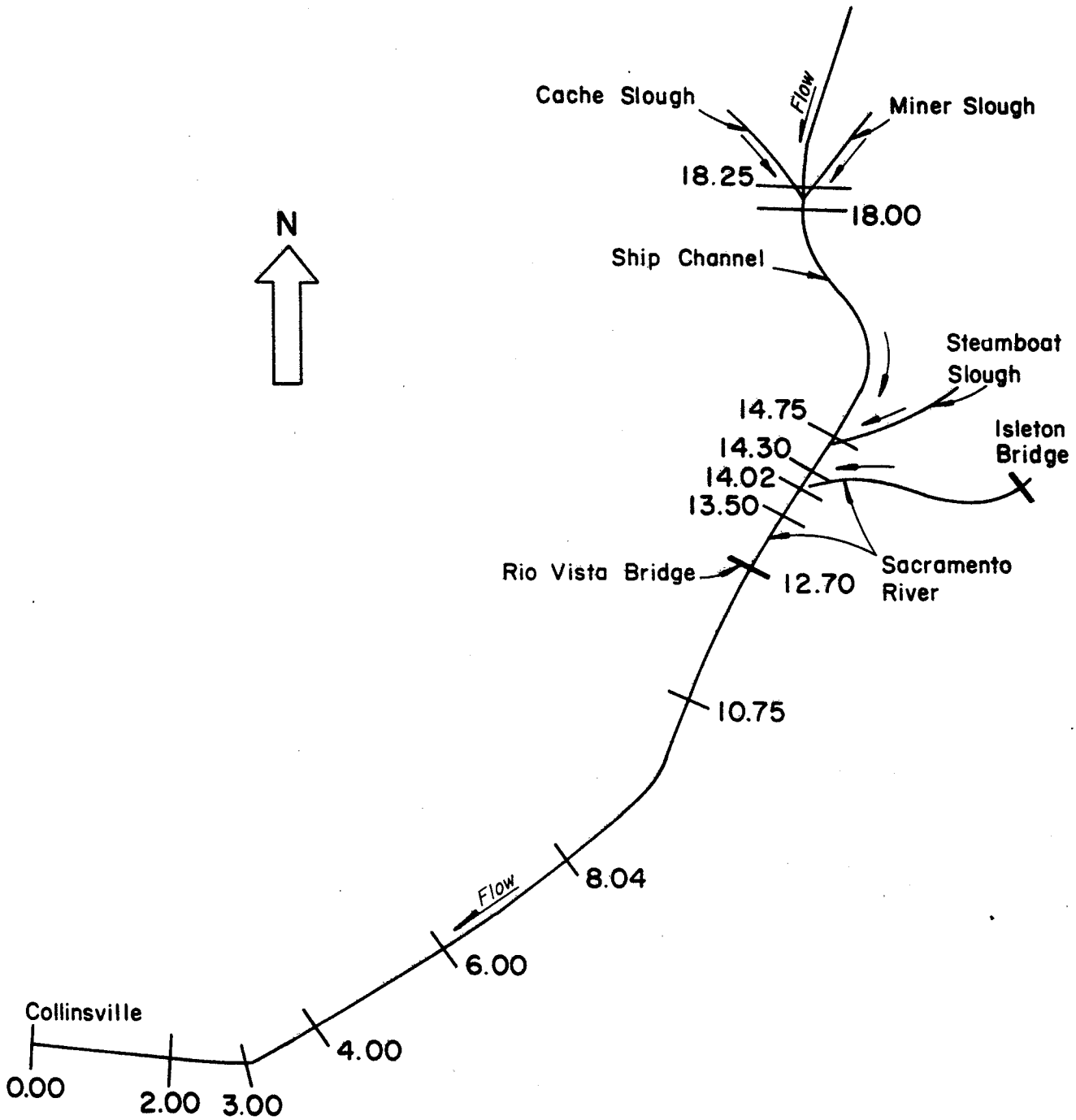

FIGURE V-5

SACRAMENTO DEEP WATER SHIP CHANNEL

SKETCH OF STUDY AREA

LOCATIONS OF CROSS-SECTIONS
BY CHANNEL MILE

(3) The study results and conclusions were based on limited data (1965-69). At least three high water and sediment discharge events (1970, 1974 and 1983) have occurred since the time period of the original data base.

(4) The original study did not consider the effects of flow turbulence induced by wind, boat prop wash and "tidal pumping" on sediment transport characterization in the study area. Although tidal effects would not have a significant impact on sediment transport characteristics of the study area during the winter high-flow months, tidal action effects during the summer low-flow months may be considerable, including reverse flows, two-tier flows, etc.

c. Study Approach and Methodology.

Another sediment engineering investigation was conducted to review the data base, analyses and conclusions from the previous reports, and to reevaluate the potential project (i.e., channel deepening) impacts on maintenance dredging of the Sacramento River Deep Water Ship Channel in light of the questions and concerns outlined above. A multiphased approach was taken in this investigation including collection of hydraulic, geomorphic and water quality parameter data during high-flow and low-flow events in the study area. This investigation was conducted by the U.S. Army Corps of Engineers Hydrologic Engineering Center in Davis, California (HEC 1983 and 1984).

d. Data Base.

Two data collection campaigns were undertaken in the study area for this investigation: one on June 20, 1983; the other on November 3-4, 1983. The purpose was to establish a data base of hydraulic, geomorphic and water quality data from which the evaluation of the sediment transport characteristics in the study area could be made. Fifteen different data collection sites were studied during this water based campaign (See Figure V-5 and Table V-9). Table V-10 lists the parameters measured and the method of measurement.

The June 1983 campaign occurred during a high-flow period with a river discharge at Freeport, California, of 46,000 cfs. The November 1983 campaign occurred during a low-flow period with an approximate river discharge of 10,300 cfs at Rio Vista.

e. Data Analyses.

Examination of the water quality constituent data (such as electrical conductance and suspended solids concentration) as well as bottom sediment sample gradations showed that Steamboat Slough and Sacramento River are the major contributors of materials to be dredged (i.e., sand materials) in the study reach while the fine materials (clays) are entering from Lindsey Slough and the Yolo Bypass. The cross section and current measurement data were essential in assessment of flow patterns in the study reach, verification of present shoaling areas and determining shoaling areas under project conditions.

TABLE V-9
Location of Sampling Stations

STATION NUMBER	STATION LOCATION
1	In Cache Slough, just upstream from the confluence with Lindsey Slough.
2	In Lindsey Slough, just upstream from the confluence with Cache Slough.
3	In Cache Slough, at the confluence with Lindsey Slough.
4	In Cache Slough, just downstream of the Sacramento Deep Water Channel. This station is located between channel markers 49 and 50.
5	In Cache Slough, approximately two miles upstream from the mouth of Steamboat Slough.
6	In Steamboat Slough, approximately 1/4 mile upstream from the mouth of Steamboat Slough.
7	In the Sacramento River, approximately 1/4 mile upstream from the confluence with Cache Slough.
8	In the Sacramento River near Collinsville (River Mile 0.0).
9	In the Sacramento River, opposite the west end of Sherman Lake (River Mile 4.0).
10	In the Sacramento River, opposite the west end of Decker Island (River Mile 6.8).
11	In the Sacramento River, opposite the confluence with Threemile Slough (River Mile 9.0).
12	In the Sacramento, just south of the Rio Vista Bridge (River Mile 12.6).
** 13	In the Sacramento River, north of the Rio Vista Bridge (River Mile 13.4).
14	In the Sacramento River, upstream from Ida Island (River Mile 17.2).
15	In the Sacramento Deep Water Channel, approximately 0.8 mile upstream from the mouth. This station was located between channel markers 53 and 54.

* Mile 0.0 is at Collinsville
** Stations 13-15 sampled on 3 and 4 November 1983, only.

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TABLE 10

Description of Data Collected at the Sampling Locations

DESCRIPTION OF MEASUREMENT	METHOD	UNITS
Dissolved Cation Concentrations Na^{+}, Ca^{++}, K', Mg^{++}	Laboratory Standard Methods	(ppm)
Electrical Conductance	YSI Model 33 S-C-T Meter^{-1}	(umhos cm^{-1})
Salinity	YSI Model 33 S-C-T Meter	(parts/thousand)
Water Temperature	YSI Model 33 S-C-T Meter	(°C)
Dissolved Oxygen	YSI Model 51-B Oxygen Meter	(mg l^{-1})
Suspended Solids	VanDorn Sampler and Millipore Filtrations by Standard Methods	(mg l^{-1})
Turbidity	HACH 2100A Nephelometric Turbidometer	(NTU)
*Secchi Depth	Standard Secchi Disc	(Meters)
**Bottom Cross Section Profiles	Apelco Recording Fathometer	(Plots, unitless)
Flow Velocity Profiles	ENDECO Type 105 Side-Cast Current Meter	(Knots, ft/sec)
Bottom Bed Materials	ECKMAN Side-Cast Dredge	(Unitless)

* Measured on 20 June 1983, only
** Measured on 3 and 4 November 1983, only

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f. Conclusions.

Evaluation of these data and other information (HEC, 1974 and U.S. Army Corps of Engineers, 1980) indicates that the proposed deepening of the ship channel from 30 feet to 35 feet will not cause an appreciable increase in the present average annual maintenance dredging volume (approximately 350,000 cubic yards per year in the natural river portion). Also, the total amount of sediment being delivered to the channel will not change on an average annual basis due to channel deepening; however, the location of areas of rapid sediment accumulation may change slightly. Local shoaling rates at some locations in the deep water ship channel may increase after deepening. This will be especially true immediately below the mouths of the Sacramento River and Steamboat Slough (two major sources of sediment).

Five feet of deepening may reduce the existing sediment transport capacity in the shipping channel near Rio Vista by as much as 6 percent. This figure (6%) was determined by comparing the existing sediment transport capacity in the ship channel to the capacity of the deepened channel by using both the Colby and Meyer-Peter and Muller (Vanoni, 1975) methods. This could result in a 6 percent increase in the shoaling rate at that location. Even though deepening may increase rates of shoaling in the ship channel near Rio Vista, it may reduce the total length of channel requiring frequent maintenance dredging by isolating the deposits to a shorter length of channel. This could lead to some minor savings in maintenance dredging due to reductions in mobilization and pumping costs.

Channel deepening may accelerate lateral sediment movements into the deep water channel if the channel side slopes become steeper as a result of the deepening. Boat traffic will cause wakes and propeller turbulence which will also accelerate lateral sediment movement into the channel. Lateral sediment transport rates are directly proportional to the channel side slope and overall surface area of sides. Thus, channel side slopes will be minimized with the project to avoid the above problems.

Details of the maintenance dredging studies can be found in Appendix F, Sediment Engineering Investigations.

26. **Sediment trap feasibility studies.**

a. Purpose. A preliminary feasibility study of the engineering and economic aspects of constructing a sediment trap on the Sacramento River near Rio Vista, California, has been completed. A properly designed trap would capture sediment in a very localized area, possibly reducing annual ship channel maintenance dredging costs by reducing the aereal extent of dredging which presently occurs. The study addressed the following:

(1) Determine the engineering and economic feasibility of the subject sediment trap and identify critical characteristics and design features for such a project (such as size, shape, trap efficiency, location, etc.).

(2) Compare the present operation and maintenance dredging costs of the Sacramento River Deep Water Ship Channel vs. the estimated costs using a sediment trap.

(3) Assess the impact of the deepening of the ship channel from 30 feet to 35 feet on the performance of the proposed sediment trap.

This study was conducted by the U.S. Army Corps of Engineers' Hydrologic Engineering Center in Davis, California.

b. Study Area. The Sacramento River and its tributaries carry sediment loads of one to six million tons per year past Sacramento, California (U.S. Geological survey, 1957-1982). Even larger loads can be assumed to pass near Rio Vista due to the large quantities of fine suspended material transported from the Yolo Bypass during periods of high flow. Approximately 350,000 cubic yards of sediment are dredged annually from the Sacramento Deep Water Ship Channel near Rio Vista (U.S. Army Corps of Engineers, 1981). The remainder of the sediment load is sufficiently fine that it remains in suspension until the flow reaches areas with lower velocities. Thus, the area immediately downstream of the confluence of Cache Slough, Steamboat Slough and the Sacramento River is an ideal site to consider for a sediment trap location.

c. Sediment Trap Design.

The design and performance of the proposed sediment trap were based on the river conditions for a representative year. That representative year was assumed to depict the river and sediment environment which would exist, on the average, during the life of the project. Such an analysis was appropriate for this preliminary evaluation. A more comprehensive analysis of several years of historical record will be required to accurately evaluate the performance of the trap. Water year 1978 was chosen to be a representative water and sediment year to use for this study. Water year 1978 had the most complete data set that was readily available for water discharge and sediment information. It also had a mean annual water discharge that was about average (U.S. Geological Survey, 1978) for discharges on the Sacramento River.

The proposed trap was first designed using an annual trappable sediment load estimated from that representative year. The trappable sediment load was computed as the "total" load minus the "flow-through" load during the representative year. The "total" load was estimated from measurements for that year. The "flow-through" load was determined from calculations of critical velocities (and corresponding discharges) which would keep the sediment in motion through the reach.

Once the annual trappable sediment load was estimated, then the amount of material that could deposit in an assumed ten-foot deep sediment trap located in the main channel was estimated based on the average annual river discharge and a critical velocity and grain size approach. Also, it was assumed the proposed trap should not go across the entire river width because the large increase in cross-sectional area would collect more sediment than is presently dredged from the existing channel. Positioned in the conveyance area of the main channel, the proposed trap location, shown in Figure V-6 and the design in Figure V-7, affects 88% of the water passing that point and thus also 88% of the sediments passing this location. Trappable sediments of 452,275 tons, or 352,513 cubic yards per year were estimated in this way. This volume and the assumed ten-foot depth were used to compute the approximate trap dimensions.

An alternate method was then used for design comparison. This alternate method sized the trap length based on the average annual sediment accumulated and dredged historically - which is approximately 350,000 cubic yards per year (of which 310,000 cubic yards per year is "trappable"). Proportioning the design trap length to the estimated annual volume, a trap length of 830 feet was calculated. The alternate trap design based on the historical average annual dredging volume was used rather than the design based on the "representative" water year, as the former permits a direct comparison with historical dredging quantities and costs. The recommended trap clean-out period is two years providing a proposed design trap length of 1,700 feet.

As mentioned above, only 88% of the River flows pass over the trap (See Figure V-7) and thus also only 88% of the sediments would be affected. The remaining 12% of annual sediment deposits in the ship channel, or 40,000 cubic yards per year may deposit downstream of the trap.

d. Economic Analysis.

An economic analysis of the construction of the proposed sediment trap and its operation and maintenance was conducted. Operation and maintenance considerations included biannual dredging of the proposed trap and also maintenance dredging every 16 years downstream of the trap. The economic analysis included mobilization and demobilization costs, disposal area preparation costs, contingencies, and engineering design, supervision and administration costs. An interest rate of 8.375% and an amortization period of 50 years were used.

Based on the assumptions, data and calculations, construction of a 10-foot deep sediment trap at River Mile 14 near Rio Vista will save the Corps approximately $168,506 per year in reduced average annual dredging costs as shown in Table V-8. The final results of the economic analysis is a computed benefit-cost ratio of 1.185.

TABLE V-11
Economic Analysis
Sediment Trap

	Without Sediment Trap	With Sediment Trap
First Cost	-	$ 1,972,000
Total Cost	$50,750,000	$42,841,000
Annual Cost	$ 1,188,116	$ 1,019,610
Annual Savings	-	$ 168,506

Since the deepening of the ship channel from 30 to 35 feet will not impact on the proposed trap cross section shown in Figure V-7, its significance on the trap efficiency is estimated to be minimal.

e. Conclusions:

Based on the preliminary feasibility study, a sediment trap on the Sacramento River can be economically constructed upstream from the Rio Vista Bridge in the natural portion of the Deep Water Ship Channel near River Mile 14. The trap can be dredged and the material deposited at the disposal site

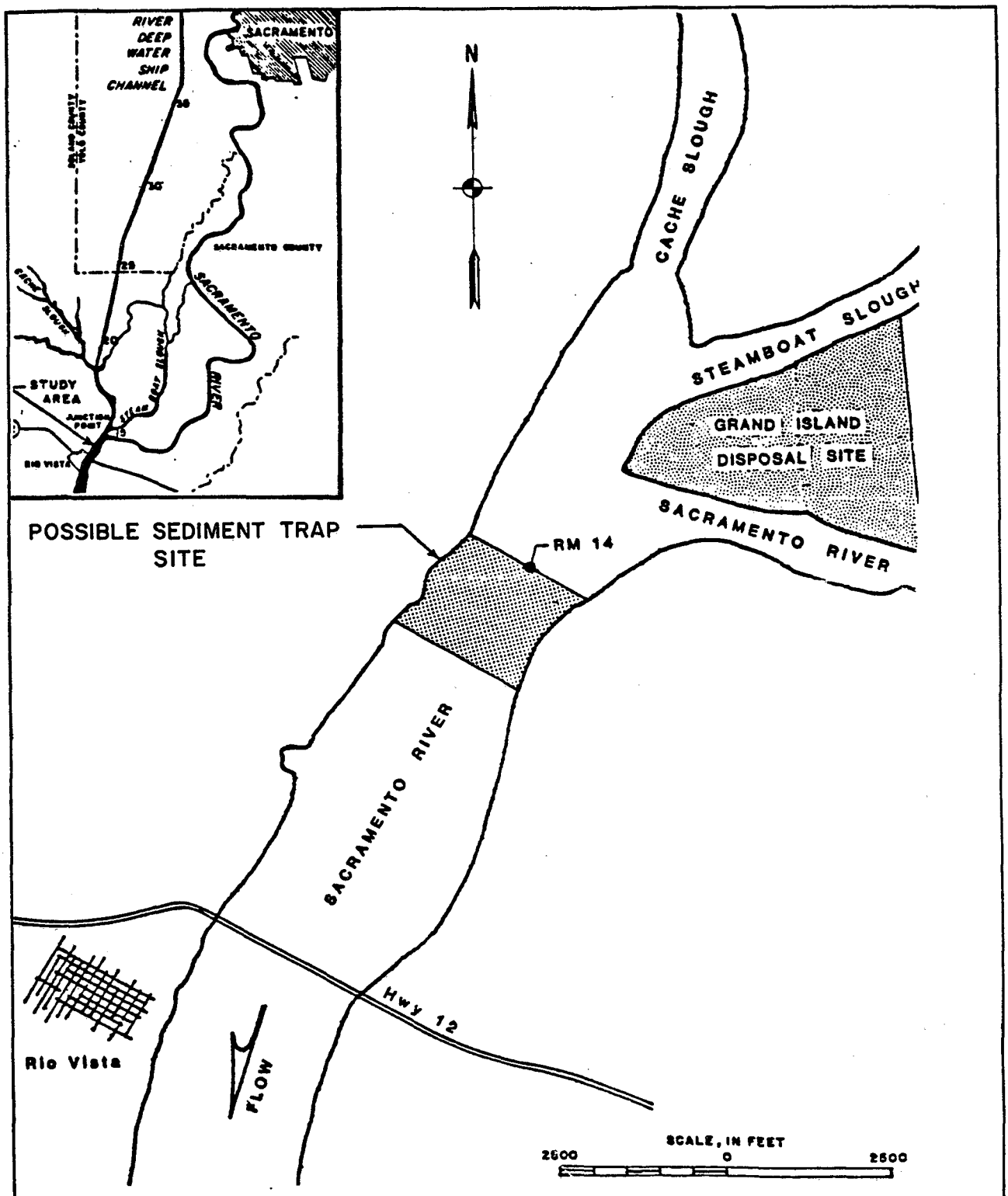

Figure V-6
POSSIBLE SEDIMENT TRAP
LOCATION MAP

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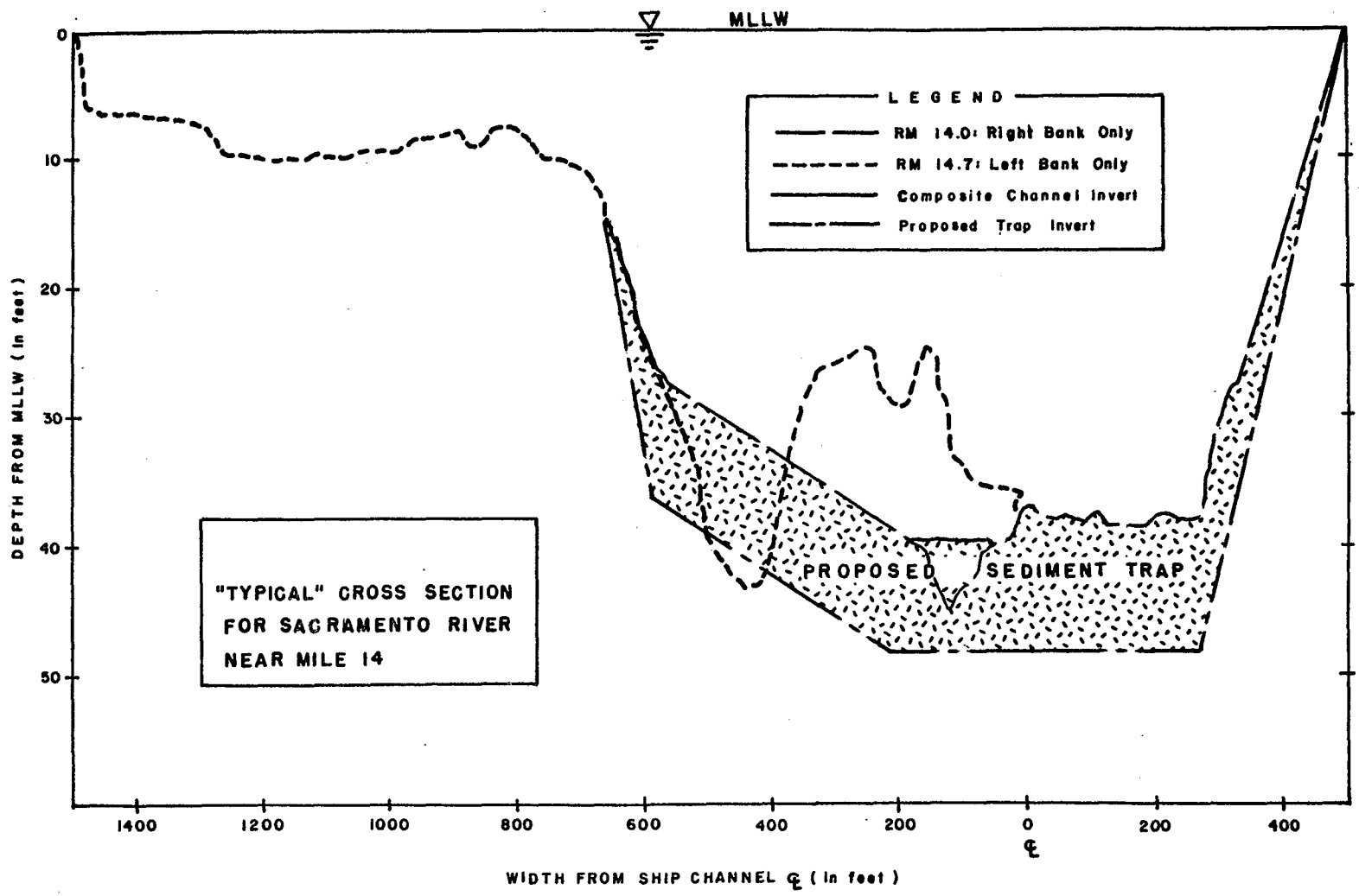

FIGURE V-7

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on Grand Island. The approximate dimensions of the trap (according to preliminary estimates) would need to be 1,200 feet wide by 1,700 feet long by 10 feet deep, and located as shown in Figure V-6. Construction of a sediment trap on the Sacramento River near Rio Vista will provide an estimated annual savings in maintenance dredging costs of $168,506, with a project benefit-cost ratio of 1.185. However, the sediment trap is not proposed at this time. More detailed studies are required to confirm the viability of the trap, and additional explorations are needed to further define costs.

f. Future Study.

As the feasibility study has shown, the proposed sediment trap is technically and economically feasible. Further studies should be conducted to determine the optimum locations and configuration of the sediment trap for the hydraulic and sediment transport characteristics of the area. These studies would principally involve data collection, problem analyses - including simulation of the hydraulic and sediment transport characteristics of the area of the sediment trap using a two-dimensional mathematical model - and reporting of study results and recommendations.

Data requirements for the study would include river bed topography, bed material gradations, soil boring data, river current velocity and direction data, water and sediment discharge data, etc.

27. **Prospect Island levee maintenance studies**. - The existing east levee along the manmade portion of the Sacramento Deep Water Ship Channel (SRDWSC) has been continually eroded by ship and wind generated waves. The biggest problem area is located on Prospect Island between Channel Mile 18.6 and 21.0. Possible causes of the bank erosion include improper gradation of quarry stone vs. filter material, saturation of uncompacted embankment material, or an underestimated design wave.

After several riprap failures along this levee, the Waterways Experiment Station (WES) made a model study of potential solutions to the bank problem as part of the Section 32 program. The WES study addressed alternative designs for reducing levee maintenance problems from Mile 18.0 to Mile 25.0. WES concluded that with the given ship size and riprap design only an increase in channel area or decrease in ship speeds would result in favorable conditions in the channel. To alleviate the erosion problem, WES recommended either an increase in channel cross-sectional area or a decrease in ship speed along with improved riprap design. The Sacramento District noted that other potential solutions to the problem included setback levees, flow easements, or a protective dike.

Due to the potential bank failure problem, the District evaluated design options in more detail. The design options included: (1) increase the cross-sectional area; (2) construct setback levees; (3) increase cross-sectional area and construct setback levees; (4) buy flow easements; (5) reduce allowable ship speeds, and (6) build a protective dike in front of the levee.

Present levee conditions along Prospect Island include 1V on 3H slopes; design specifications include 6" sand, 12" granular filter, and 27" stone (maximum size of 1300 lb). Approximately 20,590 feet of levee (89% of the total) have already been rocked. Speed limits along that length of channel include 5 knots against a 2-knot (or greater) current and 7 knots (8.05 mph) with or against a current of less than 2 knots. A survey of ship speeds along that reach shows an average speed of about 7 knots.

After detailed analysis, all six options were rejected as possible solutions to the erosion problem. The costs for all alternatives except reducing allowable ship speeds are very high. There is no assurance that setback levees will solve the problem; the WES study shows that wave action on setback levees is similar to that on present levees. The flowage easement option would remove valuable farmland from production, as well as impact wetland areas and a dredged material disposal site. Reducing allowable ship speeds might cause shipping profits to be decreased as a result of slower speeds, causing such plan to become economically infeasible.

Since much of the present levee has been protected by rock, the selected alternative is to continue to inspect and repair the levees along Prospect Island, as needed. In addition, this plan includes placing rock (as needed) on those sections of levee not presently protected.

28. **Effects on Air Quality**. - A consultant conducted an air quality emissions analysis for the Sacramento District to determine the air quality implications of the project. Specific objectives of this study included an analysis within the Port area itself (to estimate impacts from increased traffic perhaps not anticipated in existing regional air quality plans) and a regional analysis (to compare potential project versus no-project benefits weighed against increased recreational use).

To project future transportation-related emission levels, the consultant:

1. Defined the probable modes and routes of port cargo,
2. Determined the degree of utilization of ship, truck and rail systems to move the cargo,
3. Determined fuel consumption for each mode of transportation, and
4. Estimated the corresponding air pollution emissions released when that fuel is burned.

To distinguish between emissions changes around the Port and throughout the region, three analysis regions were developed in which changing transportation patterns will occur if the channel is deepened. These three areas included the Port (within a 5-mile radius of the Port), the Sacramento Air Quality Management Area (AQMA) which extends to the New York Slough along the ship channel, and a Northern California analysis zone which extends to the Bay Area and within a 100-mile radius of the Port northward into the Sacramento Valley.

Based on overall fuel consumption, the "with-project" alternative causes a definite air quality impact near the Port; the two alternatives are within 3 percent of each other within the AQMA basin; and once the entire Northern California Analysis area is considered, the "with-project" alternative has little significant impact.

The current Sacramento Air Quality Plan (AQP), in incorporating the "with-project" Port development plans and cargo projections through 1987, has already concluded that emissions around the Port from increasing cargo activities will approximately double in the next decade with or without the project.

The Clean Air Act requires that Federal actions be consistent with local and regional plans. Since the "with-project" alternative was used in the Port activity planning input into the AQP, the proposed channel deepening is thus consistent with the AQP and will therefore not create any unanticipated, adverse air quality impacts.

29. **Cultural resource studies**. - Field studies were made of all lands which will be affected by the project to determine whether any cultural resources are present which will be subject to adverse impacts. A cultural reconnaissance was performed in 1976 for the feasibility report, and an intensive cultural resources survey was completed in 1985.

a. Cultural resources reconnaissance. - The 1976 study was performed under contract by Mr. Jeff Seldomridge, California State University, Sacramento. An initial review of the literature, including the archeological site files of the California State Department of Parks and Recreation, revealed the existence of only one prehistoric aboriginal site (Yol-42) on project land.

The contractor surveyed 15% of the disposal area along the channel banks (river mile 15 to river mile 47.2), 9 other disposal sites and a once proposed passing basin.

No new archeological remains were recorded at the inspected sites. The contractor did find two artifacts, an obsidian projectile point tip and a baked clay/earth fragment, both believed to be fortuitous. Prehistoric site Yol-42, originally recorded July 1, 1960, was located and re-examined. The contractor determined that site Yol-42 (located in the southwest corner of S1) was an important archeological site and should be preserved. Suggested alternatives to prevent destruction of Yol-42 included (1) avoid impaction of the site, (2) cover the site with dredged material to protect it from further agricultural activities and (3) excavate test pits to determine the distribution and significance of the site.

b. Intensive cultural resources survey. - In 1984 an intensive survey of new sites and those not completely surveyed in 1976 was performed. Initially, an up-to-date literature review was performed, including a review of the Northwest Information Center of the California Archeological Sites Inventory housed at Sonoma State University. This literature search revealed the previously recorded archeological site Yol-42 (now identified as CA-YOL-42) reported in 1978 by Seldomridge.

The field survey revealed no archeological remains on any project lands. The contractor stated that none of the survey parcels could be classified as sensitive to the presence of cultural resources because all parcels had previously received some type of negative impact, including spoil disposal, flooding, construction or agricultural activities.

Since the current condition of CA-YOL-42 was unknown, the contractor was requested to reinspect the site and evaluate it for its potential significance and eligibility for inclusion on the National Register of Historic Places. The boundaries for disposal Site 1 had changed since the 1976 Study, and CA-YOL-42 was no longer located on project land. The evaluation was requested, however, in case the original Site 1 area is needed for future disposal.

The evaluation of CA-YOL-42 was made in accordance with guidelines set forth by the Secretary of the Interior for the evaluation of resources for inclusion on the National Register. The consultant concluded that the site contained too few surface cultural materials to fully evaluate the site. He recommended that a limited subsurface testing program be implemented to determine the vertical extent of the site and to describe the nature of any subsurface deposit. A final National Register Evaluation would have to be based upon the results of further testing.

30. **Navigation channel design**. - The factors affecting channel dimensions include the size and maneuverability of the vessel, current velocity and direction, tidal stage, wind speed and direction, vessel speed, characteristics of the channel bottom and banks, and in the case of an existing channel such as the Sacramento River Deep Water Ship Channel, any specific considerations necessary as a result of experience gained in use of the channel. A discussion of these interrelated factors as they apply to design channel width, width in bends, and depth is given below.

Shown in subparagraph f is an extensive list of references which were used as guidelines in determining appropriate channel dimensions. In some cases, the channel was designed wider than recommended in the various references and in other cases, the channel width was kept to a minimum due to special considerations. An example of a design based upon special conditions is the reach between Mile 18.6 and the Port of Sacramento, which is the manmade portion of the channel. This reach is straight and uniform, is in slack water, and has no winds perpendicular to the direction of travel. To prevent bank erosion due to wavewash, ship speeds are controlled by the imposition of speed restrictions. Wide beam vessels (those with beams wider than the most common vessel) traverse the channel only during daylight hours which further decreases the possibility of pilot error. Over 5,000 deep-draft vessel trips have been made through the deep water channel with only twelve groundings of which the majority were not in the manmade channel. These facts indicate that serious consideration can be given to minimizing channel design widths in this reach. The existing and selected channel dimensions for the Sacramento River Deep Water Ship Channel are given in Table VI-1.

TABLE VI-1

EXISTING AND SELECTED CHANNEL DIMENSIONS
(in feet)

Channel Reach	Existing Dimensions		Selected Dimensions	
	Depth	Bottom Width	Depth	Bottom Width
New York Slough to Junction Point (CM 15.0)	30	300	35	350
Junction Point (CM 15.0) to CM 18.6	30	300	35	300
CM 18.6 to the Port of Sacramento	30	200	35	250

a. Design vessel. - The "design vessel", for the purposes of this analysis, is the hypothetical vessel which represents the size range of vessels that would most commonly use the waterway. The channel or waterway is then designed to assure safe and economical passage for the "design vessel". The "design vessel" for the Sacramento River Deep Water Ship channel was developed by investigating the commodities currently handled and the types and sizes of vessels in use or likely to use the channel, and the commodities and the vessels likely to use the channel in the future. Table II-1 shows a sample of vessels using the Port to load grain during 1976-83, and Table II-4 shows the vessels loading wood chips at the Port during 1976-83. These are the two major commodities handled at the Port. The channel depth as will be discussed subsequently will be limited to

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35 feet below an established sounding datum. An allowance of 3 feet for trim, squat and keel clearance limits the design draft to 32 feet (when considering summer static draft and fresh water sinkage). The "design vessel" represents a hybrid vessel of the following dimensions:

Draft = 32.0 ft
Beam width = 83 ft
Length = 600 ft
DWT = 25,000 tons

It is recognized that larger ships do use the existing waterway and will also use the channel in the future. Therefore, the larger vessel was also reviewed under the channel design guidelines for consideration in determining the appropriate channel dimensions, which are also based on channel economics, tide levels, weather conditions and other considerations which influence channel design.

Both standard dry-bulk and wood chip vessel dimensions were used in designing the channel because of the difference in their proportions. The newer wood chip vessels have broader beams than do dry-bulk cargo vessels. However, dry-bulk vessels generally have greater drafts. Therefore, the "design vessel's" beam width was based primarily on wood chip vessels and their drafts on dry-bulk vessels.

b. Design depth. - Adequate channel depth is the main consideration in the design of navigation improvements. The appropriate channel depth is ultimately determined through an economic analysis of the most efficient drafts of current and future vessels that will be using the channel to transport a particular commodity.

The deep draft ship channels downstream of New York Slough (John F. Baldwin Ship Channels) limit the channel depth to 35 feet. These considerations were used in determining the economic channel depth which maximizes net benefits.

Despite the economic analysis, safe and efficient ship operation requires channel depths in excess of the "design vessel's" loaded freshwater static draft. The required depth of 35 feet was developed from calculations based on practical and theoretical information in the technical reports and papers referenced in paragraph 29f. The references were used in determining the depth allowances for vessel squat and trim, sinkage due to fresh water, pitch and roll, and operating clearances. All of the factors have been considered in evaluating the design depth for the channel deepening. The depth allowances for freshwater sinkage, squat, trim, roll, pitch and heave, and keel clearance are summarized in Table VI-2 for a typical vessel ("ASIA BEAUTY"). The differences between required channel depth and design channel depth shown on Table VI-2 are considered inconsequential from a practical standpoint. The following paragraphs contain discussions of the design considerations for the deepening of the ship channel.

(1) Draft. - The static draft for vessels using the Sacramento River Deep Water Ship Channel is the summer saltwater draft. The maximum permissible draft to which a vessel may be loaded is fixed by the load line assignments. The distance from the load line to the keel at midship while the vessel is stationary in summer saltwater is the vessel draft. For design purposes, this draft is 31.2 feet.

Table VI-2
DEPTH DESIGN ALLOWANCES

TYPICAL VESSEL - "ASIA BEAUTY"
(Design Draft = 31'2", Beam = 83'5", Length = 576'11")

VESSEL DRAFT AND OTHER DEPTH DESIGN ALLOWANCES (SHIP SPEED)	NEW YORK SLOUGH TO JUNCTION POINT One-way Traffic V=10.3 mph	JUNCTION POINT TO CHANNEL MILE 18.6 One-way Traffic V=10.3 mph	CHANNEL MILE 18.6 TO PORT OF SACRAMENTO One-way Traffic V=10.3 mph
Vessel draft (summer, salt water)	31.2	31.2	31.2
Freshwater sinkage	0.5	0.5	0.7
Squat	0.5	0.9	1.1
Trim, roll, pitch & heave	0	0	0
Keel clearance	2.0	2.0	2.0
Required channel depth	34.2	34.6	35.0
Design channel depth	35.0	35.0	35.0

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(2) Freshwater sinkage. - An allowance has been made for freshwater sinkage in the design depth of each channel reach. In passing from seawater having a density of 1.026 (64 lb/cu ft) into freshwater with density of 0.9991 (62.4 lb/cu ft), the "design vessel's" displacement will increase by about 3 percent. The "design vessel" with a 31.2-foot saltwater draft would have a freshwater draft of approximately 32 feet.

(3) Squat. - Vessel squat is the lowering of the water surface around a moving vessel which produces a relative change in the ship's position with respect to the channel bottom. The amount of squat varies with ship speed and the channel cross section. Due to speed restrictions on the channel, vessels typically navigate the various reaches of the Sacramento River Deep Water Ship Channel at speeds from 5 to 10 knots. Vessel squat values for each of the three reaches were determined using Figure X-1 of Chapter X, Design of Channels for Navigation, Tidal Hydraulic Commission Report No. 3 dated May 1965, and Figure 5-3 Draft EM 1110-2-1613, "Hydraulic Design of Deep Draft Navigation Projects," dated 8 April 1983. The squat varies inversely with channel width and directly with ship speed. The squat for all of the reaches along the Sacramento River Deep Water Ship Channel varies between 1 and 2.5 feet assuming the design vessel travels at the restricted speeds (and values of squat increase slightly for larger vessels).

(4) Trim. - Trim is defined as the difference in draft from bow to stern and is controlled by cargo loading. Information on trim was obtained through observations of actual operations and through consultation with port officials. Ship operators using the Sacramento Deep Water Ship Channel have generally preferred to trim a ship to an even keel and utilize high tides. Indications are that this will be the continued mode of operation with the deepened channel. Therefore, no allowance for trim is considered necessary.

(5) Roll, pitch and heave. - Vessel roll is rotation of a vessel around its longitudinal axis, induced primarily by wave action. Vessel pitch is rotation of a vessel about its transverse axis and heave is vertical body motion of a vessel. The Sacramento River Deep Water Ship Channel is relatively shallow and protected from wind, such that waves greater than 1 to 2 feet are not normally encountered. Therefore, additional allowances for roll, pitch and heave are not considered necessary.

(6) Keel clearance. - Soils explorations were made on the existing ship channel, and the materials on the channel bottom were found to be silts, clays and sands. For vessel safety and efficiency, the general practice of the Corps of Engineers has been to provide a minimum clearance of 2 feet between the vessel in motion and the channel bottom for soft bottom materials. This clearance reduces the chance of the ship's propeller striking a sunken log or other debris and reduces the possible displacement of sand which could be piled up in the path of a following ship. The deep water channel has a soft bottom. Therefore, the minimum clearance of 2 feet is considered adequate for the deepened channel.

(7) Water levels. - The ship channel design is based on excavating the channel 35 feet below Elevation -2.0 National Geodetic Vertical Datum of 1929 (NGVD). This controlling elevation was established for the existing 30-foot deep ship channel after analysis of the various river flow conditions and tides which affect the water level in the ship channel. Based on that analysis, use of elevation -2.0 NGVD as the controlling elevation will provide a depth of 35 feet or more 95 percent of the

time and a depth of 38 feet about 50 percent of the time. This controlling depth is about 0.8 feet below MLLW at Collinsville and 1.2 feet below MLLW at Rio Vista.

(8) Saltwater intakes. - Chapter X of the Tidal Hydraulic Commission Report No. 3 recommends a nominal clearance of at least 2 feet under the keel of a moving vessel in order to avoid fouling of pumps and condensers by bottom material. Since most vessel intakes are about 2 feet above the hull bottom and most ships travel the channel when water levels produce channel depths greater than 35 feet, no additional allowance is considered necessary for vessel saltwater intakes. With the saltwater intakes 2 feet above the hull bottom and a 2-foot keel clearance in addition to other allowances, the actual vessel saltwater intake clearance would be about 5 feet. This clearance was considered adequate based on a study by the Port of Oakland for SL-7 containerships in the San Francisco Bay channels.

(9) Maximum size vessel. - The design allowances for the expected maximum size vessel using a 35-foot deep channel were also determined. These calculations are based on the ship "Causeway" and the assumption of an operation freshwater draft of 32 feet at the Port of Sacramento (similar to the 31.9-foot freshwater draft for the "Asia Beauty"). The results of these calculations are presented in Table VI-3. These calculations indicate that a deeper channel is necessary for the vessel with a 32-foot draft to safely travel the channel. However, because the controlling elevation for channel depth design is below MLLW and most ships travel the channel when water levels and tides produce channel depths greater than 35 feet, the maximum size vessel is expected to continue to safely travel the channel by loading according to the expected channel water levels at the time.

(10) Summary. - Given the type of vessels which are expected to use the ship channel and the special operating procedures which the channel utilizes, a total additional depth of 3 feet for freshwater sinkage, squat, trim, and keel clearance is sufficient to allow safe and efficient operation of bulk commodity vessels. Further justification for this figure is that the 3-foot clearance (from static draft line) closely approximates actual operating procedures in the channel. The Sacramento River Deep Water Ship Channel can safely and efficiently allow travel of ships with a 31.2-foot saltwater draft when deepened to 35 feet below elevation - 2.0 NGVD without use of tides. However, larger draft vessels can be safely accommodated through use of tide levels.

c. Channel width.

Channel width is dependent on the beam and steering characteristics of the design vessel, the traffic density, the characteristics of other vessels encountered in the channel, the characteristics of the waves likely to be experienced, as well as the characteristics of the channel banks. While acknowledging no formulas for evaluating these characteristics and their complex relationships, EM 1110-2-1607 does reference, as a general guide, Chapter X of the Committee on Tidal Hydraulics Report No. 3. Study of other waterways similar to the one under study is another means of determining the appropriate balance between safe, efficient operation and economical construction. The EM cautions that accident free operation of another waterway may be reflective of an overdesigned, uneconomical project as well as an appropriately designed project.

Table VI-3

DEPTH DESIGN ALLOWANCES
MAXIMUM EXPECTED VESSEL* - "CAUSEWAY"
(Design Draft = 41'4", Beam = 106'0", Length = 736'3")

VESSEL DRAFT AND OTHER DEPTH DESIGN ALLOWANCES (SHIP SPEED)	NEW YORK SLOUGH TO JUNCTION POINT One-way Traffic V=10.3 mph	JUNCTION POINT TO CHANNEL MILE 18.6 One-way Traffic V=10.3 mph	CHANNEL MILE 18.6 TO PORT OF SACRAMENTO One-way Traffic V=10.3 mph
Vessel draft	41.3	41.3	41.3
Freshwater sinkage	0.7	0.7	0.9
Assumed loaded draft plus freshwater sinkage	32.0	32.0	32.0
Squat	0.7	1.1	2.1
Trim, roll, pitch & heave	0	0	0
Keel clearance	2.0	2.0	2.0
Required channel depth	34.7	35.1	36.1
Design channel depth	35.0	35.0	35.0

*Size as based on beam width

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(1) Lane allowances. - Guidance provided in the EM and the Committee on Tidal Hydraulics Report No. 3 indicates a range of channel widths that should be considered on the basis of user vessel characteristics and physical and hydraulic conditions in the channel area. These "guides" suggest ranges to be considered for vessel maneuvering lanes, bank clearances, and in cases where two-way traffic is involved, a vessel clearance lane as well as width in bends. These allowances are discussed below, and minimum adverse and ideal conditions are illustrated in Figure VI-1 for both one-way and two-way traffic, respectively. Other references utilized in establishing the minimum and maximum conditions are given in the reference list (subparagraph 29f).

(a) Maneuvering lane. - The maneuvering lane is that portion of the channel required for a vessel to maneuver in, in an effort to navigate a straight course. This lane should provide adequate width for the vessel to avoid encroaching on its safe bank clearance or approaching another ship so closely that dangerous interference between ships will occur. Model tests and vessel observations outlined in Tidal Hydraulic Report No. 3 indicate that maneuvering requirements for various vessels are mainly related to vessel controllability. These tests indicate that the maneuvering lane may be as little as 160 to 180 percent of the vessel beam for those with good to average controllability where there are no currents at an angle to the channel or winds or waves that cause vessel yaw. When vessels have poor controllability and yawing forces are likely to be experienced, 200 percent of the vessel beam is suggested for the maneuvering lane. In general, the controllability of various vessels was defined as follows:

1. Very good for naval fighting vessels and freighters of the Victory ship class.

2. Good for naval transports and tenders, T-2 tankers, new ore ships and freighters of the Liberty ship class.

3. Poor for old ore ships and damaged vessels.

(b) Bank clearances. - Bank clearances are required to compensate for the positive pressures against the bow of a vessel and the negative pressures against its stern as it moves in proximity to a channel bank. Pressures are created by the hydraulic compression of the water as it is "squeezed" between the vessel and the bank at its bow and the rapid evacuation of the water at the stern by the vessel's propellers. With adequate clearances, this phenomenon can be compensated and equilibrium established through application of some degree of rudder. Again the bank clearance required by a vessel is dependent upon the vessel's controllability and speed, the nature of the bank material and shoaling characteristics, the width and depth of the channel, and wind and hydraulic forces. Studies indicate that where favorable conditions exist, the bank clearance could be as little as 60 percent of the beam of the vessels if they are known to handle well close to the edge of the channel. Conversely, if strong currents, winds, and waves are known to occur frequently at an angle to the channel and the banks are composed of hard materials, as much as 150 percent of the vessel beam may be advisable.

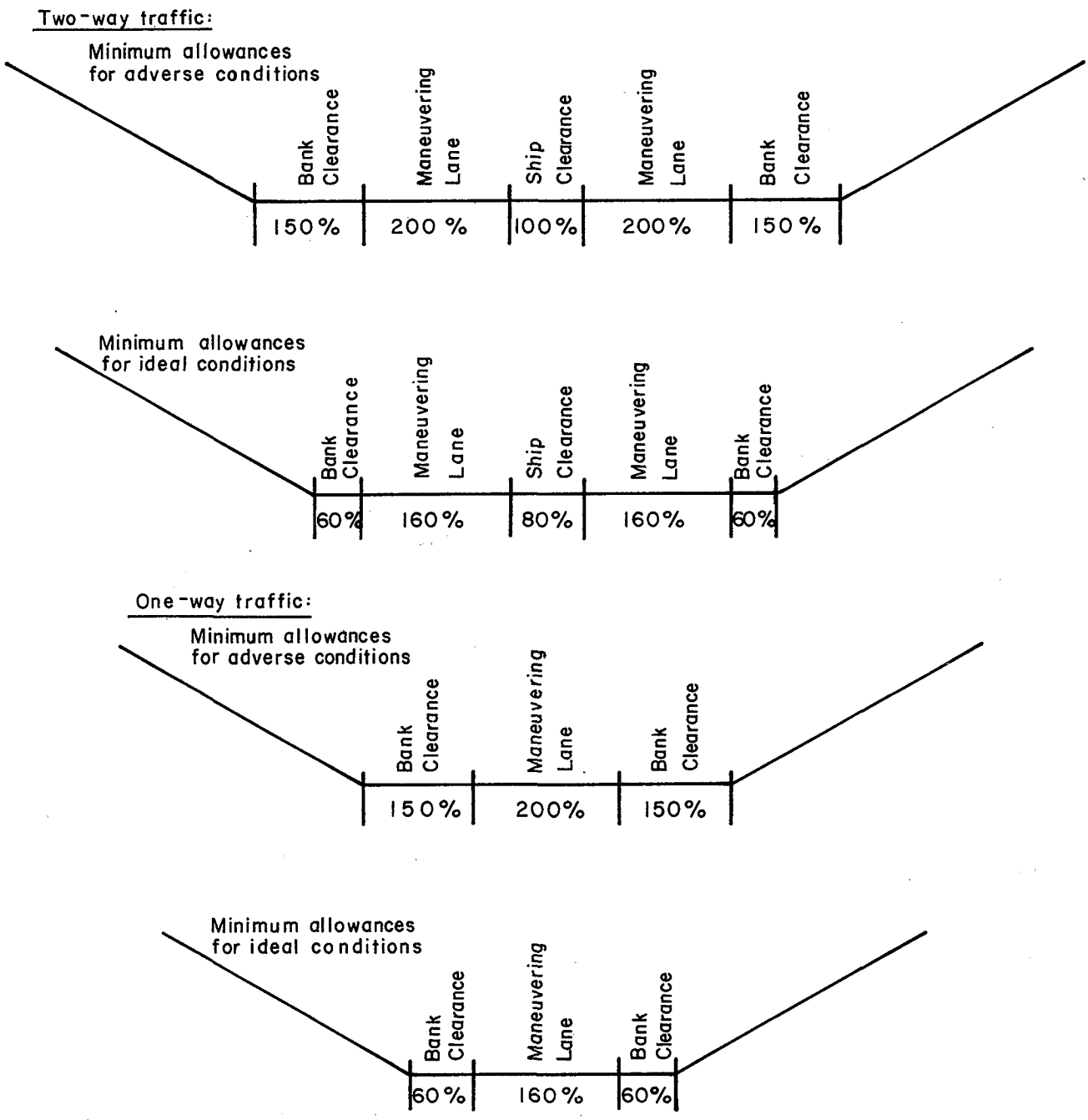

FIGURE VI - 1

LIMITATIONS FOR CHANNEL WIDTH DESIGN
(GIVEN IN % OF VESSEL BEAM)

(c) Ship clearances. - In cases where a channel is required to accommodate two-way traffic, a width allowance is necessary between the vessels to avoid adverse hydraulic interactions when passing. The conclusion of tests outlined in Tidal Hydraulic Report No. 3 indicates that in wide waterways that are well buoyed and not subject to strong currents or other yawing forces, a minimal ship clearance of as little as 80 percent of the beam of the larger vessel may be satisfactory. However, a clearance of 100 percent of the beam is recommended for less ideal conditions.

(2) Width allowances in bends. - It is customary to widen the channel in turns because the path of a vessel making a turn is wider than its path in a straight portion of a channel. Unfortunately, as pointed out in the Tidal Hydraulic Report No. 3, there is not much guidance available to determine the amount of widening that is desirable. Generally, the greater the deflection angle, the greater the width of the vessel's path. However, consideration must also be given to vessel speed, ship length, beam width and the ship's steering characteristics as well as the maneuvering skill of the ship's pilot. The Tidal Hydraulic Report No. 3 suggests that in the design of the widening of a turn, the most reasonable procedure would be to premise it on the three factors that the Panama Canal engineers established for the design of the maneuvering lanes in straight reaches, namely very good, good, and poor controllability. Based on derivation from data developed by the Panama Canal engineers for a ship with a beam width of 113 feet, the maneuvering lane widths in straight portions and turns would be as follows:

Maneuvering Lane Width in Straight Reaches and in Turns

Controllability of Vessel	Width of Maneuvering Lane as a Percent of the Vessel Beam		
	Straight Channel	Channel Turns with Deflection Angles of	
		26 deg	40 deg
Very good	160	325	385
Good	180	370	440
Poor	200	415	490

Empirical equations, suggesting that the radius of curvature of a turn is a more valid criterion as to the amount of widening required than is the size of the deflection angle, were rejected by the Panama Canal engineers since the equations neglected not only the deflection angle but also the length of the ship. The U.S. Navy Design Manual (DM-26) dated July 1968 relates the radius to the deflection angle and to the length of ships for speeds up to 10 mph. DeMiranda at the XIV Congress of P.I.A.N.C. also suggested that the radius of curvature for vessel speeds 8 to 10 mph are related to the deflection angle. Still other criteria establish a radius requirement with respect to the length of ships. However, as pointed out in Tidal Hydraulic Report No. 3, the width of channel bends is to a considerable extent based on the peculiarities of the ship and the diligence and skill of the helmsman.

(3) Reaches of the Sacramento River Deep Water Ship Channel. - The ship channel can be separated into three reaches based on conditions in the existing channel that must be considered when determining appropriate channel widths. These reaches are: New York Slough to Junction Point (CM 15.0), Junction Point (CM 15.0) to the Entrance to the manmade channel (CM 18.6), and the Entrance to the manmade channel (CM 18.6) to the Port of Sacramento.

(a) New York Slough (Pittsburg) to Junction Point (CM 15.0).- In this reach, the channel is within the Sacramento River which is narrower and subject to higher current velocities than the previous downstream reaches. Only vessels bound for or departing from the Port of Sacramento use this channel, and based on future traffic projections, a one-way channel is considered adequate in this reach. Vessel movements in the ship channels between San Francisco Bay and New York Slough which are common to ships using the Port of Sacramento and other ports are controlled by a state-of-the-art radar and radio network which is administered by the U.S. Coast Guard. To prevent collisions in the channel, the Port of Sacramento's operations office uses two-way radio communication in coordination with the Coast Guard system to control vessel movements between New York Slough and the Port of Sacramento. Wind and currents are generally parallel to the ship channel in this reach and are not a problem. Bottom sediment consists of medium to fine sand which poses no hazard to navigation provided the channel is adequately maintained. Based on these channel conditions and as shown in Figure VI-2, a value of 180 percent of the vessel's beam for the maneuvering lane, and a value of 80 percent of the vessel's beam for the bank clearance are considered appropriate for this reach.

(b) Junction Point (CM 15.0) to the Entrance to the Manmade Channel (CM 18.6). - This reach lies within a portion of Cache Slough between the Sacramento River and the manmade portion of the channel and is the narrowest portion of the natural waterway. This channel carries high winter flows from the Yolo Bypass and hence can be subject to high current velocities. This reach also needs only to provide for one-way traffic. As in the previous reach, winds and bottom sediment do not adversely affect navigation. The direction of flow in this reach is parallel to the ship channel. The increased velocities in the winter do not adversely affect navigation. However, increased power must be applied in order to maintain forward motion when going to the port. The same maneuvering lane and bank clearance should be allowed as for the reach from New York Slough to Channel Mile 15.0, as shown on Figure VI-2.

(c) The Entrance to the Manmade Channel (CM 18.6) to the Port of Sacramento. - This reach is the manmade portion of the channel and is relatively straight and uniform. This reach is in slack water and is not subject to winds perpendicular to the direction of travel. The bottom material, however, consists of silty clays and silty sands which may be a greater hazard than downstream sediments. A one-way channel is adequate. The conditions present in this reach are not characteristic of those that would adversely affect navigation. Therefore, as shown in Figure VI-3, a value of 160 percent of the vessel's beam and a value of 70 percent of the vessel's beam are considered appropriate for this reach.

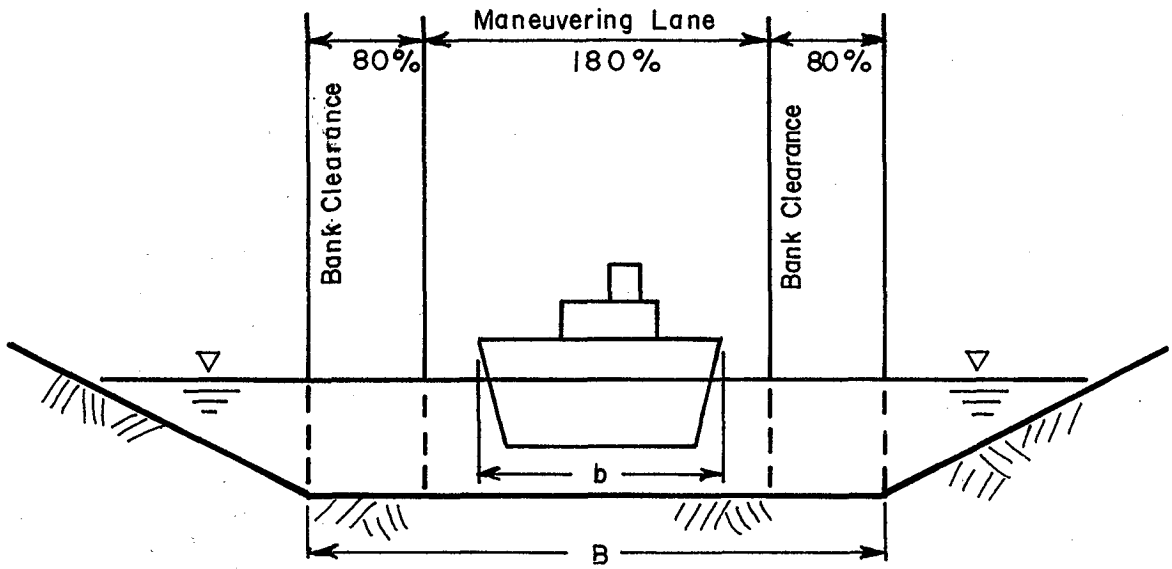

FIGURE VI - 2

ONE-WAY TRAFFIC
NEW YORK SLOUGH TO MILE 15.0
AND
JUNCTION POINT (MILE 15) TO MILE 18.6
(Given in % of Vessel Beam)

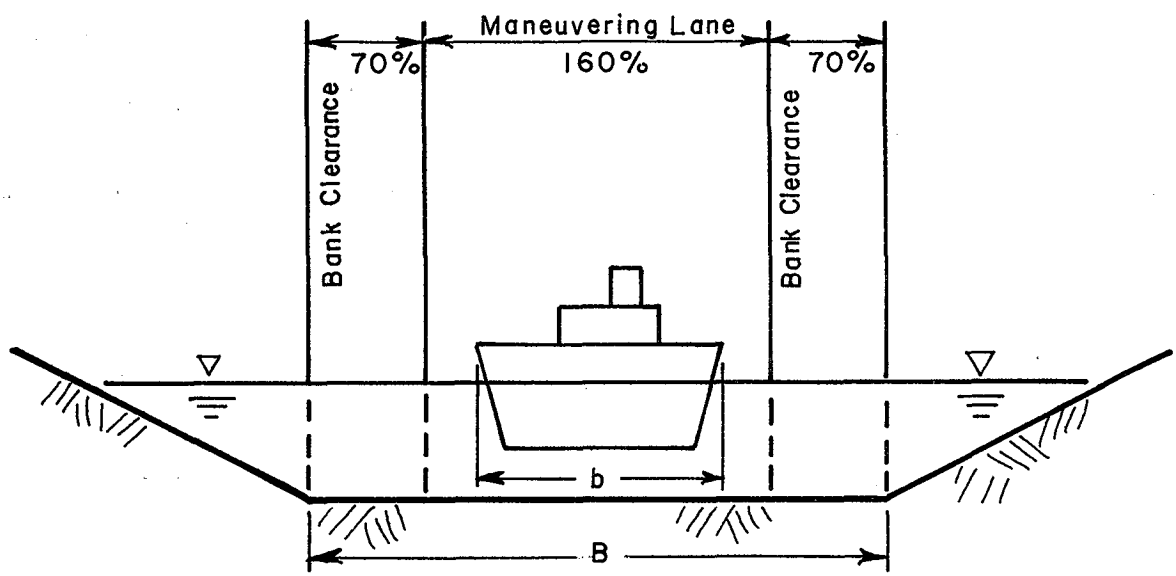

FIGURE VI - 3
ONE-WAY TRAFFIC
RIVER MILE 18.6 TO PORT OF SACRAMENTO
(Given in % of Vessel Beam)

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(4) Channel widths in straight channels. - The "design vessel" for a 35-foot deep channel has a static freshwater draft of 32 feet, a beam of 83 feet and a length of 600 feet. Table VI-4 presents a summary of minimum channel widths for the "design vessel" based on information previously presented. For comparison, also shown on Table VI-4 are channel widths for a vessel with a 100-foot beam and 800-foot length since it is known that ships exceeding these dimensions have occasionally called at the port in the past and can be expected to do so in the future.

(5) Channel widths in bends. - In examining the design criteria for ship channel bends, it is apparent that channel bends ultimately will be designed based on judgment, actual ship maneuvering experience, and empirical equations based on ship widths and lengths. To investigate possible required increases in channel widths at bends of the Sacramento River Deep Water Ship Channel, various computations were made using the empirical equations and rules of thumb contained in the Tidal Hydraulics Report No. 3, and in P.I.A.N.C. and other publications. Tables VI-5 through VI-8 show the results of such computations for the "design vessel." For the sake of comparison, information is also shown for a larger vessel with a 100-foot beam and 800-foot length.

TABLE VI-4

SHIP CHANNEL WIDTHS

Ship Channel Reach	Existing Ship Channel Bottom Width	Designed Bottom Width	Bottom Width Based on Information Presented Herein: Minimum Bottom Width for "Design Vessel" (83' beam, 600' length)		Minimum Bottom Width for Larger Vessel (100' beam, 800' length)	
			Computed	Rounded	Computed	Rounded
New York Slough to Channel Mile 15.0	300	350	282	300	340	350
Mile 15.0 to Channel Mile 18.6	300	300	282	300	340	350
Channel Mile 18.6 to the Port of Sacramento	200	250	249	250	300	300

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TABLE VI-5

BEND AT CHANNEL MILE 16.0

BEND RADIUS (Present Design Radius = 6,500 feet)

Reference	Minimum Radius Based on "Design Vessel" (83' beam, 600' length)	Minimum Radius Based on Larger Vessel (100' beam, 800' length) (ft)	(ft)
DeMiranda	5,800	8,000	
Kray, J. C.	7,000	10,000	
Navy DM-26	3,000 1/	3,000 1/	

1/ The tangent length between consecutive curves should be 1,000 ft or 2 lengths of the largest ship using the channel, whichever is larger.

INCREASE IN CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 6,500 feet)

Reference	Increase in Bottom Width for "Design Vessel" (ft)	Increase in Bottom Width for Larger Vessel (ft)
Carvalho	14	25
Kiel Canal	20	20
Chent-Terneuzan Canal	111	198
Navy DM-26	Widen on inside of curve	Widen on inside of curve

CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 6,500 feet)

Present Design Bottom Width length)	Minimum Bottom Width for "Design Vessel" in Straight Channel	Minimum Bottom Width for Large Vessel in Straight Channel	Reference	Minimum Bottom Width in Bend Based on "Design Vessel" (83' beam, 600' length)	Minimum Bottom Width in Bend Based on Larger Vessel (100' beam 800'
300	300	350	Carvalho	300	375
			Kiel Canal	300	350
			Ghent-Terneuzan Canal	400*	500*
			Navy DM-26	-	-

* These values are considered to be too conservative based on the other methods represented and the knowledge of how the vessels actually maneuver.

TABLE VI-6

BEND AT MILE 17.0

BEND RADIUS (Present Design Radius = 9,100 feet)

Reference	Minimum Radius Based on "Design Vessel" (83' beam, 600' length) (ft)	Minimum Radius Based on Larger Vessel (100' beam, 800' length) (ft)
DeMiranda	6,000	8,000
Kray, J. C.	7,000	10,000
Navy DM-26	3,000 1/	3,000 1/

1/ The tangent length between consecutive curves should be 1,000 ft or 2 lengths of the largest ship using the channel, whichever is larger.

INCREASE IN CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 9,100 feet)

Reference	Increase in Bottom Width for "Design Vessel" (ft)	Increase in Bottom Width for Larger Vessel (ft)
Carvalho	10	18
Kiel Canal	0	0
Chent-Terneuzan Canal	79	141
Navy DM-26	Widen on inside of curve	Widen on inside of curve

CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 9,100 feet)

Present Design Bottom Width	Minimum Bottom Width for "Design Vessel" in Straight Channel	Minimum Bottom Width for Large Vessel in Straight Channel	Reference	Minimum Bottom Width in Bend Based on "Design Vessel" (83' beam, 600' length)	Minimum Bottom Width in Bend Based on Larger Vessel (100' beam 800' length)
300	300	350	Carvalho	300	350
			Kiel Canal	300	350
			Ghent-Terneuzan Canal	350	475*
			Navy DM-26	-	-

* These values are considered to be too conservative based on the other methods represented and the knowledge of how the vessels actually maneuver.

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TABLE VI-7

BEND AT MILE 36.0

BEND RADIUS (Present Design Radius = 5,000 feet)

Reference	Minimum Radius Based on "Design Vessel" (83' beam, 600' length) (ft)	Minimum Radius Based on Larger Vessel (100' beam, 800' length) (ft)
DeMiranda	1,800	2,400
Kray, J. C.	7,000	10,000
Navy DM-26	3,000 1/	3,000 1/

1/ The tangent length between consecutive curves should be 1,000 ft or 2 lengths of the largest ship using the channel, whichever is larger.

INCREASE IN CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 5,000 feet)

Reference	Increase in Bottom Width for "Design Vessel"(ft)	Increase in Bottom Width for Larger Vessel (ft)
Carvalho	18	32
Kiel Canal	35	35
Chent-Terneuzan Canal	145	258
Navy DM-26	Widen on inside of curve	Widen on inside of curve

CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 5,000 feet)

Present Design Bottom Width	Minimum Bottom Width for "Design Vessel" in Straight Channel	Minimum Bottom Width for Large Vessel in Straight Channel	Reference	Minimum Bottom Width in Bend Based on "Design Vessel" (83' beam, 580' length)	Minimum Bottom Width in Bend Based on Larger Vessel (100' beam 800' length)
200	250	300	Carvalho	250	325
			Kiel Canal	300	325
			Ghent-Terneuzan Canal	400*	500*
			Navy DM-26	-	-

* These values are considered to be too conservative based on the other methods represented and the knowledge of how the vessels actually maneuver.

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TABLE VI-8

BEND AT MILE 41.0

BEND RADIUS (Present Design Radius = 8,000 feet)

Reference	Minimum Radius Based on "Design Vessel" (83' beam, 600' length) (ft)	Minimum Radius Based on Larger Vessel (100' beam, 800' length) (ft)
DeMiranda	6,000	8,000
Kray, J. C.	7,000	10,000
Navy DM-26	3,000 1/	3,000 1/

1/ The tangent length between consecutive curves should be 1,000 ft or 2 lengths of the largest ship using the channel, whichever is larger.

INCREASE IN CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 8,000 feet)

Reference	Increase in Bottom Width for "Design Vessel" (ft)	Increase in Bottom Width for Larger Vessel (ft)
Carvalho	11	20
Kiel Canal	5	5
Chent-Terneuzan Canal	90	160
Navy DM-26	Widen on inside of curve	Widen on inside of curve

CHANNEL WIDTH IN BEND
(Present Design Bend Radius of 8,000 feet)

Present Design Bottom Width	Minimum Bottom Width for "Design Vessel" in Straight Channel	Minimum Bottom Width for Large Vessel in Straight Channel	Reference	Minimum Bottom Width in Bend Based on "Design Vessel" (83' beam, 600' length)	Minimum Bottom Width in Bend Based on Larger Vessel (100' beam, 800' length)
200	250	300	Carvalho	250	325
			Kiel Canal	250	300
			Ghent-Terneuzan Canal	450*	450*
			Navy DM-26	-	-

* These values are considered to be too conservative based on the other methods represented and the knowledge of how the vessels actually maneuver.

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d. Safety aspects and other considerations.

(1) Accident records. - Since the port opened in 1963, there have been no collisions and only twelve reported groundings. The only reported incident that threatened the safety of a vessel in the Sacramento River Deep Water Ship Channel was in February 1977. The vessel Oji Maru No. 1 was stopped in mid-channel near Pittsburg due to a dredge that was in or near the ship channel. The dredge, The Missouri, was being used in maintenance dredging and was moored and left unattended. The Oji Maru No. 1 after waiting several hours for the dredge to be moved attempted to pass the obstruction and grounded on the edge of the ship channel. No damage was incurred due to this incident. Besides this grounding, eleven other groundings were reported, ten due to shoaling problems and one due to a misplaced buoy (all freed without damage to equipment and personnel). The majority of the groundings occurred in the reach from Channel Mile 6.2 to Channel Mile 15.0. In this reach, especially in the vicinity of the Rio Vista Bridge (CM 13.0), rapid shoaling occurs. The deposition of silt carried through the smaller upstream rivers and sloughs that have relatively higher velocities than the wider Sacramento River channel causes the channel width to decrease as the silt deposits on the channel bottom. The groundings may therefore have been caused by the decrease in lane width or depth due to shoaling.

(2) Channel operating procedures. - The outstanding safety record for the Sacramento River Deep Water Ship Channel is attributable to the operating procedures used on the channel. Existing vessel traffic is limited to one-way travel from Avon to the Port of Sacramento and is monitored by state-of-the-art radar and two-way radio communication to keep the channel clear from obstructions and other traffic. Besides this and proper seamanship, the following procedures also are utilized to ensure safe vessel travel.

(a) Pilots. - The San Francisco Bay Pilots Association furnishes pilots for the vessels that are to travel to inland ports. The pilots are experienced on the ship channels and know where problem areas exist. The pilots do not travel the Sacramento River Deep Water Ship Channel in a wide beam vessel after dusk because a loaded or large ship transiting the channel in the dark could deviate from the center of the channel undetected. Since large vessels currently have only about 50 feet of clearance on each side and the pilot cannot detect slight changes in vessel direction, the probability of vessel accidents increases. The pilots do not unduly risk the vessel, cargo or crew at any time.

(b) Vessel schedule. - The larger beamed vessels are not scheduled for evening travel. Loaded vessels with drafts greater than the design also schedule their departures to coincide with high tides to eliminate the need to stop in the manmade portion of the channel. The vessels must reach New York Slough on high tides since the channel above this point is too narrow to anchor in. (Vessels only have bow anchors and would be swung across the channel by tidal action.) Vessels can also be scheduled so that any potential delays due to the one-way channel are minimized and collisions avoided.

(c) Speed restrictions. - Speed restrictions have been established for the existing channel, and all ocean going or port bound vessels operate under these controlled speeds. Between Toland's Landing (CM 6.2) and the Rio Vista Bridge (CM 13.0) when going against a current, the maximum speed over the bottom is 8 knots. When going with the current, in slack water, or against a current of 2 knots or less, the maximum speed through the water is limited to 10 knots. Between the Rio Vista Bridge and the Port of Sacramento when going against a current, the maximum speed over the bottom is limited to 5 knots. When going with the current, in slack water, or against a current of 2 knots or less, the maximum speed through the water is limited to 7 knots. It is not anticipated the existing speed limits will be modified for the deepened channel.

(3) Vessel congestion. - 2,665 deep draft vessels have called at the port during the 20+ years the port has been in operation. This is equivalent to 5330 transits of the channel. The existing navigation traffic is limited to one-way movement. This traffic pattern will remain the same with the channel improvements, and the two-way movement from Avon to New York Slough stated in the feasibility report has been deferred until the number of vessel movements warrants widening. The construction of that reach under the San Francisco Bay to Stockton project will not provide additional width for two-way traffic at the present time but will allow the safe passage of vessels loaded to a deeper draft now and into the near future. Congestion on the channel is not a problem today with 100-150 vessels calling at the Port per year (range for the last ten years) but between 450-475 vessels are expected to call at the Port and 250-300 vessels are expected to call at Collinsville in year 2037, the last year of economic life.

(4) Effects on bank erosion. - Ship generated waves, wind waves and river currents contribute to bank erosion along the Sacramento River Deep Water Ship Channel. The controlling force varies in the different reaches and on either side of the channel according to channel characteristics, traffic and bank materials. Many of the levees along the channel were revetted in conjunction with construction of the existing 30 foot deep channel and the Federal government has the responsibility for operation and maintenance of portions of the levees along the ship channel. Non-Federal interests are responsible for the remaining areas. Most of the bank protection maintenance work accomplished has been in the reach between Channel Mile 15 and Channel Mile 25 (in the manmade portion of the channel).

A comparative analysis of ship generated waves for the existing and proposed ship channels was made using the approach presented in EM 1110-2-1613, "Hydraulic Design of Deep Draft Navigation Projects." Also, the refraction and diffraction techniques contained in the Shore Protection Manual were used to compare the bank runups on riprapped slopes. The analyses indicate that since squat values will not change significantly and the largest change in the ship to shore distance is only 25 feet, there will be no significant change in ship generated wave effects on bank erosion. Therefore, the existing responsibilities for maintenance will not be altered.

(5) Views of Coast Guard and waterway users.

(a) Coast Guard. - South Pacific Division personnel discussed the proposed project with the Twelfth Coast Guard District, Aids to

Navigation Branch, on 30 January 1981, who indicated that their concerns centered on the need to relocate or replace navigational aids. They have recently been coordinated with to provide information on the relocation of navigation aids. The cost of required navigational aids has been included in the cost estimate for the selected plan of improvement.

(b) Channel pilots. - Channel pilots were interviewed to discuss possible areas of concern and their opinions of various aspects of the project. All the pilots interviewed were in favor of the project. They feel that the deepening and widening will increase safety for the larger ships visiting the Port of Sacramento. The main problem areas on the channel are just below the Rio Vista Bridge, the curves on the manmade portion of the channel, the crosswind and currents in the Cache Slough, and bank suction at Toland's Landing. The pilots feel that the channel widening will help to alleviate and/or increase safety in these areas. The pilots do not foresee any safety problems associated with the extended approach to construction, since the likelihood of larger ships visiting the Port of Sacramento will not be realized until the channel improvement projects downstream (John F. Baldwin Project) are completed.

The pilots were also asked about the practice of ships taking on salt water as ballast at sea and then discharging it at the Port. This is a common practice for the wood chip vessels. They need the ballast at sea so the ship will stay low enough in the water for adequate maneuverability. Once in the ship channel, the ships need to stay low enough in the water to be able to cross under the bridges and power lines. The Port has asked the pilots to request the ship captains to discharge the salt water and take on brackish water prior to heading upstream to the Port. It is difficult to determine how this practice has worked since the number of wood chip vessels visiting the Port has decreased in the last few years due to the world economic situation.

The pilots feel that for the most part the navigation aids are adequate but a few more could be placed downstream of the Rio Vista Bridge and in the Cache Slough area. They do not feel that any restrictions on ship travel (day time only, extra aids, etc.) need to be implemented because of the project, but they would like to have daytime travel for the largest ships before, during and after construction. They feel that ship sizes are getting larger, approaching the Panama size vessel. They state that these ships will have no major problems navigating the channel but the length of the ships will be limited to approximately 750 feet due to the curves in the manmade channel. The detailed interviews are included in Appendix A.

(c) Others. - Other waterway users have previously communicated their views. By letter dated 31 December 1980, the Commanding Officer, Naval Weapons Station, Concord, California, indicated that the channel improvements would improve navigability and, therefore, enhance the Navy's rigorous safety program covering shiploading and improvement operations. Captain J. S. Going of the Harbor Safety Committee of the Marine Exchange commented on the safety aspects of the proposed improvements in his 2 January 1981 letter. Captain Going stated that the improvements would enhance vessel maneuverability and directional stability and consequently lessen exposure to the possibility of grounding, lessen risk to structures enroute, and reduce risk to the safety of vessels and their crews. H. B. Sims, Master of the SS Cornucopia, by letter dated 1 December 1980,

stated that deepening the channel to 35 feet would eliminate the need to wait for favorable tidal conditions, improve operation efficiency, and prove beneficial to the marine industry as a whole.

e. Summary and justification of design. - Factors affecting channel dimensions include the size and maneuverability of the vessel, current velocity and direction, tidal stage, wind speed and direction, vessel speed, characteristics of the channel bottom and banks, efficiency and economics and in the case of an existing channel, any specific considerations resulting from experience gained in the use of the channel. The channel dimensions are summarized below with a discussion of the justification for the chosen design.

Reach	Width (feet)	Depth (feet below -2.0 NGVD)
New York Slough to Junction Pt. (15.0)	350	35
Junction Point to the Entrance to the Manmade Channel (CM 18.6)	300	35
Entrance to the Manmade Channel to the Port of Sacramento	250	35

The channel depth required is 35 feet below elevation - 2.0 NGVD without accounting for the tides. This allows the design draft of 31.2 feet (in salt water) sufficient depth for keel clearance, squat and freshwater sinkage. Trim and pitch, roll, and heave are considered negligible due to the vessel's loading conditions (i.e., even keel) and the calmness of the channel waters, respectively. However, larger drafted vessels can safely transit the channel by using greater water depths due to tidal action.

The appropriate channel widths were determined according to the lane percentages discussed in paragraphs 29c, the size of the vessel, and specific considerations. The following paragraphs discuss the chosen design and justification for the specified reaches.

(1) New York Slough to Junction Point (CM 15.0). - The design width of 350 feet throughout this reach is justified by the need for sufficient width to allow the safe passage of ships. Ten of the twelve groundings reported occurred within this reach. The shoaling in this reach is suspected to account for a majority of these groundings. The channel width based on the design vessel with a beam of 83 feet and the considerations in paragraph 29c yield a width of 300 feet. However, due to the shoaling reducing the channel width between maintenance dredging contacts and other considerations, it was decided to increase the channel width to allow a contingency in order to insure the safe passage of vessels. The larger vessel (100-foot beam) using the channel was chosen to determine the design width of 350 feet. The design will lessen the effect of shoaling on navigation and may slightly reduce the frequency of maintenance dredging. The 3 mile portion from New York Slough to Collinsville will not require deepening or widening due to its natural depth of over 35 feet and width over 400 feet.

(2) Junction Point (CM 15.0) to the Entrance to the Manmade Channel (CM 18.6). - The design vessel in this reach is the 83-foot beam vessel. There are no characteristics of the banks, bottom sediment or alignment which necessitate the need for a design based on a larger vessel. The design channel width of 300 feet is based on the lane percentages and considerations described in paragraph 29c.

(3) Entrance to the Manmade Channel (CM 18.6) to the Port of Sacramento. - The design considerations and lane percentages applied to the design vessel produce a channel width of 250 feet. Interviews with the pilots reveal that they believe the width is sufficient for safe passage of the design vessel and larger vessels. The larger vessels currently use the channel without much problem. The 250-foot channel will enhance the safety for all vessels since the vessels will be traveling at deeper drafts. In addition, expanding the channel width beyond 250 feet would significantly increase construction and disposal costs due to the large quantity of material encountered in cutting the banks of the manmade channel. There are no characteristics within the channel (bank material, bottom sediment, wind and alignment) which cause any detrimental effects on vessel passage.

(4) Bends. - The bends in the reaches will be transitioned and aligned to accommodate the vessel's increased path. The construction of the channel will be sequenced to deepen to the design depth and then widen to the specified channel width. The widening of the curves to the design widths will occur in the deepening sequence in order to allow an added degree of safety for vessel passage until the widening of the straight channel reaches is completed.

f. References - Following is a list of references used in determining the appropriate channel dimensions for the project.

(1) EM 1110-2-1607, Tidal Hydraulics, dated August 2, 1965.

(2) Chapter X, Design of Channels for Navigation, Tidal Hydraulic Commission Report No. 3, dated May 1965.

(3) Waugh, R. G., "Planning and Designing Deep Draft Navigation Channels," a paper presented at Waterways Experiment Station Deep Draft Navigation Channel Design Conference, Vicksburg, Mississippi, May 16, 1978.

(4) Bulletin No. 16, pages 88-93; Permanent International Association of Navigation Congresses, publication dated 1973.

(5) "Proposed Procedures for Determining Ship Controllability Requirements and Capabilities," a paper presented at the First Ship Technology and Research (STAR) Symposium, Washington, D.C., August 26-29. 1975.

(6) Eda, H., "Directional Stability and Control of Ships in Restricted Channels," a paper presented at the Annual Meeting, New York, N.Y., November 11 and 12, 1971, of The Society of Naval Architects and Marine Engineers.

(7) 24th International Navigation Congress, Section 1, Inland Navigation, Subject 3.

(8) U.S. Navy Dept. Design Manual, Harbor and Coastal Facilities, Navdocks DM-26 Facilities Engrg. Command, Washington, D.C., July 1968.

(9) DeMiranda, C.F.V. XIV Congress, Permanent International Association of Navigation Congresses, 2nd Section, 1st Communication, Cairo, 1926.

(10) Kray, J. C., Layout and Design of Channels and Maneuvering Areas, Permanent International Associaton of Navigation Congress, Volume II, 1975.

(11) Sewell, T. F. D., "Factors Involved in Developing the Suez Canal," P.I.A.N.C., 1978.

(12) Mobile Harbor Channel Design Summary Report as presented by Mr. Jim Baxter, Mobile District at the Deep Draft Channel Design Conference, 16-18 May 1978, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Mississippi.

(13) ETL 1110-2-209, Engineering and Design - Navigation Channels and Channel Depths, dated February 23, 1976.

(14) ER 1110-2-1404, Deep Draft Navigation Project Design, September 24, 1981.

(15) Em 1110-2-5025, Engineering and Design - Dredging and Dredged Material Disposal, March 25, 1983.

31. **Surveys and explorations**.

a. Surveys. - Color aerial photographs of the project channel were taken from Collinsville to the Port of Sacramento in 1977 and used to estimate impacts to wetland vegetation along the ship channel due to the widening and deepening. Field visits supplemented the evaluation of disposal sites for environmental purposes. Field surveys allowed reasonable approximations of disposal site volume capacities.

Quantity estimates for project dredging from Collinsville to Sacramento are based on the latest available sounding data. Most of the channel has been sounded for maintenance dredging purposes since 1980. One exception is the Cache Slough project reach (Channel Mile 15.0 to 18.6), which has not needed maintenance dredging since original construction. Recent surveys in that reach have been completed and the results incorporated into this GDM.

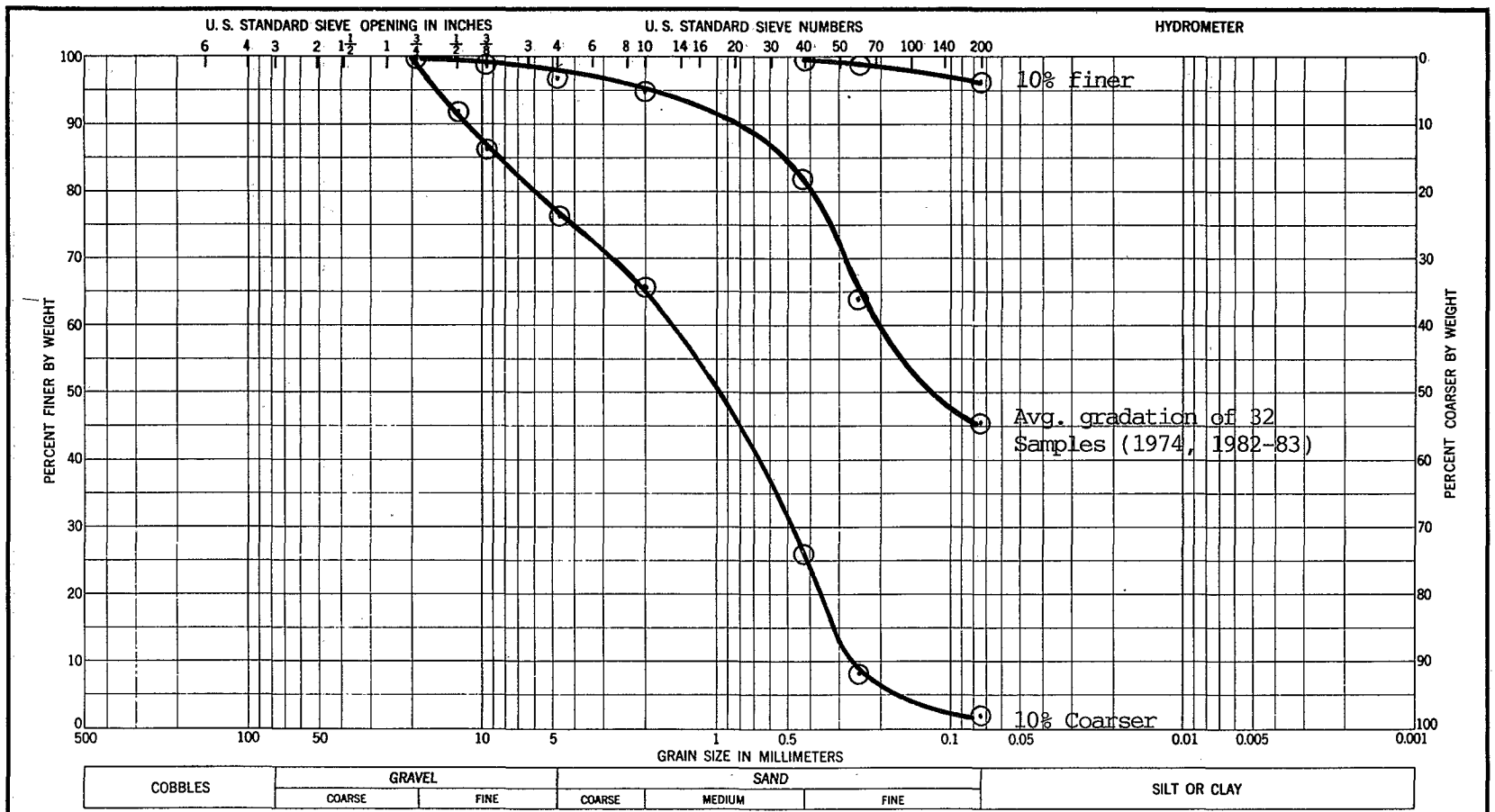
b. Explorations. - Extensive soils information was obtained during design and construction of the original 30-foot ship channel. A summary of that information is included in Appendix G. In addition, in November 1974, six over-water borings were made in the Sacramento River Deep Water Ship Channel from Mile 0.0 to the center of the Turning Basin in the Port of Sacramento. The hole locations are indicated on Plate D-1. A total of 24 push-tube samples were obtained, ranging in depth from 4 feet to 12.5 feet.

In August 1982 and May 1983, ten additional borings were made along the channel. These are designated as 2F-1A through 2F-4A and 2F-5 through 2F-10. Twenty-five 3" diameter Shelby tube samples were taken from depths of 4 to 6 feet. Adjacent to sites 2F-1A through 2F-4A, companion samples 2F-1B through 2F-4B were taken for chemical analyses of the bottom sediments. At present, a third phase of channel bottom explorations is being undertaken to further determine the soil characteristics and aid in the design of the disposal sites in order to meet water quality requirements. Explorations along the entire channel length will be obtained by over-the-water drilling equipment. Samples of soil and water will be obtained at 31 sites using established procedures. These samples will be subjected to tests including the modified elutriate test, the elutriate test, column settling tests, grain size distribution and other soil characteristic tests. The results will be used to obtain water quality certification, aid in the design of the disposal sites and provide information on the types of materials to be expected in the dredging process. The results will be available prior to the start of construction. The laboratory soil results for the previously completed explorations are discussed in paragraph 38, and chemical test results are covered in the FSEIS.

c. Laboratory testing. - The South Pacific Division Laboratory performed primary testing on river bottom samples from the 1974 and 1982-83 explorations. A total of 32 gradation samples (22/1974 and 10/1982-83) were tested. Testing consisted of gradation analyses, Atterberg limits, moisture-density (1982-83 only), and chemical tests. The test results are discussed in Appendix G. The gradation curve, Figure VI-4, indicates the average grain size distribution of the 32 samples with 80% of the samples falling between the 10% finer and 10% coarser curves. The liquid limit (LL) ranged from 35 to 198 (Avg 89) and the plasticity index (PI) ranged from 16 to 124 (Avg 55). Some samples were classified as organic clay, sand and gravelly sand. In general, however, the samples are classified as fine grained silty and clayey sand. Moisture-density tests performed on the 1982-83 samples indicate dry unit weights ranging from 58.0 pcf to 107.2 pcf (Avg 84 pcf). These unit densities are probably much higher than in-situ values since the test samples were obtained by driving a standard split-spoon sampler. Additional explorations are planned during preparation of plans and specifications.

32. **Dredging**. - All channel dredging will likely be done by hydraulic suction dredge to a maximum depth of 36 feet below elevation - 2.0 NGVD. This depth includes 1 foot of over depth dredging below the 35-foot depth to allow for the inaccuracies in the dredging process. Approximately 21.5 million cubic yards will be dredged and disposed on about 4464 acres of upland disposal area with a total available capacity of 30 million cubic yards.

The quality, classification, and other data on the material to be dredged is included in Appendix G, Analysis of Bottom Sediments. Dredging and disposal operations will be accomplished in a manner to comply with applicable State and Federal water quality standards.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
Avg. of 32 Samples	4'-12' Depth	Silty and Clayey Sand		35-198		16-124

Project SRDWSC River Bottom Sampling Mile 0 to Mile 43

Area

Boring No.

Date January 1985

GRADATION CURVES

Figure VI -4

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33. **Dredged material disposal**. - A detailed description of all dredged material disposal sites is included in Appendix D, Dredged Material Disposal Areas. These descriptions are based on field investigations and include topography, vegetation, fish and wildlife values, and any existing improvements.

Based on existing topography, an average depth of in-situ channel fill was computed, and existing and future land use and wildlife and esthetic values of each was determined. Table IV-2 in Chapter 4 summarizes the area and capacity of each site. Guidance in selection and sizing of the disposal areas was drawn from the Dredged Material Research Program (DMRP), such as (1) TR D-77-21, "Sizing of Containment Areas for Dredged Material," October 1977 and (2) TR DS-78-10, "Guidelines for Designing, Operating, and Managing Dredged Material Containment Areas," December 1978, and EM 1110-2-5025, "Dredging and Dredged Material Disposal," March 25, 1983. Generally, dredged material disposal dikes will be of new construction using the guidance developed by the DMRP, specifically TRSPD-77-9, "Design and Construction of Retaining Dikes for Containment of Dredged Material," August 1977. Based on foundation explorations primarily obtained prior to original construction, field observations, and experience during maintenance dredging disposal site operation, the following dike cross sections should be used. Unless otherwise noted, the standard containment dike cross section (1V:3H; 12 ft crest width) and interior dike cross section (1V:2H; 8 ft crest width) should be used. See Table VI-9 summarizing the containment dike maximum heights. Generally, the maximum height for the standard interior dikes should be 12 feet. Where higher interior dikes are required, 1V:2.5H slopes could be used to a maximum height equal to the containment dikes for that site.

Dredged material disposal site capacity is based on an allowance of volume twice the in-situ channel sediment volume. The factor is required to allow for bulking of sediments at the site, water ponding volume, capacity to allow sufficient detention time to meet water quality standards, potential increases in disposal quantities due to contractor overdredging and other uncertain factors. In addition, a two-foot freeboard for the disposal sites is required. The actual sizing of disposal sites in accordance with DMRP Technical Report TS 98-10 will be made using the results from the additional soils explorations and settling tests. These explorations and testing will be performed shortly and additional explorations may be made during the preparation of plans and specifications.

Material from most disposal areas will be available, at the discretion of the owners of the sites, for commercial uses such as fill material or for future construction needs outside the immediate project area. These needs might include levee construction or improvement in the Delta, future highway construction, or structural fill for commercial and industrial development. The material from maintenance dredging has been in the past removed periodically from disposal sites S-16 (Rio Vista) and S-14 (Grand Island) and used as fill material. Similarly, material dredged during deepening of the Sacramento River Deep Water Channel would be available for reuse in other areas.

TABLE VI-9
RECOMMENDED MAXIMUM CONTAINMENT
DIKE HEIGHTS

SITE	MAX HT. (FT)	NOTES
S-1	20	
S-4	20	
S-7	20	
S-9	20	
S-11	20	Raise southern levee 5 or 6 feet to attain the 20 ft height.
S-12	5	Weak foundation. Use 1V:4H slopes. Maximum rate of fill 5 ft/yr to 15 ft maximum.
S-13	20	
S-14	15	
S-16	20	
S-19	15	Remove and recompact dredge deposits beneath proposed containment dikes.
S-20	20	
S-21	20	Marsh areas should be avoided. Extensive vegetation on present levee.
S-31	20	Same as S-19
S-32	20	Same as S-19
S-35	20	Marsh area near river should be avoided.

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34. **Recreation plan**. - In the 1980 Feasibility Report for the deep water ship channel project, eleven potential recreation sites with facilities ranging from fishing access to day-use/camping areas were identified. Potential recreation developments were discussed with several non-Federal agencies as potential recreation sponsors; these agencies were the State of California, Sacramento County, Yolo County, Solano County, East Yolo Community Services District, and the City of Rio Vista. After intensive coordination efforts, the 1980 Recommended Plan was limited to new recreation development at the dredged material disposal site adjacent to the existing facilities at Sandy Beach County Park. This was the only area for which a non-Federal recreation sponsor would commit to cost-sharing in the construction and acceptance of operation and maintenance requirements.

In the 1970's, the Corps had agreed to lease approximately 30 acres of the northern portion of the Rio Vista dredged material disposal area at a nominal cost to Solano County. Solano County developed recreation facilities on a portion of that area. During the 1980 feasibility studies, Solano County proposed expanding those facilities to encompass the entire planned (approximately 30 acres) area. Proposed facilities included day-use picnic sites, a swimming beach, auto access, camping units, automobile and car trailer parking, restrooms, and other support facilities. These facilities were similar and complemented those of the recreation area already developed at the site by Solano County. The proposed recreation facilities recommended in the feasibility report were on part of that Solano County leased area. Since then, Solano County has constructed and developed the proposed facilities (contained in the Feasibility Report) on the leased area at their own expense.

Solano, Yolo and Sacramento Counties were coordinated with in 1984 and 1985 to determine interest in recreation development. All three counties submitted letters of interest for recreation development and requested that consideration be given in the future to use of certain dredged material disposal sites for this development. Solano County Parks Department expressed interest in S-19 (Decker Island), S-21 and S-35 (Collinsville - Montezuma Hills area); East Yolo Community Services District is interested in S-1; and Sacramento County Department of Parks and Recreation was interested in developing part of S-14 (Grand Island). Sacramento County has recently sent a letter withdrawing their interest in this site. See Appendix C for further details.

No recreation development is included in the Selected Plan for the project since no sponsors have submitted letters of intent for any specific recreation development. If letters are received in the future, the recreation development will be considered and the design evaluated at that time. In the meantime, a recommendation to defer recreation will be made.

35. **Habitat mitigation plan for fish and wildlife**. - Impacts to fish and wildlife resources caused by the proposed dredging and disposal activities were evaluated using two methods: a traditional approach and the Habitat Evaluation Procedures (HEP).

a. Traditional approach. - An estimate was made of the amount of each habitat type gained or lost due to dredging, dredge disposal, deposition, or erosion over the study period. The total change in amount of each habitat was estimated for both the No Action (no changes within the channel) and

Selected Plan (deepening and widening the channel) by computing the average annual acreage of each habitat type (wetland or upland) existing over the 55-year study period. The 55-year study period is five originally proposed years for the construction and 50 years post-construction. Because the habitat changes would not be spread evenly over the 55 years, but would mostly occur in the first eight years, it was necessary to calculate the weighted average over the 55 years. The weighted average of each habitat type was calculated; results are discussed in the FSEIS.

b. HEP analysis. - The findings of the HEP analysis are based on project changes provided by the Corps of Engineers prior to June 1985, available data, field investigations, and surveys conducted according to the methods set forth in the Fish and Wildlife Service's HEP analysis. These procedures provide a means to calculate an index of existing and future conditions. Characteristics of the community area were appraised with respect to their value in providing the necessary habitat requirements for selected species. The habitat carrying capacity is displayed as Habitat Unit Values, an index of quality and quantity of the habitat being evaluated. The basic objective of these procedures is to quantify in nonmonetary terms the impacts of the plan and to provide a basis for determining the preservation, compensation and enhancement measures which are needed to maintain the integrity of the ecosystem. The methods and results are described in the FSEIS.

c. Selection of method. - The results of the Habitat Evaluation Procedure were selected for several reasons. First, the HEP is a scientific approach preferred by the fish and wildlife agencies which uses computer modeling techniques to analyze the data. In addition, the HEP uses a multidisciplinary team approach. Subject experts from several agencies participated in decision-making: the U.S. Fish and Wildlife Service, California Department of Fish and Game, Corps of Engineers, Port of Sacramento, and the National Marine Fisheries Service. Group agreement was reached on basic land use assumptions prior to actual analysis.

d. HEP results. - The disposal activities could impact a total of 4,464 acres for the construction phase. Of this total, approximately 2,000 acres could also be used for periodic maintenance dredging disposal. The non-wetland disposal sites are situated in areas mainly used for agricultural purposes (2,239 acres) or in grasslands (2,029 acres), with the remainder in successional stages at existing disposal areas or bare ground. Also, based on an evaluation of cross section information, the maximum possible impact associated with the widening of the channel is the destruction of 43 acres of marsh and riparian vegetation and nine acres of mud flat, of which approximately one-half will reestablish within 7-10 years.

Mitigation needed to offset the project impacts to wetland area and riparian vegetation are explained in detail in Appendix I of the GDM and in the attached FSEIS. Based on the analysis using Habitat Evaluation Procedures, an evaluation team assigned wildlife values to habitat areas impacted by the proposed work and determined that a total of 63 acres of wetland and riparian habitat should be created at Prospect Island. This wetland creation would fully mitigate for project impacts. The mitigation wetland plan has been conceptually designed taking into account factors determined by the HEP. It is based on Corps of Engineers mitigation policy. The design concept represents the likely appearance of the mitigation lands

as determined from present engineering judgement and knowledge from construction of similar lands on other projects. The design will be further refined and coordinated with the fish and wildlife agencies in the final design process of developing the plans and specifications for construction.

36. **Wetlands enhancement potential**. - The disposal of dredged material on lands which are below mean sea level elevation provides the opportunity for enhancement of the fish and wildlife resources of the project area. Section 150 of the Water Resources Development Act of 1976 (PL 94-587) directs the Corps of Engineers to consider establishment of wetland areas, where appropriate, in connection with dredging required for water resource development projects, with costs up to $400,000 borne by the United States. As part of previous investigations, establishment of wetland areas were considered on several locations. One possibility at this time is the development of wetlands on Sherman Island as an enhancement measure for the channel widening and deepening. The fish and wildlife agencies have conditionally recommended development at this time, subject to further study and coordination. In the near future, the potential for the establishment of wetlands will be further investigated. The design of the potential site will be based on maximizing the use of dredged material to create specific habitat and will likely take the form of other enhancement lands developed on Donlon Island and Venice Cut Island under the San Francisco Bay to Stockton deepening project. No construction is proposed at this time.

37. **Levee setbacks**. No levee setbacks are planned. Recent surveys in the Cache Slough project reach (Channel Mile 15.0 to 18.6) have been conducted to determine the exact location of the channel in relation to the low levee along Egbert Tract. The channel can be aligned to avoid or minimize the cutting of the channel banks along the adjacent levees. The alignment will be further refined in the design phase of preparing the plans and specifications. At one time, it was thought that the deepening would cut too close to the levee and that levee setbacks would be required. The proper location of the channel with respect to the levees and the fact that the channel is to be deepened at the existing width of 300 feet eliminate the need for levee setbacks.

38. **Bank protection**. - Bank protection will be provided as needed for existing levees. The proposed deepening will not change the responsibilities for levee maintenance. Under the original project, the responsibilities for maintenance were defined based on primary use. Levees primarily needed for navigation are the responsibility of the Federal government. Levees primarily needed for flood control under the Sacramento River Flood Control Project are maintained by local interests. The responsibilities will not change as a result of the deepening project. No significant increase in bank protection requirements is anticipated as a result of the deepening. However, it is expected that continued maintenance of either the existing channel or the deepened channel will not require placement of additional bank protection.

Bank protection design will depend on its location. Bank protection has been placed along practically all of the Ryer Island levees bordering Cache Slough under either the original channel deepening project authority or Sacramento River Bank Protection Project authority. The maintenance of that bank protection is the responsibility of the State Reclamation Board.

Currently, the Corps has authority to place bank protection in that reach under the existing deep water channel authority if damage can be primarily attributed to deep draft navigation traffic. However, damages to that bank protection in recent years have been the result of factors not related to deep draft navigation. This is not expected to change due to the project. Therefore, no increase in bank protection is anticipated due to the project. If it is found during the life of the project that the damage to the banks can be directly attributed to deep draft navigation traffic, then the placement of additional bank protection under this project will be evaluated on a case by case basis.

39. **Foundation conditions for retention dikes**. - The foundation soils beneath the proposed containment dikes throughout the project reach generally vary from peaty soils from Collinsville to Prospect Island to alluvial soils upstream of Prospect Island. Based on boring logs contained in the 1949 Definite Project Report, from Channel Mile 25 to Channel Mile 43, the foundation soil is generally clay from the surface to an average depth of 10 feet, overlying varying combinations of silts, clays, sands, and gravels to about 25 feet.

For the most part, beneath 25 feet, soils are sand or gravelly sand. In 1958, an extensive exploration program was conducted on Prospect Island. The explorations covered Channel Miles 18.2 to 26.8. Based on the "Supplementary Soils Report," dated March 27, 1959 the upper foundation soils on Prospect Island are weak, highly compressive peat and organic clay and silty soils from the ground surface to a maximum depth of 20 feet. Beneath 20 feet, the soil is composed of firm clay and silty and clayey sand. Soil borings conducted in 1971 on Grand Island indicate an upper 5 feet of fine sand to silty sand overlying silty and organic clays to a depth of at least 22 feet. The clays are described as soft to stiff with one Standard Penetration Test run at 22 feet, with the number of blows N = 2 (soft clay). In 1955, soil borings were made on Sherman Island in the near vicinity of the proposed disposal site (S-20). The upper 4 to 20 feet are composed of sand or clayey sand, overlying peat and clay to about 40 feet, followed by sandy clay to 50 feet, with sand to 60 feet. Some proposed disposal sites have been used in the past for maintenance dredging. These dredged soils are generally loose and have developed shrinkage cracks. The dredged soils beneath the proposed dikes will have to be removed and recompacted.

Tentative cross sections and maximum containment dike heights have been selected based on field observations and the general foundation information discussed above. Throughout most of the project, a dike section with a 12-foot crest, 1V:3H slopes and a maximum height of 20 feet has been selected. For interior dikes, an 8-foot crest width with 1V:2H slopes to 12 feet high has been selected. For interior dikes higher than 12 feet, the slopes are flattened to 1V:2.5H. Prior to construction, it is advisable for those constructing the sites to perform borrow and foundation explorations with laboratory testing at each of the disposal sites. This would ensure an adequate final design at each site.

40. **Source of construction materials**. - The material for containment dike construction can be obtained locally at each of the disposal sites. The borrow material at each site will be either indigenous silt, clay and sand, or silt and sand deposited from past maintenance dredging. In either case, the borrow material would be obtained from the disposal site interior. This

will also increase the disposal site capacity. Prior to construction, an exploration and testing program should be developed and conducted by those performing the construction to determine the engineering properties of the borrow materials.

41. **Real estate requirements**. - The Port of Sacramento agreed to provide the requirements of local cooperation. The channel deepening will require the acquisition of rights on up to 4464 acres of land for dredged material disposal. Approximately 3400 acres is owned (or there are dredged material disposal rights) by either the Port of Sacramento, the Corps of Engineers, or the State Reclamation Board. About 1060 acres is in private ownership and rights will need to be temporarily obtained prior to construction for the construction period. Permanent rights will be needed for the areas where fish and wildlife habitat development for mitigation will be constructed. These rights will require the lands to be used for the intended fish and wildlife purposes in perpetuity.

The bulk of the land acquisition is for dredged material disposal easements. The selection of disposal sites will not be finalized until preparation of plans and specifications. The local sponsor, the Port of Sacramento, will furnish all necessary rights-of-entry for design purposes and all rights-of-way for construction and maintenance. Construction equipment access to the various sites is available from existing public and private roads.

42. **Relocations**. - All necessary relocations will be accomplished by local interests at their expense. All known utilities that are located within the project limits are itemized below in Table VI-10 and their locations are shown on Plate IV, Sheets 1-5. See Table IV-3 for list of Relocations.

TABLE VI-10
Location of Utility Crossings

Mile	Description	Owner	Proposed Action
	Pittsburg to Collinsville - No dredging required due to depth		
0.0	**Collinsville to Junction Point (CM 15.0)**		
1.7	8" Submarine Pipeline	Dow Chemical, USA	None
1.7	Submarine Telephone Cable	General Telephone	None
5.00	26" Pipeline	Pacific Gas and Electric	Lower
4.00	Overhead powerline	Pacific Gas and Electric	None
6.00	Overhead power line	Pacific Gas and Electric	None
6.40	Overhead power line	U.S. Bureau of Reclamation	None
7.00	2 - 12 3/4" high pressure gas line	Pacific Gas and Electric	Lower
8.80	5kv submarine cable	U.S. Army	None
10.00	Pipeline	Standard Oil (Chevron)	None
12.10	Natural gas line	Natural gas (PG&E)	None
12.40	Submerged power line	Great West Power (PG&E)	None
12.50	2 - 10 3/4" high pressure gas line	Pacific Gas and Electric	Lower
12.60	Armored Submarine Cable	Great West Power (PG&E)	None
12.70	Submarine telephone cable	Delta T & T (General Telephone)	None
12.70	3 submarine cables	Division of Highways	None
12.70	Submarine telephone cable	Pacific Gas and Electric	None
12.70	22kv power cable	Pacific Gas and Electric	None
12.93	22kv submarine power cable	Pacific Gas and Electric	None
13.00	Outfall Structure	Blackwelders	None
15.00	**Junction Point (CM 15.0) to Entrance to the Manmade Channel (CM 18.6)**		
15.10	Overhead power line	Ettlinger	None
15.20	Overhead power line	Pacific Gas and Electric	None
17.90	4000 V submerged cable	Pacific Gas and Electric	Lower
18.6	**Entrance to the Manmade Channel (CM 18.6) to Port of Sacramento**		
22.80	Overhead power line	Pacific Gas and Electric	None
23.40	4" gas line	Pacific Gas and Electric	Lower
24.50	Overhead power line	Pacific Gas and Electric	None
24.80	Overhead power line	Pacific Gas and Electric	None
35.90	Overhead power line	Pacific Gas and Electric	None
36.00	Overhead power line	Great West Power (PG&E)	None
38.10	8" pipeline	Standard Oil (Chevron)	None

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TABLE VI-10 (continued)
Location of Utility Crossings

38.80	Outfall Structure	Reclamation District 900	None
41.20	Overhead power line	Pacific Gas and Electric	None
41.40	Outfall Structure	Continential Industrial Park	None
41.50	Overhead power line	Pacific Gas and Electric	None
41.52	Outfall Structure	Continential Industrial Park	None
42.50	Outfall Structure	Port of Sacramento	None

Barge Canal and Lock Structure - No work being done in this reach.

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CHAPTER VII - COSTS

43. **Basis of estimate of first cost**. - The estimated first cost for the selected plan is summarized in Table VII - 1. The cost is based on October 1 1985 price levels. The cost of lands and relocations is based on costs previously estimated by the Sacramento District, Real Estate Division and updated to present price levels. The unit prices used for construction are based on plant, labor, material breakdown and adjustment of average bid prices received on comparable work. A 15 percent contingency allowance was applied to all of the construction work due to the sensitivity of the cost estimate to changes in the estimated quantity of dredged material and the costs to dispose of it. A 35 percent contingency allowance was used for Real Estate estimates due to the preliminary nature of the estimates. Suitable allowances have been made for Engineering and Design and Supervision and Administration which are based on cost experience on comparable work in the Sacramento District. Costs shown are based on current cost sharing allocations specified by the project authorization. The cost sharing is further described in Chapter X Local Cooperation. The detailed estimate of first costs are presented in Table VII - 2.

44. **Basis of estimate of annual cost**. - The estimate of annual cost for the selected plan is presented in Table VII - 3. The annual cost is based on 8-1/8 percent interest rate and a 50-year amortization period. Interest during construction was added to the first cost. Annual charges also include operation and maintenance cost and are based on experience in the Sacramento District. The Selected plan will not increase the amount or extent of maintenance dredging of the channel above preproject conditions. Accordingly, there will be no increase in annual cost. Costs for the operation and maintenance of the fish and wildlife mitigation lands is not expected. No net loss in productivity of lands is reported since any project impacts on lands will be temporary (1-2 years) during dredged material disposal and the lands are expected to be returned to the former use. Corps guidance considers these losses negligible. Therefore, they are reported as zero.

Table VII-1

First Cost Summary

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL, CALIFORNIA

COST ACCT NO.	ITEMS	FEASIBILTY REPORT & ENVIRON. IMPACT (OCT 79 BASE) $	PB-3 DATED 28 FEB 86 (OCT 85 BASE) $	CURRENT GDM ESTIMATE (OCT 85 BASE) $
	FISH AND WILDLIFE FACILITIES			
	FEDERAL WORK			
06.	FISH AND WILDLIFE FACILITIES	250,000	360,000	700,000
30.	ENGINEERING AND DESIGN	25,000	35,000	65,000
31.	SUPERVISON AND ADMINISTRATION	25,000	35,000	65,000
	SUBTOTAL	300,000	430,000	830,000
	NON-FEDERAL COSTS	0	0	380,000
	CORPS OF ENGINEERS COSTS	300,000	430,000	450,000
	NON-FEDERAL WORK			
	LANDS AND DAMAGES	400,000	680,000	100,000
	SUBTOTAL	400,000	680,000	100,000
	NON-FEDERAL COSTS	400,000	680,000	50,000
	CORPS OF ENGINEERS COSTS	0	0	50,000
	TOTAL FEDERAL & NON-FEDERAL	700,000	1,110,000	930,000
	NAVIGATION			
	FEDERAL WORK			
09.	CHANNELS	56,980,000	62,780,000	43,390,000
	Avon to New York Slough	5,300,000	0	0
	Salinity Control Structure	8,100,000	0	0
	Remaining Work	43,580,000	62,780,000	43,390,000
	New York to Collinsville	6,480,000	9,440,000	0
	Collinsville to Sacto	37,100,000	53,340,000	43,390,000
30.	ENGINEERING AND DESIGN	3,650,000	3,670,000	2,190,000
	Avon to New York Slough	350,000	0	0
	Salinity Control Sturcture	500,000	0	0
	Remaining Work	2,800,000	3,670,000	2,190,000
	New York to Collinsville	400,000	520,000	0
	Collinsville to Sacto	2,400,000	3,150,000	2,190,000

Table VII-1 (Continued)

First Cost Summary

COST ACCT NO.	ITEMS	FEASIBILTY REPORT & ENVIRON. IMPACT (OCT 79 BASE) $	PB-3 DATED 28 FEB 86 (OCT 85 BASE) $	CURRENT GDM ESTIMATE (OCT 85 BASE) $
31.	SUPERVISON AND ADMINISTRATION	4,290,000	4,310,000	1,510,000
	Avon to New York Slough	400,000	0	0
	Salinity Control Sturcture	600,000	0	0
	Remaining Work	3,290,000	4,310,000	1,510,000
	New York to Collinsville	490,000	640,000	0
	Collinsville to Sacto	2,800,000	3,670,000	1,510,000
	SUBTOTAL	64,920,000	70,760,000	47,090,000
	NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS	0	0	(230,000)
	SUBTOTAL	64,920,000	70,760,000	46,860,000
	NON-FEDERAL COSTS	0	0	11,710,000
	NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS	0	0	230,000
	TOTAL NON-FEDERAL COSTS	0	0	11,940,000
	CORPS OF ENGINEERS COSTS	64,920,000	70,760,000	35,150,000
	NAVIGATION AIDS (USCG) COSTS	180,000	260,000	550,000
	Avon to New York Slough	50,000	0	0
	Remaining Work	130,000	260,000	0
	New York to Collinsville	30,000	45,000	0
	Collinsville to Sacto	100,000	215,000	35,150,000
	TOTAL FEDERAL COSTS	65,100,000	71,020,000	35,700,000
	NON-FEDERAL WORK			
	LANDS AND DAMAGES	5,080,000	5,930,000	2,960,000
	Avon to New York Slough	1,610,000	0	0
	Remaining Work	3,470,000	5,930,000	2,960,000
	New York to Collinsville	370,000	630,000	0
	Collinsville to Sacto	3,100,000	5,300,000	2,960,000
	RETENTION DIKES	8,340,000	11,170,000	13,850,000
	Avon to New York Slough	470,000	0	0
	Remaining Work	7,870,000	11,170,000	13,850,000
	New York to Collinsville	1,330,000	1,930,000	0
	Collinsville to Sacto	6,540,000	9,240,000	13,850,000

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Table VII-1 (Continued)

First Cost Summary

COST ACCT NO.	ITEMS	FEASIBILTY REPORT & ENVIRON. IMPACT (OCT 79 BASE) $	PB-3 DATED 28 FEB 86 (OCT 85 BASE) $	CURRENT GDM ESTIMATE (OCT 85 BASE) $
	RELOCATIONS	930,000	1,030,000	1,020,000
	Avon to New York Slough	220,000	0	0
	Remaining Work	710,000	1,030,000	1,020,000
	New York to Collinsville	0	0	0
	Collinsville to Sacto	710,000	1,030,000	1,020,000
	TOTAL NON-FEDERAL COSTS	14,350,000	18,130,000	17,830,000
	TOTAL FEDERAL & NON-FEDERAL	79,450,000	89,150,000	65,470,000
	RECREATION FACILITIES			
	FEDERAL WORK			
14.	RECREATION FACILITIES	1,070,000	1,550,000	0
30.	ENGINEERING AND DESIGN	130,000	170,000	0
31.	SUPERVISION AND ADMINISTRATION	100,000	130,000	0
	TOTAL RECREATION FACILITIES	1,300,000	1,850,000	0
	NON-FEDERAL			
	LANDS AND DAMAGES	50,000	90,000	0
	TOTAL NON-FEDERAL COSTS	50,000	90,000	0
	TOTAL FEDERAL & NON-FEDERAL	1,350,000	1,940,000	0
	SUMMARY OF COSTS			
	TOTAL FEDERAL COSTS	66,700,000	73,300,000	36,200,000
	TOTAL NON-FEDERAL COSTS	14,800,000	18,900,000	30,200,000
	TOTAL PROJECT COSTS	81,500,000	92,200,000	66,400,000

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Table VII-2

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
DETAILED ESTIMATE OF FIRST COST
(1 October 1985 Price Levels)

COST ACCT NO	DESCRIPTION		TOTAL COST $
	NAVIGATION		
	NEW YORK SLOUGH (PITTSBURG) TO SACRAMENTO		
	FEDERAL WORK		
09.	CHANNELS		43,390,000
30.	ENGINEERING & DESIGN		2,190,000
31.	SUPERVISION & ADMINISTRATION		1,520,000
	SUBTOTAL		47,090,000
	NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS		- 230,000
	SUBTOTAL		46,860,000
	NON-FEDERAL COSTS	25%	11,710,000
	NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS		230,000
	TOTAL NON-FEDERAL COSTS		11,940,000
	CORPS OF ENGINEERS COST	75%	35,150,000
	NAVIGATION AIDS (USCG) COSTS		550,000
	TOTAL FEDERAL COSTS		35,700,000
	NON-FEDERAL WORK		
	LANDS AND DAMAGES		2,960,000
	RETENTION DIKES		13,850,000
	RELOCATIONS		1,020,000
	TOTAL NON-FEDERAL COSTS		17,830,000
	TOTAL FEDERAL AND NON-FEDERAL COSTS (NAVIGATION)		65,470,000
	FISH AND WILDLIFE MITIGATION		
	FEDERAL WORK		
06.	FISH AND WILDLIFE FACILITIES		700,000
30.	ENGINEERING & DESIGN		65,000
31.	SUPERVISION & ADMINISTRATION		65,000

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Table VII-2 (Continued)

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
DETAILED ESTIMATE OF FIRST COST
(1 October 1985 Price Levels)

COST ACCT NO	DESCRIPTION		TOTAL COST $
	SUBTOTAL		830,000
	TOTAL NON-FEDERAL COSTS	45 %	380,000
	TOTAL CORPS OF ENGINEERS COSTS	55 %	450,000
	NON-FEDERAL WORK		
	LANDS AND DAMAGES		100,000
	SUBTOTAL		100,000
	TOTAL NON-FEDERAL COSTS	45%	50,000
	TOTAL CORPS OF ENGINEERS COSTS	55%	50,000
	TOTAL PROJECT FEDERAL COSTS		36,200,000
	TOTAL PROJECT NON-FEDERAL COSTS		30,200,000
	TOTAL PROJECT FEDERAL AND NON - FEDERAL COSTS		66,400,000

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Table VII - 3

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
DETAILED ESTIMATE OF ANNUAL COST

INVESTMENT COST: NEW YORK SLOUGH (Pittsburg) To SACRAMENTO

FEDERAL:		$
First Cost		36,200,000
Interest During Construction		6,932,550
GROSS (OR NET) INVESTMENT		43,132,550
NON-FEDERAL		$
First Cost		30,200,000
Interest During Construction		5,783,509
GROSS (OR NET) INVESTMENT		35,983,509
TOTAL FEDERAL & NON-FEDERAL GROSS (OR NET) INVESTMENT		79,116,059

ANNUAL COST

FEDERAL:		$
Interest Rate	In Percent % 8.125%	3,504,520
Amortization Rate:	0.00167	71,970
For A Period Of Years Equal to 50		
Adjustment For Net Loss in Productivity		
Of Lands (negligible)		0
Maintenance And Operation:		0
(No change from existing channel)		0
TOTAL FEDERAL ANNUAL COST		3,576,490
NON-FEDERAL:		$
Interest Rate	In Percent % 8.125%	2,923,660
Amortization Rate	0.00167	60,041
For A Period Of Years Equal to 50		
Adjustment For Net Loss in Productivity		
Of Lands (negligible)		0
TOTAL NON-FEDERAL ANNUAL COST		2,983,701
TOTAL PROJECT ANNUAL COST		6,560,191

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45. **Comparison of first cost estimates**

a. Changes in First Cost. - Feasibility Report Dated Jul 80 (Oct 1979 base) v/s PB-3 Dated 28 Feb 86 (Oct 1985 base).

FISH AND WILDLIFE FACILITIES	$
FEDERAL WORK	
06. Fish and Wildlife Facilities: Price level change.	+110,000
30. Engineering and Design: Price level change.	+10,000
31. Supervision and Administration: Price level change.	+10,000
Subtotal	+130,000
NON-FEDERAL COSTS	0
CORPS OF ENGINEERS COSTS	+130,000
NON-FEDERAL WORK	
Lands and Damages: Price level change.	+280,000
Subtotal	+280,000
NON-FEDERAL COSTS	0
CORPS OF ENGINEERS COSTS	+280,000
TOTAL FEDERAL AND NON-FEDERAL COSTS	+410,000
NAVIGATION	
FEDERAL WORK	
09. Channels: The net increase of $5,800,000 is due primarily to (1) price level change (+$25,120,000); (2) partially offset due to deleting Avon to New York Slough (-$7,640,000); and (3) deleting Salinity Control Structure (-$11,680,000).	+5,800,000
30. Engineering and Design: The net increase of $20,000 is due primarily to (1) price level change (+$1,140,000); (2) partially offset due to deleting Avon to New York Slough (-$460,000); and (3) deleting Salinity Control Structure (-$660,000).	+20,000
31. Supervision and Administration: The net increase of $20,000 is due primarily to (1) price level change (+$1,330,000); (2) partially offset due to deleting Avon to New York Slough (-$520,000); and (3) deleting Salinity Control Structure (-$790,000).	+20,000
Subtotal	+5,840,000
NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS	0
Subtotal	+5,840,000

NON-FEDERAL COSTS	0
NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS	0
TOTAL NON-FEDERAL COSTS	0
CORPS OF ENGINEERS COSTS	+5,840,000
NAVIGATION AIDS (USCG) COSTS: Price level change.	+80,000
TOTAL FEDERAL COSTS	+5,920,000
NON-FEDERAL WORK	
Lands and Damages: The net increase of $850,000 is due primarily to (1) price level change (+$3,590,000); and (2) partially offset due to deleting Avon to New York Slough (-$2,740,000).	+850,000
Retention Dikes: The net increase of $2,830,000 is due primarily to (1) price level change (+$3,450,000); (2) and partially offset due to deleting Avon to New York Slough (-$680,000).	+2,770,000
Relocations: The net increase of $100,000 is due primarily to (1) price level change (+$420,000); and (2) partially offset due to deleting Avon to New York Slough (-$320,000).	+100,000
TOTAL NON-FEDERAL COSTS	+3,780,000
TOTAL FEDERAL AND NON-FEDERAL COSTS	+9,700,000
RECREATION FACILITIES	
FEDERAL WORK	
14. Recreation Facilities: Price level change.	+480,000
30. Engineering and Design: Price level change.	+40,000
31. Supervision and administration: Price level change.	+30,000
TOTAL RECREATION FACILITIES COSTS	+550,000
NON-FEDERAL	
Lands and Damages: Price level change.	+40,000
TOTAL NON-FEDERAL COSTS	+40,000
TOTAL FEDERAL AND NON-FEDERAL COSTS	+590,000
TOTAL FEDERAL COSTS	+6,600,000
TOTAL NON-FEDERAL COSTS	+4,100,000
TOTAL PROJECT COSTS (Federal and non-Federal)	+10,700,000

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b. Changes in First Cost. - PB-3 Dated 28 Feb 86 (Oct 1985 base) v/s Current General Design Memorandum Estimate (Oct 1985 base).

FISH AND WILDLIFE FACILITIES

FEDERAL WORK

06. Fish and Wildlife Facilities: The increase is due to repricing based on a more detailed quantity cost estimate breakdown.	+340,000
30. Engineering and Design: The increase is due to reanalysis of project requirements.	+30,000
31. Supervision and Administration: The increase is due to reanalysis of project requirements.	+30,000
Subtotal	+400,000
NON-FEDERAL COSTS: The increase is due to current cost sharing allocations.	+210,000
CORPS OF ENGINEERS COSTS: The increase is due to changes explained above and due to current cost sharing allocation.	+190,000

NON-FEDERAL WORK

Lands and Damages: The decrease is due to repricing based on a more current real estate appraisal, and elimination of 156 acres of upland habitat as per selected mitigation plan.	-580,000
Subtotal	-580,000
NON-FEDERAL COSTS: The decrease is due to current cost sharing allocation.	-630,000
CORPS OF ENGINEERS COSTS: The increase is due to current cost sharing allocation, and as explained above.	+50,000
TOTAL FEDERAL AND NON-FEDERAL COSTS	-180,000

NAVIGATION

FEDERAL WORK

09. Channels: The net decrease of $19,360,000 is due primarily to (1) decrease in remaining dredging quantity -9,391,000cy and related decreases in contingencies (-$25,640,000); (2) partially offset due to repricing based on a more detailed quantity cost estimate (+$3,383,000); (3) increase in cost due to changing from 4 contracts to 7 contracts (+$1,273,000); (4) adding Turning Area dredging (+$1,414,000); and (5) adding Berthing Area dredging (+$210,000).	-19,360,000

30. Engineering and Design: The net decrease of $1,470,000 is due primarily to (1) decrease in the remaining quantitities (-$1,625,000); (2) partially offset due to adding Turning Area dredging (+$65,000); (3) adding Berthing Area dredging (+$10,000); and (4) changing from 4 contracts to 7 contracts (+$80,000).	-1,470,000
31. Supervision and Administration: The net decrease of $2,790,000 is due primarily to (1) decrease in the remaining quantitities (-$2,900,000); (2) adding Turning Area dredging (+$50,000); (3) adding Berthing Area dredging (+$10,000); and (4) changing from 4 contracts to 7 contracts (+$50,000).	-2,790,000
Subtotal	-23,620,000
NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS: The decrease is due to work being done for non-Federal sponsor at 100% cost reimbursible basis.	-230,000
Subtotal	-23,850,000
NON-FEDERAL COSTS: The increase is due to current cost sharing allocation.	+11,730,000
NON-FEDERAL CONTRIBUTION FOR BERTHING AREA COSTS: The increase is due to work being done for non-Federal sponsor at 100% cost reimbursible basis.	+230,000
TOTAL NON-FEDERAL COSTS	+11,960,000
CORPS OF ENGINEERS COSTS: The decrease is due to changes explained above and current cost sharing allocation.	-35,580,000
NAVIGATION AIDS (USCG) COSTS: The increase is due to repricing, and reanalysis of existing work.	+290,000
TOTAL FEDERAL COSTS	-35,290,000
NON-FEDERAL WORK	
Lands and Damages: The net decrease of $2,970,000 is due to (1) decrease is due to repricing based on a more detailed quantity cost estimate breakdown (-$2,980,000); and (2) partially offset due to adding Turning and Berthing Areas Lands (+$10,000).	-2,970,000
Retention Dikes: The net increase of $6,830,000 is due primarily to (1) increase in retention dikes quantities 3,454,000cy (+$4,800,000); (2) adding Turning and Berthing Area dredging (+$50,000); (3) changing form 4 contracts to 7 contracts (+$1,980,000).	+6,830,000

Relocations: The net decrease of $10,000 is due primarily to (1) decrease based on a more detailed quantity cost estimate breakdown (-$10,000); and (2) deleting Avon to New York Slough (-$320,000).	-10,000
TOTAL NON-FEDERAL COSTS	+3,850,00
TOTAL FEDERAL AND NON-FEDERAL COSTS	-19,480,000

RECREATION FACILITIES

FEDERAL WORK

14. Recreation Facilities: The decrease is due to deferral of this item.	-1,550,000
30. Engineering and Design: The decrease is due to deferral of this item.	-170,000
31. Supervision and Administration: The decrease is due to deferral of this item.	-130,000
TOTAL RECREATION FACILITIES	-1,850,000

NON-FEDERAL WORK

Lands and Damages: The decrease is due to deferral of this item.	-90,000
TOTAL NON-FEDERAL COSTS	-90,000
TOTAL FEDERAL AND NON-FEDERAL COSTS	-1,940,000
TOTAL FEDERAL COST	-37,100,000
TOTAL NON-FEDERAL COSTS	+15,500,000
TOTAL PROJECT COSTS (Federal and non-Federal)	-21,600,000

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46. **Navigation Benefits**. - This section summarizes the navigation benefits that result from deepening the Sacramento River Deep Water Ship Channel by an additional 5 feet. The benefits are directly attributable to increased economic efficiency associated with deep-draft vessel transportation. A thorough discussion of the methodology and procedures used in deriving the navigation benefits was presented in the Sacramento River Deep Water Ship Channel, California, Feasibility Report and Environmental Impact Statement for Navigation and Related Purposes, July 1980. The study area, inbound and outbound commodity movements, and commodity projections which were developed in the Feasibility Report, also provide the basis for the present analysis.

The primary accomplishment of the selected plan is the savings in ocean transportation costs. These savings contribute to national economic development and are considered a project benefit. Most ocean vessels when fully loaded cannot negotiate the existing channel without incurring costly tidal delays, and many vessels sail with less than full cargo loads. This forces vessels to stop at other ports and "top-off" or sail light-loaded to their destination. Economies of scale savings from using larger vessels are lost if total cargo capacity of the vessels is not fully utilized. Whether the vessels "top-off" or sail lightloaded to their destination port, transportation costs are higher than if the vessel could fully load at one port.

Estimates of transportation savings for the proposed channel improvements were derived by comparing transportation costs for the prospective ocean commerce on the improved channel with transportation costs on the existing project channel. The first step in this procedure was to determine probable future changes in the composition of the vessel fleet over the life of the channel improvements and to estimate the share of prospective commerce that would be transported in each size of vessel at both existing and improved channel depths. The primary considerations in developing these estimates were length of the trade route, volume of annual movement, historic and projected trends in vessel construction, and the scale economies provided by the larger ocean going carriers. Having determined the tonnage to be transported in each size of vessel, by individual commodity and time period, the next step was to compute total transportation costs. This was accomplished by applying the unit cargo costs at the different channel depths to the tonnage to be carried in each size of vessel. Transportation savings were then determined by comparing the total transportation costs on the improved channel with the transportation costs on the existing project channel.

Operating costs for bulk carriers and tankers were obtained from the Institute for Water Resources, Corps of Engineers. The operating costs were prepared by the United States Maritime Administration from information obtained through conferences with ship operators and ship builders and from data contained in maritime publications. Basic cost units are vessel hourly operating costs, including components of interest and amortization of the vessel investment, crew wages, fuel, maintenance, repairs, stores, supplies, subsistence, insurance, profit, and miscellaneous expenses. These operating costs are based on information in effect as of May 31, 1982. With this data, a voyage transportation cost and the corresponding unit cargo costs for several sizes of vessels operating on major trade routes were calculated under without and with project conditions.

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The benefits expected from future industrialization were estimated using representative unit savings per ton computed for existing and proposed cargo movements by water-oriented industries along the channel. These unit savings per ton were multiplied by the projected tonnages in each future time frame and discounted over the economic life of the project.

Benefits would also be derived from the project commodities that will move only if the channel is deepened (induced tonnages). The benefits are primarily savings in transportation costs attributable to induced grain shipments and future industrialization along the improved channel. Analysis of the data indicates that the selected plan will bring about a substantial reduction in the amount of grain that must be transported to San Francisco, to "top-off" the larger bulk grain vessels that now have to sail light-loaded from the Port of Sacramento because of insufficient channel depths. The transportation savings realized by channel deepening would result in reduced topping-off operations. This saving per ton was multiplied by the projected additional grain movements through the Port of Sacramento in each future time period and discounted over the economic life of the project.

The average annual navigation benefits for deepening the Sacramento River Deep Water Ship Channel are shown in Table VIII-1. The benefits shown are for the selected plan of improvement as described in the previous chapters. The values were derived using a procedure identical to that used in determining the benefits in the 1980 Feasibility Report. The commodity projections shown in the Feasibility Report were used in the reassessment of the benefits to reflect the current plan of improvement. The difference from the Feasibility Report is that the base year for benefits to begin was updated from 1987 to the current base year of 1991. This appears in column one of Table VIII-1. The sequenced construction which makes the project affordable for the local sponsor was also accounted for. In 1991, the channel will be deepened and widened from New York Slough to the entrance to the manmade channel and deepened in the manmade channel. At that time, the majority of benefits will begin, since the channel will be deepened along the entire length and the vessels will be able to travel fully loaded. The remaining widening of the manmade channel will be completed by 1994.

Interviews and discussions with the Port of Sacramento and the pilots' organization indicate that the sequenced construction will not adversely affect vessel movement while the channel is being widened. Operational constraints on vessels such as restrictions on vessel speed will not be necessary since the vessel sizes during the widening period are not likely to vary from those which currently use the channel without restriction. Time delays or increases in travel time and costs are not anticipated. However, a small potential for a deviation in projected commodity movements through the Port of Sacramento from 1991 to 1994 was accounted for in the derivation of the values. This is shown in column two of Table VIII-1. The benefits are based on a 50-year economic life and 8-1/8 percent interest rate.

In summary, navigation benefits derived from deepening the channel from 30 feet to 35 feet are the result of transportation savings from the movement of cargo on larger ocean going vessels with their inherent economies of scale, reduction in delays due to tides, reduction of present light-loading

practices, and movement of project induced tonnage. These transportation savings would accrue to companies shipping through the Port of Sacramento and to new industries which will locate adjacent to the channel in the future.

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TABLE VIII-1

Average Annual Navigation Benefits
For Deepening the Sacramento River
Deep Water Ship Channel to 35 Feet
(8 1/8 Percent Interest)
(Thousands of Dollars)

Item	Feasibility Report Average Annual Benefits 1/ (Oct 1985 dollars)	Average Annual Benefits of Selected Plan 2/ (Oct 1985 dollars)
Port of Sacramento		
Rice	$ 1,714.6	$ 1,690.0
Other grains and oilseeds	1,814.9	1,787.0
Logs	272.4	270.0
Wood Chips	1,028.7	1,010.0
Fertilizers and fertilizer materials	2,304.3	2,249.0
Other bulk commodities	770.2	760.0
Future industrialization	1,423.1	1,396.0
Project-induced tonnage	1,492.7	1,458.0
Subtotal	$10,820.9	$10,620.0
Collinsville-Montezuma Hills		
Future industrialization	$ 3,065.3	$2,893.0
Project-induced tonnage	1,730.0	1,677.0
Subtotal	$ 4,795.3	$4,570.0
TOTAL	$15,617.3	$15,190.0

1/ Feasibility Report values updated to base year 1991 and adjusted to present price levels.

2/ Revised Feasibility Report values at base year 1991, adjusted for selected construction schedule.

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CHAPTER IX - PROJECT JUSTIFICATION

47. Project Justification. - Annual benefits for the selected plan have been evaluated at October 1985 price levels and an interest rate of 8-1/8 percent. First costs for the selected plan have been evaluated at October 1985 price levels and at a the authorized interest rate of 8-1/8 percent.

Table VIII-1 shows the average annual navigation benefits for both the Port of Sacramento and the Collinsville-Montezuma Hills area. The benefits for the Collinsville-Montezuma Hills area, however, are not being used for project justification. This area is considered to be the last good site for deep draft port development in California. However, in the six years since the submission of the feasibility report, there have been fundamental changes in the conditions that favored port development at the time. There is no reasonable certainty now that such port development will occur at the Collinsville-Montezuma Hills area in the foreseeable future. However, local groups are actively seeking port development of this area again, and the possibility exists that port development may occur at some point in the future.

The selected plan results in average annual costs of $6.5 million and average annual benefits of $10.6 million. The plan is economically justified, having a benefit-cost ratio of 1.6 to 1.

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48. **Cost Sharing**. - Costs for construction and maintenance of the selected plan have been apportioned between Federal and non-Federal interests in accordance with the authorizing act, "An Act Making Supplemental Appropriations For the Fiscal Year Ending September 30, 1985, and For Other Purposes", PL 99-88, and existing proposed Federal law and policy. The following tabulation summarizes the Federal and non-Federal first costs for the project based on cost sharing as proposed in the authorizing document. At this time, the cost sharing provisions have not yet become Federal law. If the cost sharing in the authorizing act is changed by subsequent Federal law prior to construction, then the requirements for local cooperation will be complied with and revised accordingly.

Federal and non-Federal
First Costs

	Federal	non-Federal
As per the Authorizing Act,	$ 36,200,000	$ 30,200,000

The first cost includes the cost of construction and value of lands for fish and wildlife mitigation facilities. The total construction cost and value of lands of $930,000 will be cost shared in the same proportionment as the total project cost for the construction of the general navigation features of the project. In this case, fifty-five percent of the cost, $500,000 is a Federal expense and forty-five percent, $430,000, is a non-Federal expense. The Federal government will construct the fish and wildlife facilities and the non-Federal project sponsor will provide the lands and the funds necessary to meet the specified cost sharing percentage.

In accordance with the authorizing act and current policy, the local sponsor is required to provide, during the period of construction, a cash contribution equal to 25% of the total cost of construction of the general navigation facilities assigned to commercial navigation. In addition, the local sponsor is required to repay with interest, over a period not to exceed 30 years following the completion of construction, 10% of the total cost of construction of general navigation facilities assigned to commercial navigation. However, the additional 10% can be waived if the local sponsor's cost percentage for lands, easements, rights-of-way, relocations and disposal areas compared to the total project costs attributable to construction of the general navigation facilities is greater than or equal to 20%. The cost percentage for this project is calculated to be twenty-seven percent, which is greater than 20%. Therefore, the additional 10% has been recommended for waiver and is not included in the cost summary. The Federal and non-Federal first costs and annual costs are shown in Table X-1.

Since there is no increase in maintenance dredging, the operation and maintenance of the deepened channel will become part of the ongoing maintenance of the channel. Therefore, the operation and maintenance cost contribution is zero. The responsibility for maintenance of the navigation channel continues to be a Federal requirement. The local sponsor is responsible for maintenance of other features of the project. Maintenance costs for the mitigation land are considered nominal since the area is not expected to require maintenance activity. A monitoring program will be

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conducted after construction to assess habitat development. The costs of this program are considered nominal. Therefore, no operation and maintenance cost is associated with the mitigation land. The project cost summary includes the cost of dredging the berthing area at the Port of Sacramento to the 35-foot depth. This work is the responsibility of the local sponsor. However, it has been requested to be completed as part of the project on a 100% cost reimbursable basis to the Federal government.

The cost for net loss in productivity of lands is considered negligible due to established guidance on the topic. In addition, any agricultural lands used for dredged material disposal will only be temporarily impacted during construction (1-2 years) and are expected to be returned to agricultural use after construction.

No cost for recreation facilities is included since there are no local sponsors participating at this time. If a local sponsor expresses interest in recreation development in the future, then a local cooperation agreement will be developed that incorporates the appropriate requirements and cost sharing provisions.

Under Section 150 of the Water Resources Development Act of 1976, Public Law 94-587, first costs for establishing wetlands are a Federal responsibility (up to a maximum of $400,000). The potential to develop fish and wildlife enhancement lands on lower Sherman Island will be investigated in the near future. Based on Section 150, PL 94-587 operation and maintenance of the wetland area would be a non-Federal responsibility. Since the wetlands enhancement is under investigation, it is not shown as a project cost.

TABLE X-1
COST APPORTIONMENT

	FEDERAL	NON-FEDERAL	TOTAL PROJECT
First Cost	36,200,000	30,200,000	66,400,000
Interest During Construction	6,932,550	5,783,509	12,716,059
TOTAL	43,132,550	35,983,509	76,116,059
Annual Cost	3,504,520	2,923,660	6,428,180
Amortization	71,970	60,041	132,011
Operation and Maintenance	0	0	0
Loss in Productivity of Lands	0	0	0
TOTAL	3,576,490	2,983,701	6,560,191

49. **Required local cooperation**. - The detailed requirements for local cooperation are given in Appendix H. Since the time that the requirements for the project were reported to the Assistant Secretary of the Army on November 20, 1981, the project has been authorized and new laws on cost sharing have been proposed. The following paragraphs outline the current requirements of local cooperation. These requirements are based on present Federal policy, the cost sharing and financing requirements of Senate Bill 1567, the requirements of Section 221 of Public Law 91-611, and other (non-cost sharing) requirements contained in the project authorizing documents.

a. General requirements. - Prior to construction of navigation improvements, local interests shall be required to furnish assurances satisfactory to the Secretary of the Army that they will:

(1) Provide during the period of construction a cash contribution equal to 25 percent of the total cost of construction of the general navigation facilities assigned to commercial navigation. Also, provide during the period of construction a cash contribution and value of lands equal to 49 percent of the total costs of construction and land for the construction of the required fish and wildlife mitigation facilities.

(2) Not have any recourse for reimbursement of any nature from the Government for contribution of funds provided pursuant to the agreement except with respect to excess contributions.

(3) Construct at their own expense all project facilities other than those for general navigation and provide, maintain, and operate at local expense adequate public terminal and transfer facilities open to all on equal terms.

(4) Operate and maintain at no cost to the Government all other project features as specified by the Secretary of the Army.

(5) Hold and save the Government free from all claims for damages due to the dredging work and the deposition of dredged material, and due to the construction of new levees or reconstruction of existing levees along the Sacramento River Deep Water Ship Channel, including damages to such levees and the protected lands or damages due to the failure of such levees, except damages due to the fault or negligence of the Government or its contractors.

(6) Hold and save the Government free from all damages to wharves, bridge piers and other marine and submarine structures, and agricultural and other lands due to the initial dredging work and subsequent maintenance dredging, except damages due to the fault or negligence of the Government or its contractors.

(7) Hold and save the Government free from all damages due to the construction of the fish and wildlife mitigation and enhancement facilities, except damages due to the fault of the Government or its contractors.

(8) Provide without cost to the Government all lands, easements, and rights-of-way, including suitable borrow and dredged material disposal areas, as may be determined by the Chief of Engineers to be necessary for construction, and operation and maintenance of the project.

(9) Provide without cost to the Government all necessary dredged material disposal dikes, bulkheads and embankments or the costs of such retaining works.

(10) Provide, without cost to the Government, all necessary interests in property and perform all necessary utility and facility alterations and relocations.

(11) Accomplish without cost to the Government all alterations and relocations of buildings, streets, storm drains, utilities, irrigation facilities, new bridges or bridge alterations, pipelines, powerlines and other structures and improvements made necessary by the project construction and operation and absorb any increased annual maintenance and operation costs that might result from such alterations and relocations.

(12) Provide to the Government the lands, easements, rights-of-way or other proprietary interests in lands necessary for fish and wildlife mitigation development and the subsequent operation and maintenance; with the understanding that the costs therefore will be shared by the Government and the local interest in the same proportion as total costs for construction of the general navigation facilities assigned to commercial navigation; and preserve such lands for fish and wildlife purposes in perpetuity so as to serve their intended functions.

(13) If subsequent to the date of a signature of the Local Cooperation Agreement, Congress enacts into law a change for the cost sharing for this project, the parties hereto shall be bound to comply with such a change, and the agreement will be amended accordingly.

b. Cost sharing. - The present federal administration has proposed cost sharing guidelines for all navigation projects. These guidelines will require that a percentage of the construction costs be provided by the local sponsor. The Sacramento-Yolo Port District has agreed to provide these construction costs as long as a mechanism is available by which the District can generate revenue from users of the facility. The present proposal calls for the Port District to provide during the period of construction a cash contribution equal to 25 percent of the total costs of construction of the general navigation facilities assigned to commercial navigation. Past proposals have considered 50 percent of the total construction cost or 70 percent of total project costs.

50. **Measures taken by non-Federal interests**.

a. Navigation. - At the time of preparation of the Feasibility Report, the Sacramento-Yolo Port District formally presented their intent to provide the local assurances for navigation improvements. In November 1984 and January 1985, the Sacramento-Yolo Port District formally provided their intent to sponsor the project at either a 50-percent or 70-percent cost-sharing level. (See letters in Appendix J.) At recent meetings, the Sacramento-Yolo Port District has expressed their intent to sponsor the project under present cost sharing.

b. Recreation. - Currently, there are no local sponsors for recreation development of disposal sites. A recommendation for deferral of recreation will be made. However, Solano County, Sacramento County and the East Yolo Community Services District have provided letters of interest in future recreation development. (See letters in Appendix C.)

51. **Extent of interest in the project**. - The Sacramento-Yolo Port District, the city of Sacramento and other State and local agencies have continued to show a high interest in the project. These entities have expressed a need for the navigation facilities to be provided by the selected plan.

52. **Public participation**. - Close contact with Federal, State, County and local agencies has been maintained since advance planning was initiated in late 1982. The major public participation activities by the Corps in connection with this project are as follows:

a. 11 February 1982. California Water Commission meeting to discuss various issues including new federal cost-sharing guidelines and the impacts of a saltwater barrier upstream of the Benicia Bridge.

b. 17 March 1982. California Water Commission meeting to discuss various issues including funding, cost sharing and O&M changes for port projects.

c. 14 April 1982. Various state and federal agencies met to discuss technical aspects of the Bay-Delta model upgrading program and future operation and maintenance.

d. 23 September 1982. Meeting with the Port of Sacramento to discuss the possibilities of the Port utilizing an area located northwest of its existing facilities for future dry storage development or dredged material disposal.

e. 9 November 1982. Meeting at the Bay-Delta Model to coordinate the repeatability test plan with representatives of DWR and USBR.

f. 6 January 1983. Meeting with the Port of Sacramento to discuss mitigation, operation, and maintenance, salinity at the turning basin, model testing and air quality.

g. 19 January 1983. Meeting with Yolo County to discuss recreation development in Yolo County as part of the project.

h. 3 February 1983. Meeting with FWS to discuss the Port of Sacramento objections to the wildlife mitigation requirements.

i. 4 May 1983. Meeting with DWR and USBR to review the preliminary results from the repeatability testing.

j. 4 May 1983. Meeting with the Port of Sacramento and FWS to discuss wildlife mitigation.

k. 12 July 1983. Meeting with DWR and USBR to review the results of the Plan 1 and Base 1 series of tests conducted for the dual purpose of determining model repeatability and the impact of the project deepening under critically dry conditions.

l. 11 October 1983. Meeting with the Port of Sacramento to discuss available funding and the anticipated completion date of the GDM on the project.

m. 17 October 1983. Meeting with DWR and USBR to clarify the methods used by these two agencies to evaluate probable salinity impacts on th SWP and the CVP.

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n. 10 February 1984. Meeting with USBR and DWR to discuss salinity impacts on the project.

o. 28 February 1984. Meeting with DWR to discuss computer operation studies to evaluate the impact of the project on the SWP.

p. 6 March 1984. Meeting with USBR to discuss their operation studies.

q. 28 March 1984. Meeting with USBR, DWR, and the Port of Sacramento to discuss the status of the project studies.

r. 4 June 1984. Meeting with the State Department of Transportation to discuss the relocation of cables and impact on the Rio Vista Bridge from the project.

s. 10 August 1984. Meeting with DWR to discuss results of State operations studies related to possible Delta salinity increases due to the project.

t. 31 August 1984. Meeting with the Port of Sacramento to discuss possible cost-sharing arrangements for the project.

u. 6 September 1984. Meeting with DWR to discuss potential additional State operation studies.

v. 9 September 1984. Meeting with the Port of Sacramento to discuss local costs and retention dikes.

w. 2 October 1984. Meeting with DWR and the Port of Sacramento to discuss dredge disposal sites.

x. 11 October 1984. Meeting with USBR and DWR to discuss salinity impacts of the project.

y. 26 October 1984. Meeting with the Port of Sacramento to discuss the proposed disposal sites for the project.

z. 26 October 1984. Meeting with the Port of Sacramento and Sacramento County Parks representatives to discuss development of a portion of Grand Island for recreation as part of the project.

aa. 13 November 1984. Meeting with USBR and DWR to discuss potential salinity mitigation measures for the project.

bb. 28 December 1984. Meeting with the Port of Sacramento to discuss salinity issues and disposal sites for dredged material.

cc. 14 January 1985. Meeting with Sacramento, Solano and Yolo County Parks representatives and the California Parks and Recreation to discuss alternative types and locations of recreation development and cost-sharing policies.

dd. 28 January 1985. Meeting with the Port of Sacramento to discuss various issues including the status of the COE Investigations, cost-sharing and the Port's 404 Permit.

ee. 29 January 1985. Meeting with DWR to discuss various issues, including possible use of CVP water for any required mitigation.

ff. 8 February 1985. Meeting with the Port of Sacramento and USFWS to discuss the 404 Permit needed to fill Lake Washington and disposal sites near the port.

gg. 12 February 1985. Various agencies met to establish the assumptions and scope of the HEP study for the project.

hh. 27 February 1985. Meeting with the Department of Water Resources and Bureau of Reclamation to discuss DWR operations studies on salinity and to discuss the use of CVP water to mitigate for impacts of navigation projects.

ii. 5 March 1985. Meeting with the Bureau of Reclamation to discuss possible use of CVP water to mitigate the project impact.

jj. 14 March 1985. Meeting with Solano County to identify the location of the southerly park boundaries and to discuss Solano County's desires for park expansion as part of the project.

kk. 11 April 1985. Meeting with the DWR to discuss DWR operations studies on salinity and various assumed project impact curves.

ll. 18 April 1985. Meeting with the Bureau of Reclamation to discuss the cost of water chargeable to the project if CVP water is used to mitigate for potential project impacts.

mm. 28 May 1985. Meeting with DWR and USBR to discuss definable salinity impacts of the project and to establish a monitoring program as the best method of determining the magnitude of impacts, if any.

nn. 29 May 1985. Meeting with DWR and USBR to discuss alternatives for mitigation of any impacts on salinity caused by the project.

oo. 11 June 1985. Meeting with DWR and USBR to discuss DWR's basic analytical approach to their firm yield studies.

pp. 2 July 1985. Meeting with the Port of Sacramento to discuss cost-sharing and the possibility of a 2-phased construction approach.

qq. 9 August 1985. Meeting with the Port of Sacramento to discuss the cost-sharing provisions developed in connection with the FY 1985 Supplemental Appropriations Bill for new construction starts.

rr. 6 September 1985. Meeting with the Port of Sacramento to discuss the basis of the cost estimates for the project.

ss. 20 September 1985. DWR and USBR met with the Corps to discuss the proposed salinity monitoring program for the project.

tt. 26 November 1985. Meeting with DFG and FWS to discuss the possible creation of wetlands at the Sherman Island Waterfowl Management Area as an enhancement feature of the project.

uu. 2 December 1985. Meeting with the Endangered Species Office to discuss the endangered species coordination for the project.

vv. 10 December 1985. Various agencies met at the Sherman Island Waterfowl Management Area to view and discuss the potential Sherman Island enhancement area.

ww. 13 December 1985. Field meeting with the Endangered Species Office to view and discuss wildlife habitat on DMD sites 35, 21, 13 and 14.

xx. 19 December 1985. Meeting with the Port of Sacramento to discuss "new start" cost-sharing requirements for the project.

yy. 7 January 1986. Meeting with the Endangered Species Office to discuss the status of the Biological Assessment for the project.

zz. 9 January 1986. Field meeting with Port of Sacramento to inspect and discuss selected DMD sites east side of ship channel.

aaa. 13 January 1986. Meeting with DWR to discuss comments on draft GDM, potential maximum salinity impacts and the details of the salinity monitoring program.

bbb. 17 January 1986. Field meeting with Port of Sacramento to inspect and discuss selected DMD sites on the west side of ship channel.

ccc. 23 January 1986. Meeting with Port Director of Port of Sacramento to discuss project costs, cost sharing and requirements of local cooperation.

53. **Coordination**. - Continuous coordination has been maintained with interested governmental agencies and citizens' groups throughout the GDM studies. Staff level coordination has been maintained with the following agencies and groups regarding environmental, recreation, and design considerations.

a. Federal agencies. -

Fish and Wildlife Service	(FWS)
National Park Service	(NPS)
U.S. Geological Survey	(USGS)
Environmental Protection Agency	(EPA)
U.S. Bureau of Reclamation	(USBR)
U.S. Coast Guard	(USCG)
National Marine Fisheries Service	(NMFS)
Soil Conservation Service	(SCS)

Several field investigations were conducted jointly with the FWS, NMFS, EPA, State agencies, and the Corps of Engineers. These investigations have played a significant role in selecting dredged material disposal sites and developing conceptual mitigation plans. EPA assisted the Corps in testing sediment samples taken from the channels. USBR and FWS participated in evaluating model test results and possible project effects on salinity.

b. State agencies. - Coordination has been maintained with the following departments within the Resources Agency:

Department of Fish and Game	(DFG)
Department of Boating and Waterways	(DBW)
Department of Parks and Recreation	(DPR)
Department of Water Resources	(DWR)
Regional Water Quality Control Boards	(RWQCB)
Air Resources Board	
Water Resources Control Board	
State Historic Preservation Officer	(SHPO)

The DFG personnel participated in field investigations of dredged material disposal areas and of wildlife mitigation and enhancement areas. Coordination was conducted with representatives of the DPR, DBW, and DFG to determine the State's interest in sponsoring recreation development and to develop appropriate conceptual recreation plans.

c. Local agencies. -
Yolo County
Solano County
Sacramento County
East Yolo Community Services District
Sacramento-Yolo Port District
Solano County Mosquito Abatement District

Considerable coordination was conducted with the Sacramento-Yolo Port District regarding designating acceptable dredged material disposal areas. Coordination was also maintained with Solano County, Sacramento County, and the East Yolo Community Services District to formulate conceptual recreation plans that these agencies could sponsor in the future.

54. **Coordination with the U.S. Fish and Wildlife Service**. - In fulfillment of the provisions of the U.S. Fish and Wildlife Coordination Act of 1958, the U.S. Fish and Wildlife Service has provided a detailed report on Fish and Wildlife Resources in 1980 which was included in the Feasibility Report. The U.S. Fish and Wildlife Service has since reassessed and updated the resources report to reflect the selected plan. The U.S. Fish and Wildlife Service submitted a supplement to the 1980 report in January 1986. The supplemental report, which appears in Appendix E of the Final Supplemental Environmental Impact Statement (FSEIS) for this project, contains recommendations on loss prevention, loss compensation and wetland enhancement. The recommendations are listed and responses provided in the subparagraphs below.

a. Loss prevention measures.

(1) Recommendation. - "That the report of the District Engineer, Corps of Engineers, include the conservation and development of fish and wildlife resources among the purposes for which the project is to be authorized."

(2) Response. - The Sacramento River Deep Water Ship Channel project was authorized in August 1985 by "An Act Making Supplemental Appropriations for the Fiscal Year Ending September 30, 1985 and for Other Purposes." The project authorization was based on a report provided by the District Engineer to the Assistant Secretary of the Army. The report was compiled from the 1980 Feasibility Report for the project, which was coordinated with respect to the conservation and development of fish and wildlife resources, in fulfillment of the Fish and Wildlife Coordination Act of 1958. The authorized project represents the plan for improvement that was developed with full consideration of the conservation and development of fish and wildlife resources as is required by legislation and policy reguarding the topic.

b. Loss compensation.

(1) Recommendations. - To compensate for the loss of wildlife habitat values due to the construction of the project, 63 acres on the southern portion of Prospect Island should be converted to tidal wetlands as described in the Discussion Section of the supplement to the Coordination Act Report. The development costs to develop the area should be a project cost. The U.S. Fish and Wildlife Service (FWS) and the California Department of Fish and Game (DFG) should be consulted for technical assistance during advance planning of the development area. Also, once developed, the site should be monitored by the Corps and the U.S. Fish and Wildlife Service to evaluate the success of the development.

(2) Response. - The selected plan of improvement, as described in the preceding paragraphs and in Appendix I, calls for compensation for the loss of wildlife habitat values through the conversion of 63 acres of agricultural land on the southern portion of Prospect Island to tidal wetlands. The development plan will be constructed to create the habitat types as described in the supplement to the Coordination Act Report. The FWS and DFG will be consulted during advance planning and design for technical assistance and will be included in the Corps' post construction monitoring of the development. All costs of development of the 63-acre compensation area are considered project costs.

c. Enhancement.

(1) Recommendation. - The Corps should use material dredged from the Sacramento River Deep Water Ship Channel to construct islands within the open water area immediately west of Sherman Island for the enhancement of wetlands. The details of the development should be coordinated with FWS, DFG, and National Marine Fisheries Services (NMFS) and the costs should be a Federal cost.

(2) Response. The potential to develop wetlands as part of the project exists under Section 150 of the Water Resources Development Act of 1976. The wetland development potential at several locations has been discussed in the past. However, support for sites has not existed until only recently when renewed interest in the use of the open water area at Sherman Island was identified in comments to the draft of this document. The use of the Sherman Island site is consistent with the intent of Section 150 and the

beneficial use to which material from the dredging can be used. The development of Sherman Island is not scheduled at this time; however, its use and development will be investigated through future coordination with the FWS, DFG, NMFS and EPA. The Federal cost of development under Section 150 is limited to $400,000.

CHAPTER XII - RECOMMENDATIONS

55. **Recommendations**. - In accordance with the findings in this report, the District Engineer recommends that the selected plan for navigation presented herein for the New York Slough to Port of Sacramento section of the Sacramento Deep Water Ship Channel deepening project be approved as the basis for preparation of plans and specifications. The selected plan includes (1) deepening the existing channel alignment to 35 feet below elevation -2.0 NGVD, (2) widening the New York Slough to Junction Point reach to 350 feet (the existing 300 foot width between Junction Point and channel mile 18.6 remains the same) and the entrance to the manmade channel to the Port of Sacramento reach to 250 feet, and (3) construction of the fish and wildlife mitigation development on Prospect Island. The plan should be constructed with such modifications that the Chief of Engineers may consider advisable, at a currently estimated Federal first cost of $36.2 million provided non-Federal navigation interests meet the local cooperation requirements contained in Chapter X and in the subsequent Local Cooperation Agreement.

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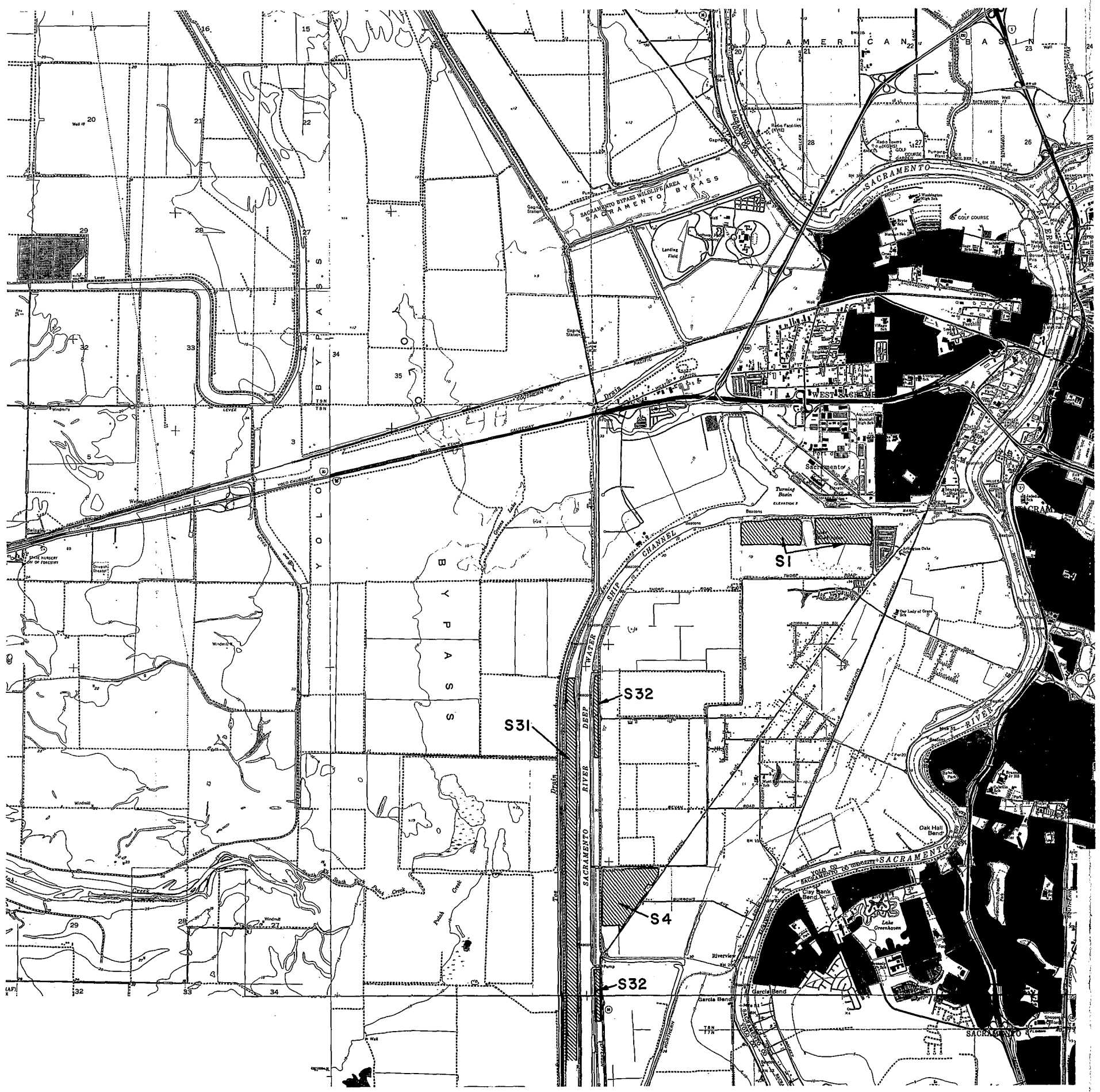

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GRAPHIC SCALE

1" = 2000' 0 2000' 4000' 6000' 8000' 10000'

REVISION	DATE	DESCRIPTION	BY	BY

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. W. BRAUN
CHECKED: J. VERES
SUBMITTED: Thomas H. Parrott

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDEXED ON THIS SHEET

APPROVAL RECOMMENDED: R. CLEM, CIVIL DESIGN BRANCH
APPROVED: Jerome C. Wisser, CHIEF, ENGINEERING DIVISION
DATE: MARCH 14, 1986

PREPARED UNDER THE DIRECTION OF
WAYNE J. SCHOLL
COL., CORPS OF ENGINEERS, U. S. A.
DISTRICT ENGINEER

SCALE:
SPEC. No.
SHEET 1
FILE No. 52-6-368

ENVIRONMENTAL ENHANCEMENT HYDRO ENGINEERING

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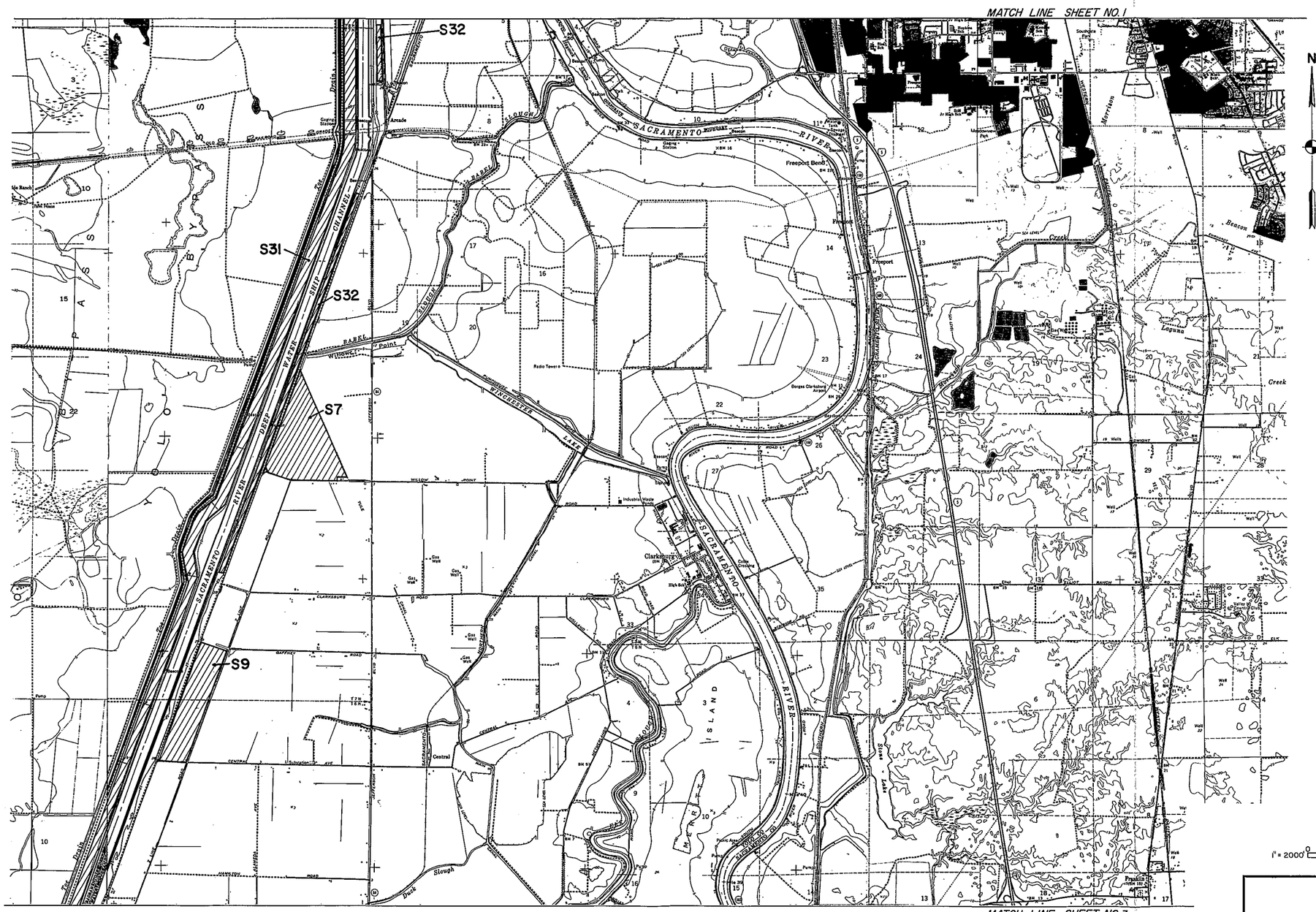

GRAPHIC SCALE

1" = 2000' 0 2000' 4000' 6000' 8000' 10000'

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SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. BRAUN
CHECKED: J. VERES

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SUBMITTED: Herman H. Gold III
DATE APPROVED: 13 Mar 86
SCALE: AS SHOWN
SPEC. No.
SHEET 2
FILE No. 52-6-368

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

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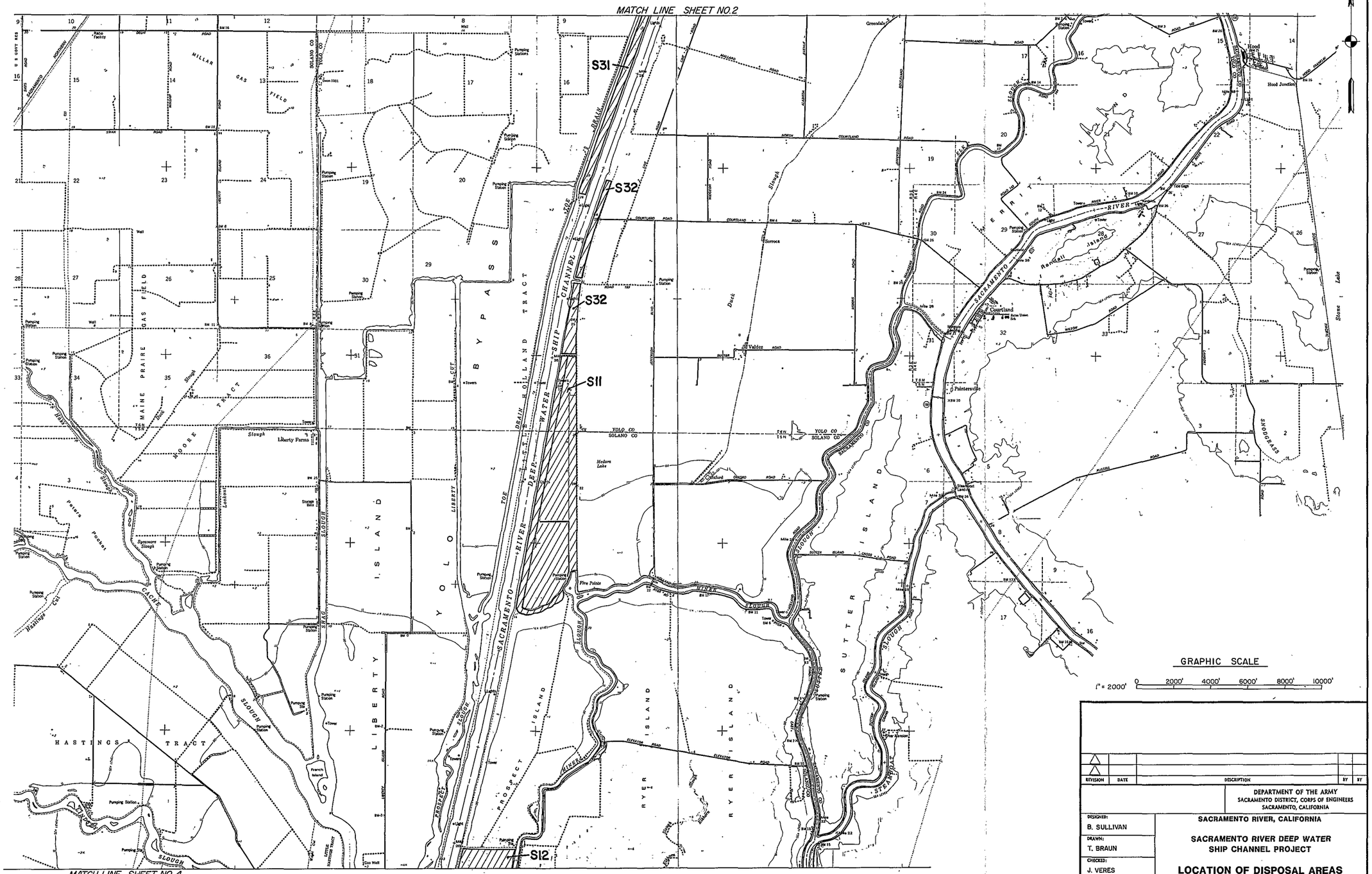

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SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. BRAUN
CHECKED: J. VERES
SUBMITTED:
DATE APPROVED: 13 MAR 66

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SCALE: AS SHOWN
SHEET 3
SPEC. No.
FILE No. 52-6-368

PLATE I

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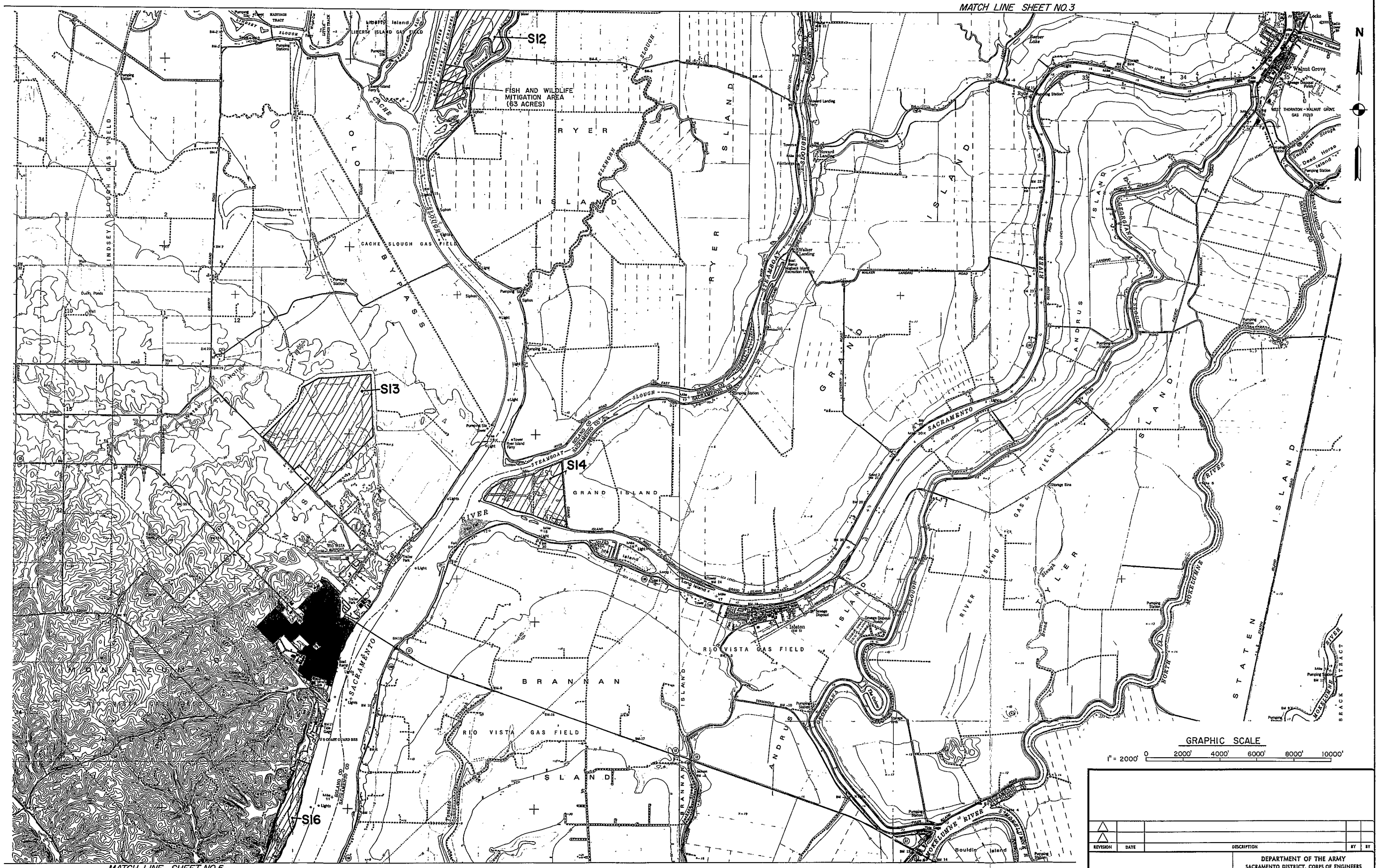

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

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SACRAMENTO, CALIFORNIA

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DRAWN: T. BRAUN
CHECKED: J. VERES
SUBMITTED:
DATE APPROVED:

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SCALE: AS SHOWN | SPEC. No. | SHEET 4 | FILE No. 52-6-368

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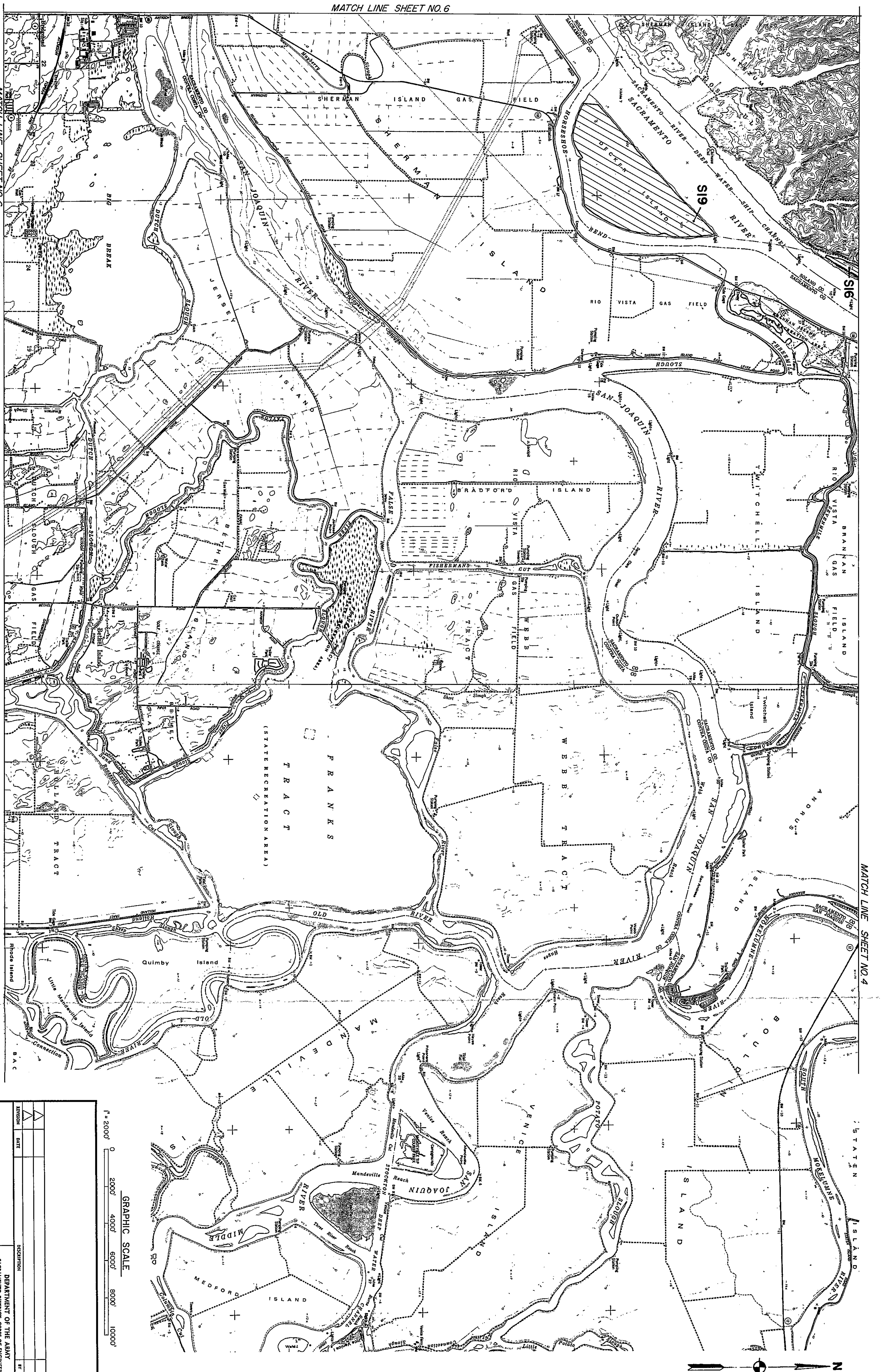
ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING



DESIGNED: B. SULLIVAN
DRAWN: T. BRAUN
CHECKED: J. VERES
SUBMITTED:

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SACRAMENTO, CALIFORNIA

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP-WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SCALE: AS SHOWN | SHEET 5 | FILE No. 52-6-368

PLATE I

SAFETY PAYS

FUNCTIONAL ANALYSIS - VE PAYS

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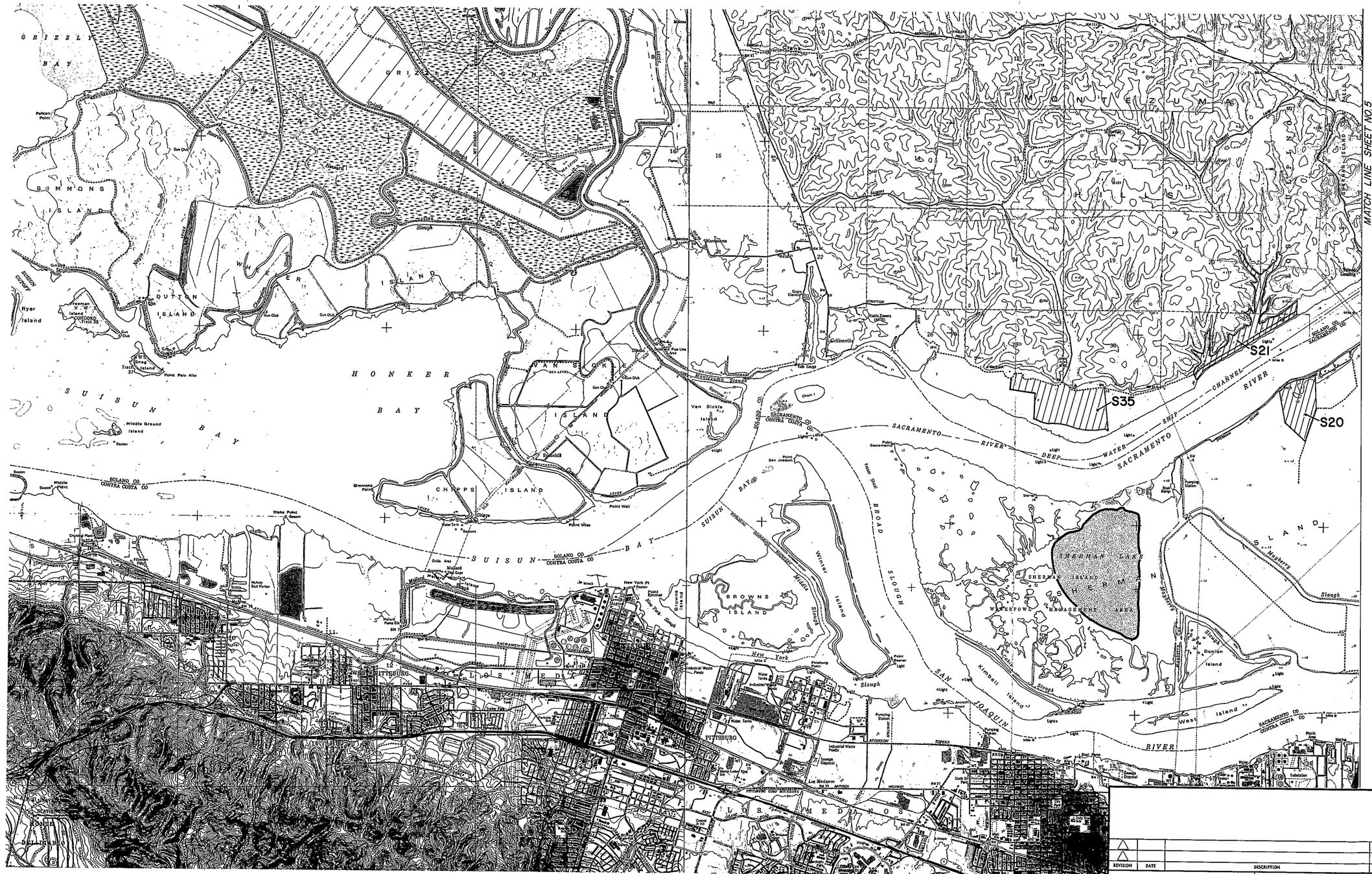

POTENTIAL DISPOSAL AREA FOR WETLANDS ENHANCEMENT

GRAPHIC SCALE

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REVISION	DATE	DESCRIPTION	BY	BY
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SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. BRAUN
CHECKED: J. VERES

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SUBMITTED: Lawrence F. Gold III
DATE APPROVED: 13 Mar 86
SCALE: AS SHOWN
SPEC. No.
SHEET 6
FILE No. 52-6-368

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

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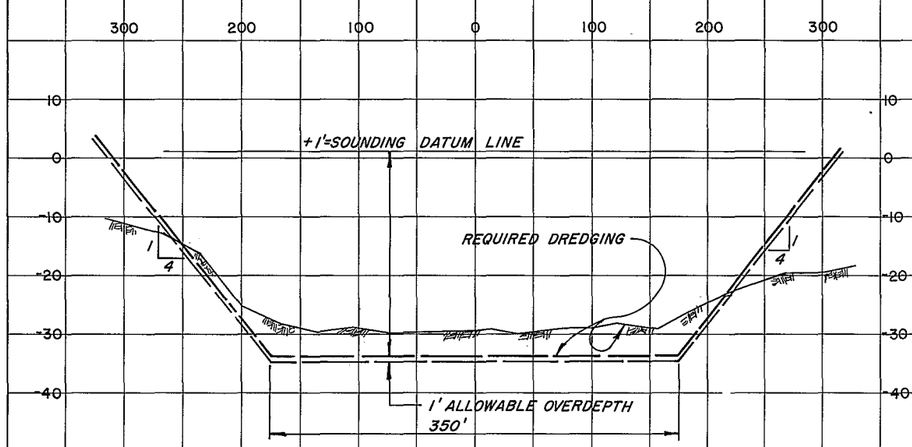
ELEVATIONS

CORPS OF ENGINEERS DATUM



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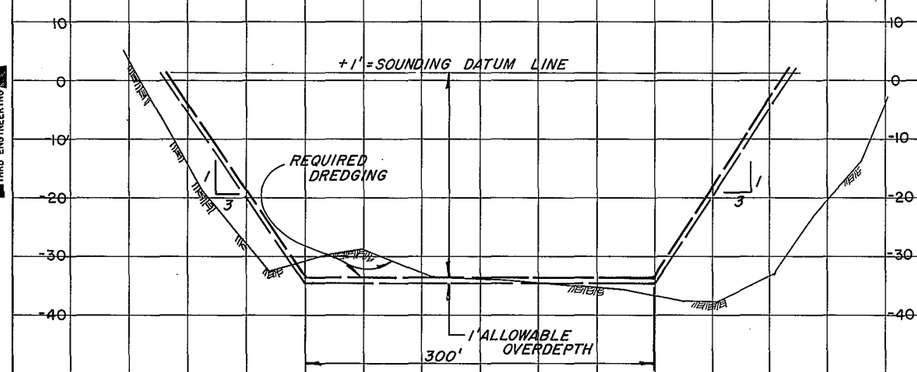
MI. 0.0 TO MI. 15.0



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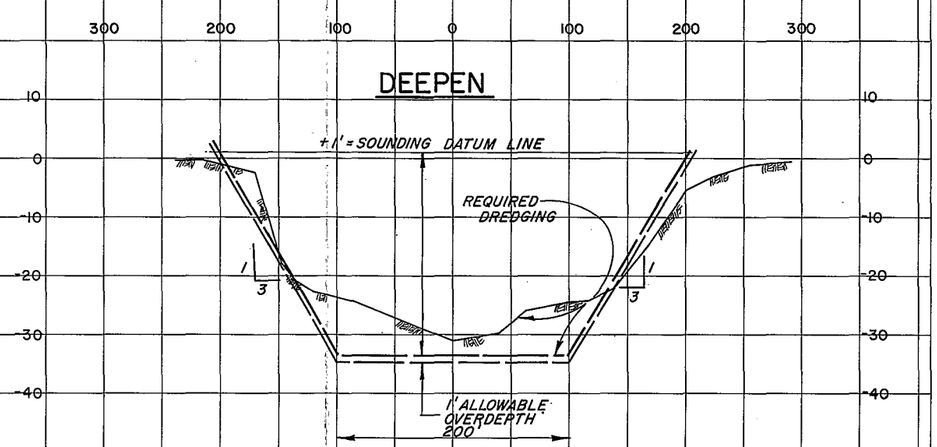
DEEPEN



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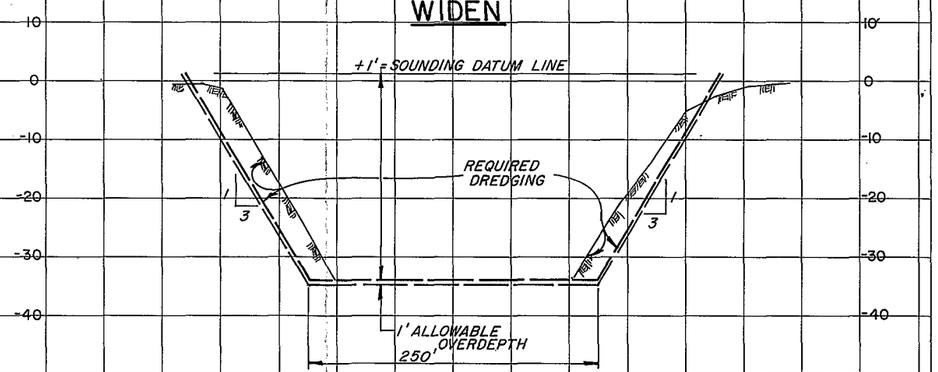
WIDEN



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GRAPHIC SCALE

1"=10'-0" 0 5' 10' 20' 30' 40' 50' Vertical

1"=50'-0" 0 25' 50' 100' 150' 200' 250' Horizontal

REVISION	DATE	DESCRIPTION	BY	BY
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SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. W. BRAUN
CHECKED: J. VERES
SUBMITTED:
DATE APPROVED:

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

CHANNEL CROSS SECTIONS

SCALE: AS SHOWN SPEC. NO.
SHEET 1 FILE NO. 52-6-372

ENVIRONMENTAL ENHANCEMENT THRU ENGINEERING

SAFETY PAYS

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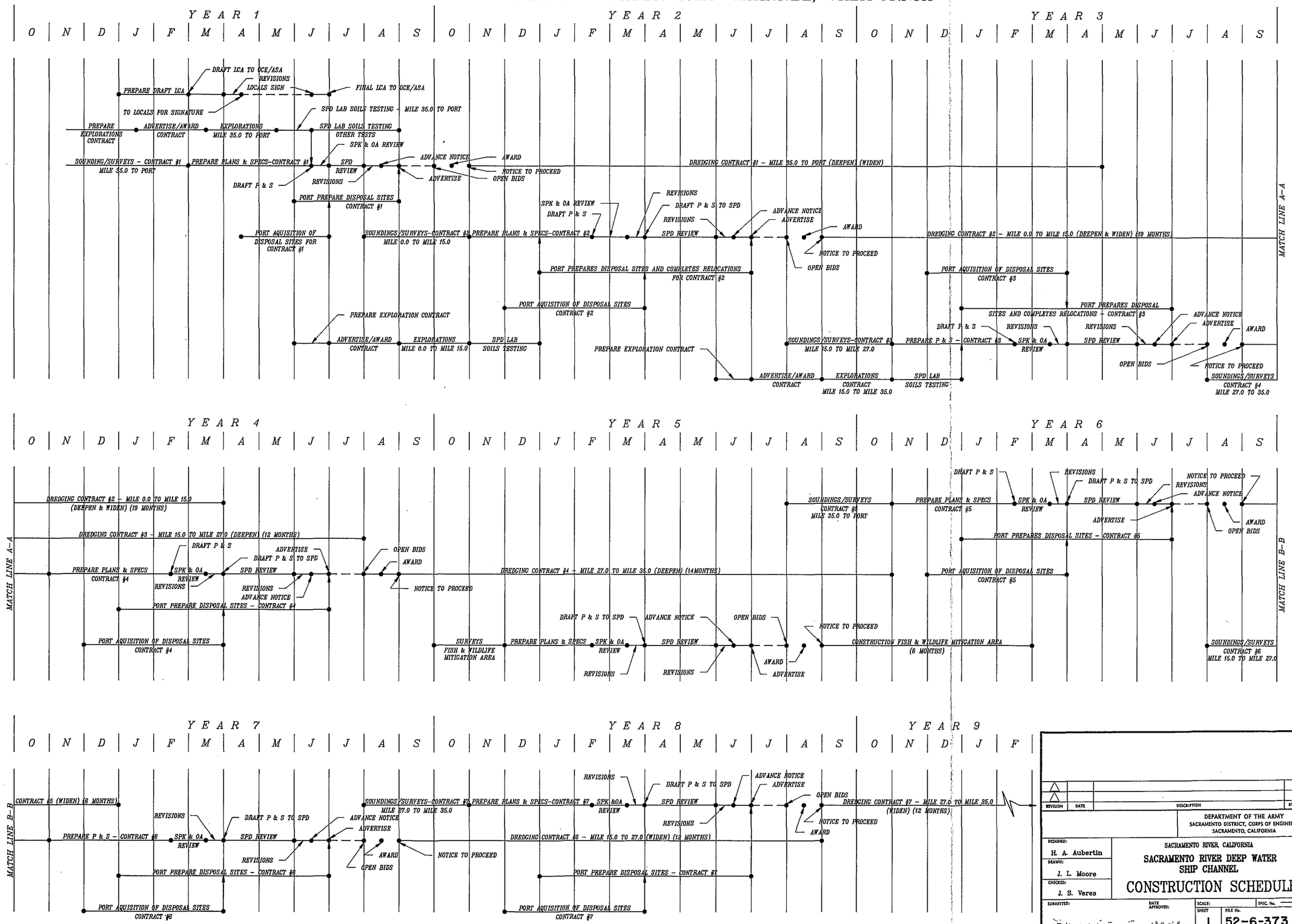
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL, CALIFORNIA



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SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: H. A. Aubertin
DRAWN: J. L. Moore
CHECKED: J. S. Veres
SUBMITTED:
DATE APPROVED:

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CONSTRUCTION SCHEDULE

SCALE:
SHEET 1
FILE No. 52-6-373
SPEC. No. ——

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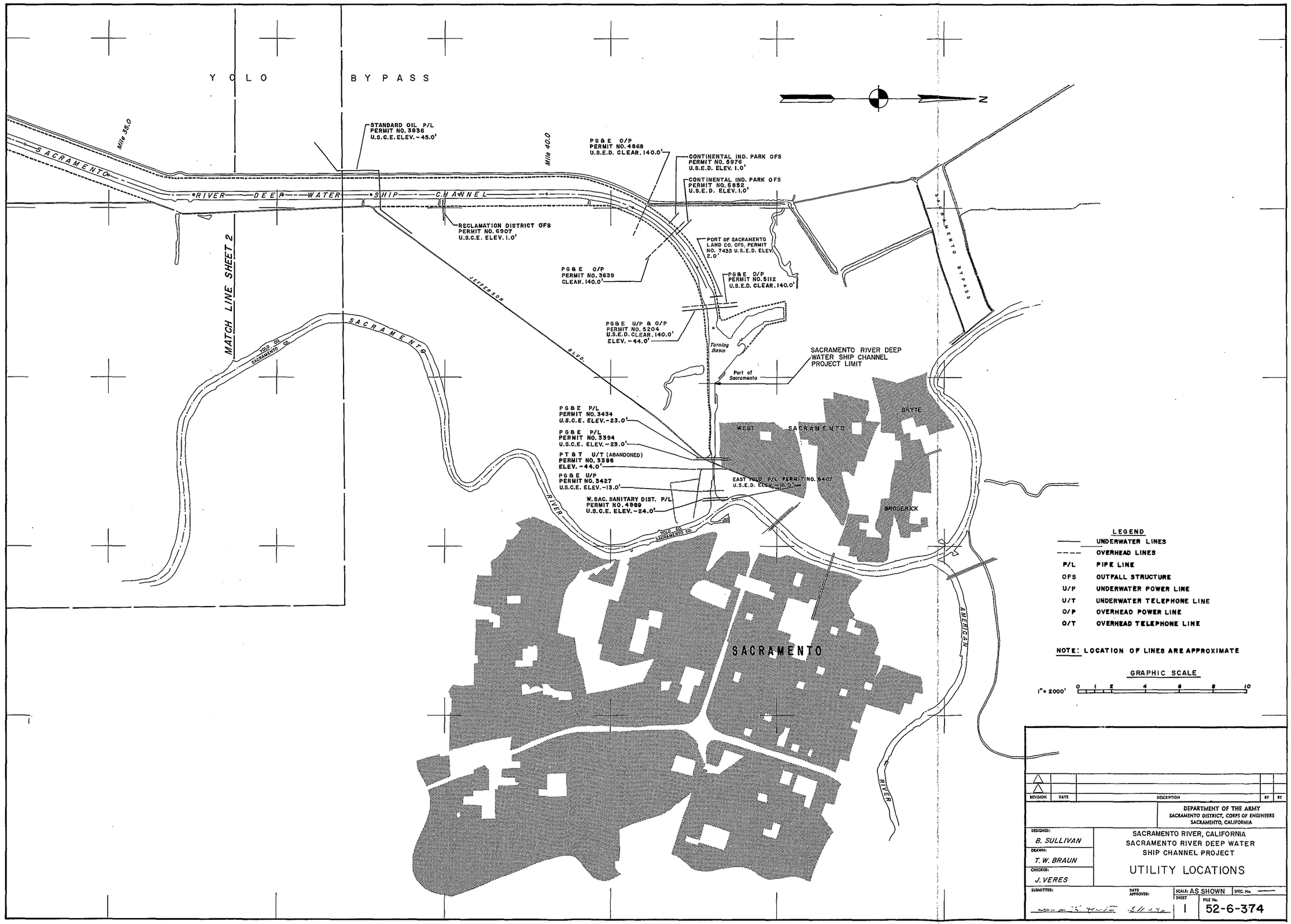

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PLATE IV

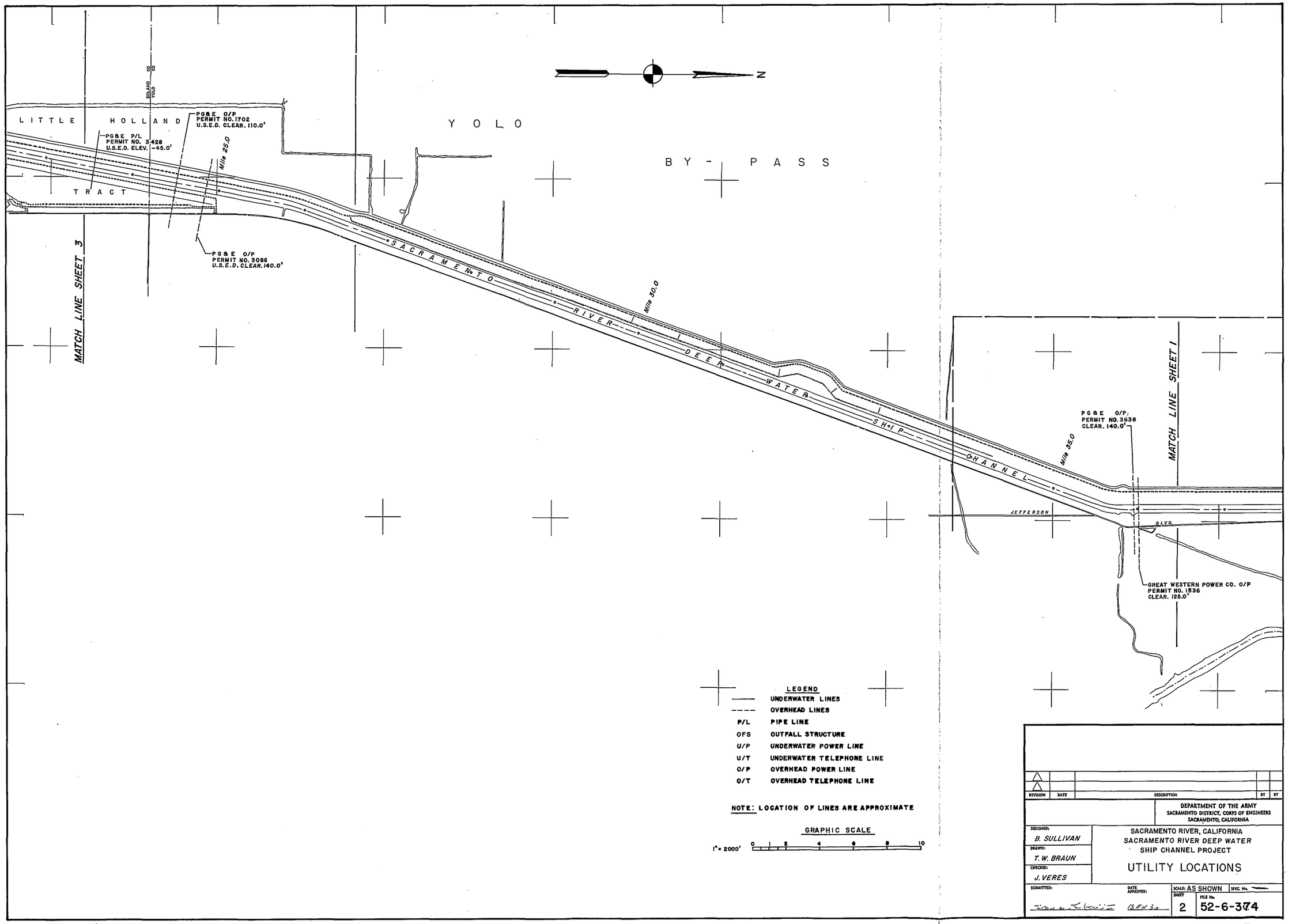

PLATE IV

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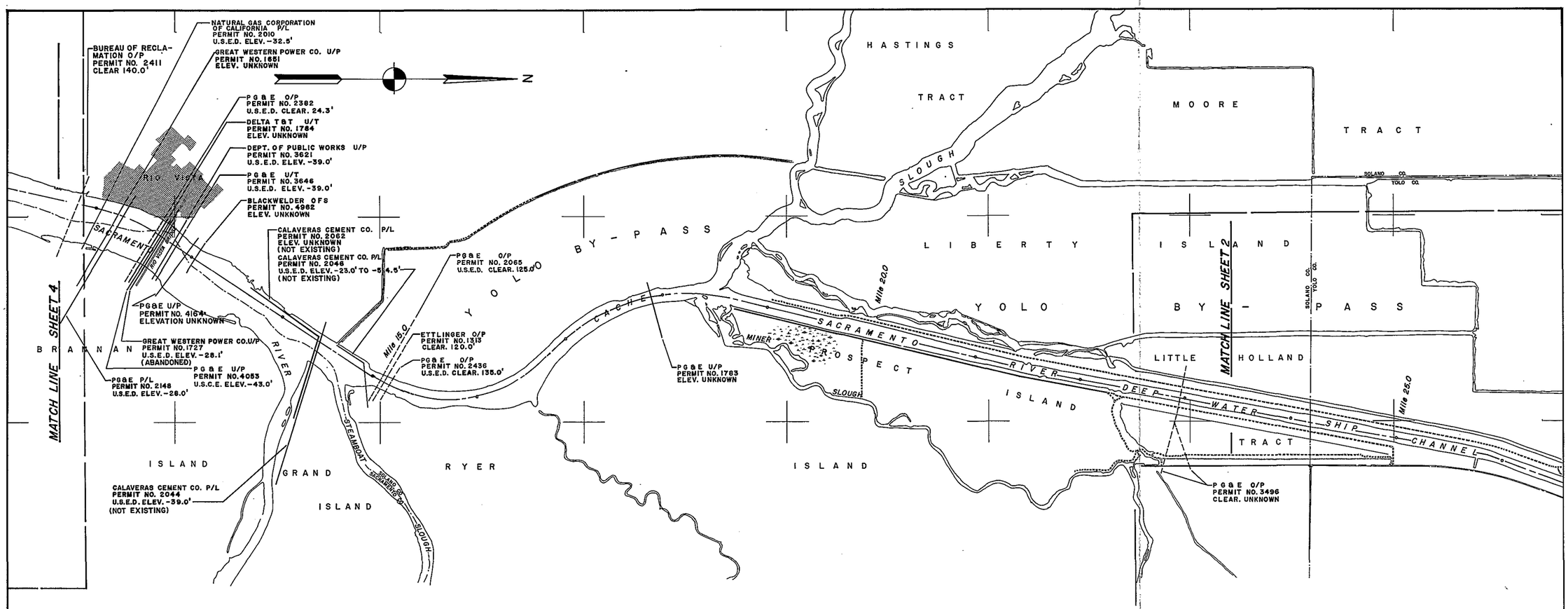

LEGEND

———	UNDERWATER LINES
- - - -	OVERHEAD LINES
P/L	PIPE LINE
OFS	OUTFALL STRUCTURE
U/P	UNDERWATER POWER LINE
U/T	UNDERWATER TELEPHONE LINE
O/P	OVERHEAD POWER LINE
O/T	OVERHEAD TELEPHONE LINE

NOTE: LOCATION OF LINES ARE APPROXIMATE

GRAPHIC SCALE

1" = 2000' 0 1 2 4 6 8 10

REVISION	DATE	DESCRIPTION	BY	BY
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DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. W. BRAUN
CHECKED: J. VERES

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

UTILITY LOCATIONS

SUBMITTED: [signature]
DATE APPROVED: 13 Oct 56
SCALE: AS SHOWN
SHEET 3
FILE No. 52-6-374
SPEC. No. ——

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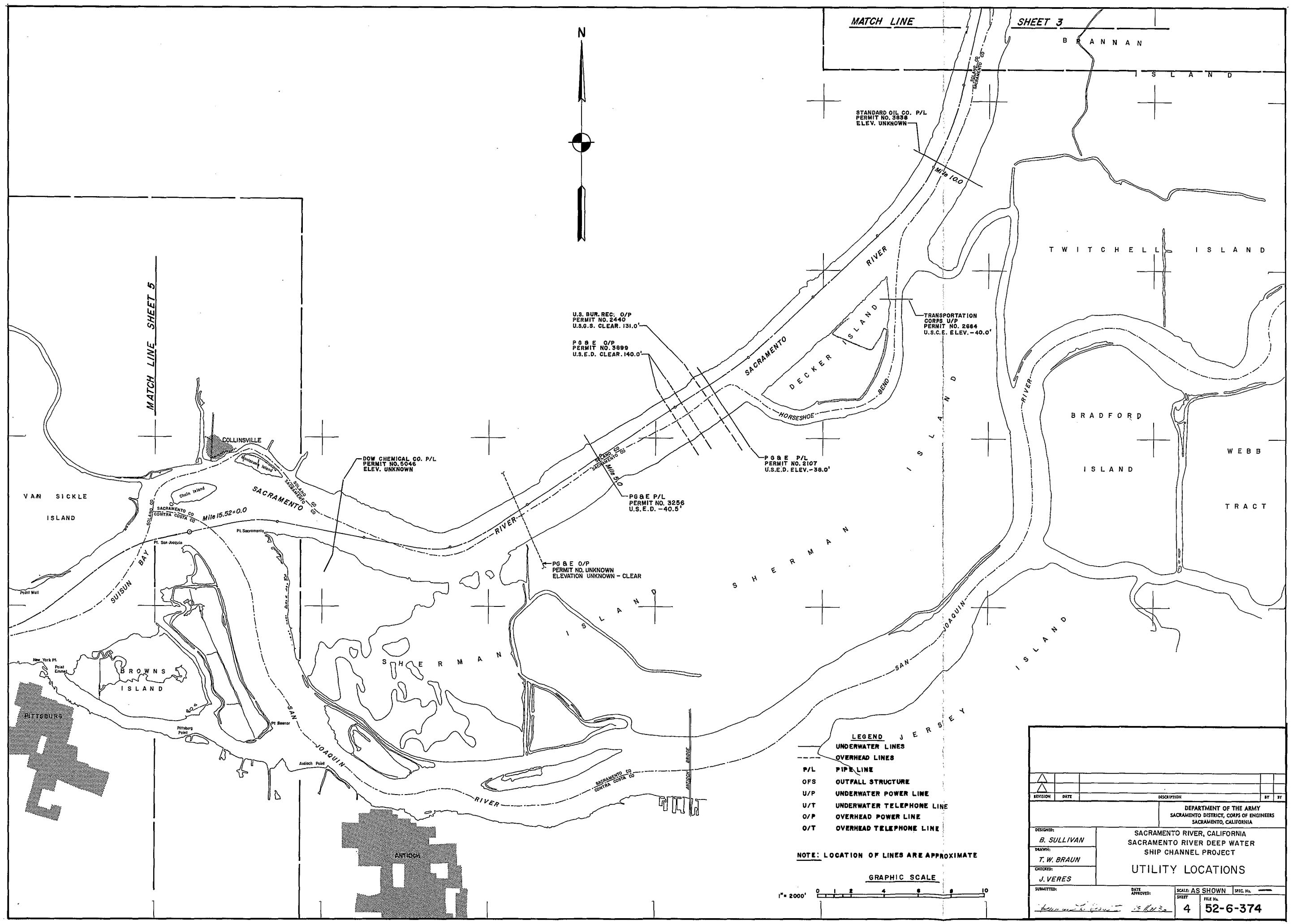

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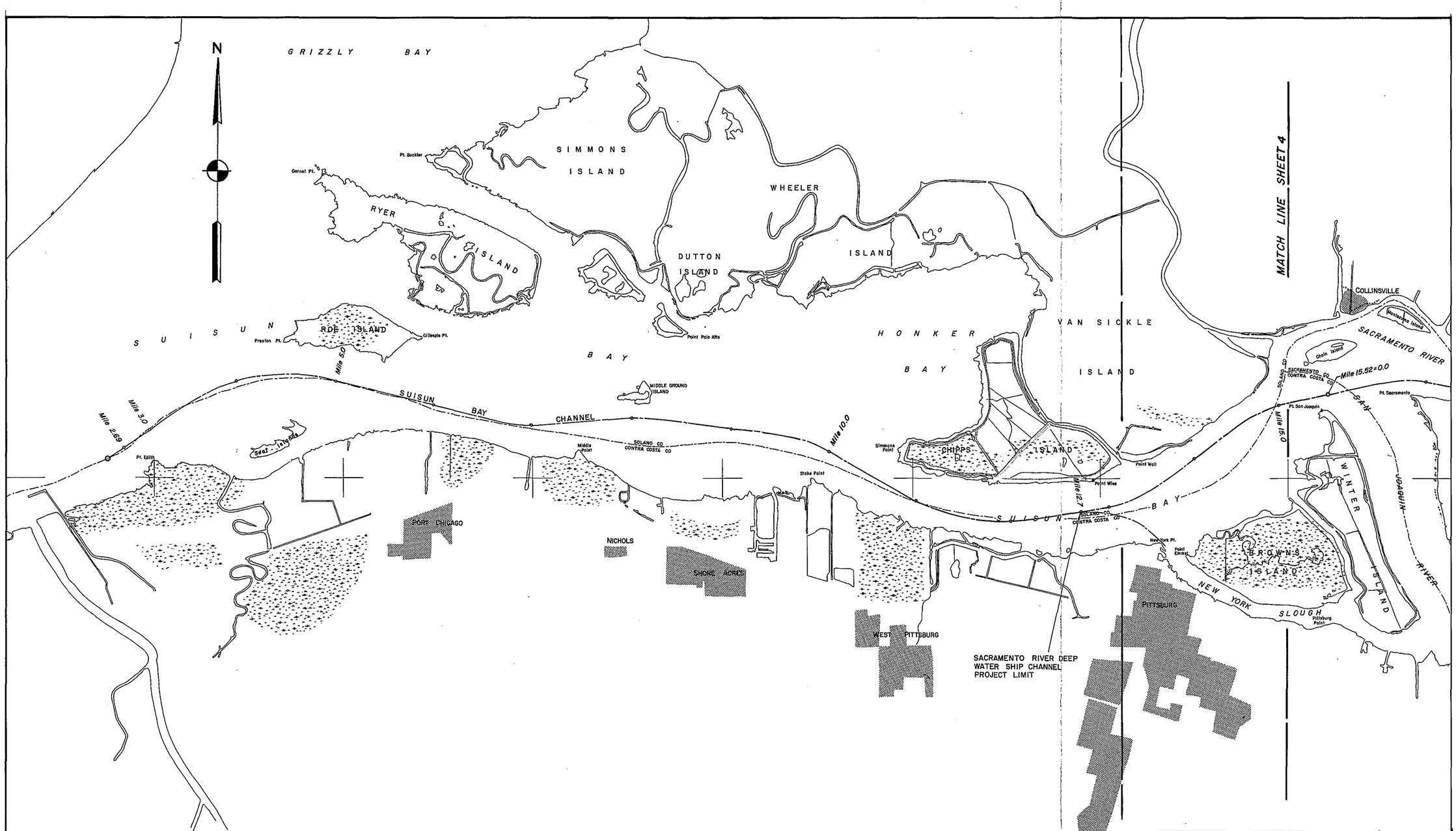

LEGEND

———	UNDERWATER LINES
- - - -	OVERHEAD LINES
P/L	PIPE LINE
OFS	OUTFALL STRUCTURE
U/P	UNDERWATER POWER LINE
U/T	UNDERWATER TELEPHONE LINE
O/P	OVERHEAD POWER LINE
O/T	OVERHEAD TELEPHONE LINE

NOTE: LOCATION OF LINES ARE APPROXIMATE

GRAPHIC SCALE

1" = 2000' 0 1 2 4 6 8 10

REVISION	DATE	DESCRIPTION	BY	BY
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DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. W. BRAUN
CHECKED: J. VERES
SUBMITTED:
DATE APPROVED:

SACRAMENTO RIVER, CALIFORNIA
SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

UTILITY LOCATIONS

SCALE: AS SHOWN
SPEC. No.
SHEET 5
FILE No. 52-6-374

PLATE IV

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C-090718

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

PREPARED BY
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA
MARCH 1986

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CALIFORNIA

( ) Draft Supplemental Statement
(X) Final Supplemental Statement

Responsible Office: U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814-4794

1. Name of Action: (X) Administrative ( ) Legislative

2. Purpose: The purpose of this Final Supplemental Environmental Impact Statement (FSEIS) is to update the description of the impacts that are expected to result from the widening and deepening of the Sacramento River Deep Water Ship Channel.

3. Abstract: The navigation problems and needs of the Sacramento Deep Water Ship Channel were originally investigated in response to resolutions of the House of Representatives Committee on Public Works, adopted on July 10, 1968 and December 11, 1969. Four alternative plans were considered: (1) Increased use of Lighter Aboard Ship (LASH); (2) Intermodal transport of cargo to alternative ports; (3) Deepening the channel; and (4) No Action. Of the four alternatives, only the deepening alternative met the needs of the study area. The EIS completed in July 1980, analyzed the impacts of the four alternatives and two variations on the deepening alternative: the National Economic Development plan and the Environmental Quality plan. The Department of the Army recommended in its report to Congress that the deepening project be authorized. The project is a new construction start in the President's budget for Fiscal Year 1986. The project was authorized on August 15, 1985 by "An Act Making Supplemental Appropriations for the Fiscal Year Ending September 30, 1985, and for Other Purposes", Public Law 99-88.

This FSEIS analyzes two alternatives: the No Action Plan and the Selected Plan. The Selected Plan consists of: deepening the channel from 30 to 35 feet from New York Slough to the Port of Sacramento; widening the channel from 300 to 350 feet between New York Slough and Junction Point (channel mile 15.0) (the existing 300 foot width between Junction Point and channel mile 18.6 remains the same) and from 200 to 250 feet from channel mile 18.6 to the Port of Sacramento; and disposing of dredged material on 15 disposal sites located on both sides of the entire channel and totaling 4,464 acres.

Significant impacts of the Selected Plan that were evaluated in detail include the temporary loss of 52 acres of marsh and riparian habitat adjacent to the ship channel. There are no other significant or long-term impacts asssociated with the project.

4. Report Coordination: This FSEIS will be coordinated with government agencies, citizen groups, and individuals known to have an interest in the project. On November 19, 1984, a Notice of Intent to Prepare a Draft

C-090720

C-090720

Supplemental EIS was published in the Federal Register. Comments on the Notice of Intent were considered in preparing the DSEIS. The DSEIS was filed with EPA and notice of availability of the DSEIS was published in the Federal Register on September 13, 1985. Comments received on the DSEIS were used to prepare the Final Supplemental EIS.

The FSEIS will be filed with EPA and a notice of availability is expected to be published on _____ 1986.

5. Environmental Documentation: The 1980 Feasibility Report and EIS were filed with EPA on 8 May 1981 and were transmitted to Congress for information on 4 October 1983 by the Assistant Secretary of the Army (Civil Works). Since the project was not recommended at that time, a Record of Decision was not signed or filed with the Environmental Protection Agency.

Send your comments on this Final Supplemental Environmental Impact Statement to the District Engineer at the address above within 30 days of the publication date shown above, and refer any questions to Jeff Groska at (916) 551-1860 or FTS 460-1860.

C—090721

C-090721

Final Supplemental EIS
Sacramento River Deep Water Ship Channel
Modifications for Navigation and Related Purposes

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APPENDICES

A Pertinent Correspondence

B Air Quality Emissions Analysis

C Section 404 (b) (1) Evaluation

D Endangered Species Coordination

E Fish and Wildlife Coordination Act Report

F Fish and Wildlife Traditional Mitigation Analysis

C—090724

C-090724

1. SUMMARY

1.1 Major Conclusions and Findings. - The Selected Plan will result in deepening and widening of the Sacramento River Deep Water Ship Channel from New York Slough to the Port of Sacramento. (A more precise description of the Selected Plan is included in Section 3 of this FSEIS). This plan will assist in accomplishing the authorized goal of the project, which is to provide savings in transportation costs through channel modifications to accommodate larger and deeper draft ships. In comparison to a No Action Plan, the Selected Plan will:

- o Result in transportation cost savings due to (1) movement of cargo via larger ocean-going vessels with their inherent economies of scale, (2) elimination of excessive tidal delays, (3) reduction of present light-loading and topping-off practices, and (4) movement of project-induced tonnage.

- o Temporarily eliminate riparian habitat along both banks of the manmade channel (above river mile 18.6) and upland and seasonal wetland habitats on the one-time dredged material disposal sites used during the eight year construction period.

1.2 Areas of Controversy. - The following areas of controversy are possible for the Selected Plan:

- o Salinity changes (Section 5.3) and impacts on aquatic organisms.

- o Impacts on riparian, upland, and wetland habitats and effectiveness of the proposed mitigation measures (see Sections 4.1, 5.1,and 6).

1.3 Unresolved Issues. - There are no unresolved issues.

1.4 Relationship to Environmental Requirements. - Compliance with environmental requirements is described below. The compliance categories used in this evaluation were assigned based on the following definitions. Full compliance: all requirements have been met. Partial compliance: some requirements remain to be met but will be met prior to construction. Noncompliance: none of the requirements have been met to date, but will be met prior to construction. Not applicable: The statute, Executive Order, or other policy is not applicable to the project. The No Action Plan is generally in compliance with applicable requirements. All compliance is summarized in Table 1.

FEDERAL STATUTES

Preservation of Historical and Archeological Data Act of 1974, National Historic Preservation Act of 1966, and Executive Order 11593, Protection and Enhancement of the Cultural Environment. Full compliance. An intensive cultural resource survey and literature review has been completed for the project area. The report was submitted to the State Historic Preservation

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Table 1

Compliance of Selected Plan(1)
With Environmental Requirements

FEDERAL	
Archaeological/Historic Preservation Act	full
Clean Air Act	full
Clean Water Act	partial
Coastal Zone Management Act	not applicable
Endangered Species Act	full
Federal Water Project Recreation Act	full
Fish and Wildlife Coordination Act	full
Land and Water Conservation Fund Act	not applicable
Marine Protection, Research, and Sanctuary Act	not applicable
National Environmental Policy Act	full
Rivers and Harbors Act	full
Watershed Protection and Flood Prevention Act	not applicable
Wild and Scenic Rivers	not applicable
Flood Plain Management (EO11988)	full
Protection of Wetlands (EO11990)	full
Prime and Unique Farmlands	full
STATE	
Resources Agency Basic Wetlands Protection Policy	full
Delta Recreation Concept Plan	not applicable
Delta Master Recreation Plan	full
LOCAL	
Delta Advisory Planning Council	full
Solano County	full
Yolo County	full
Sacramento County	full
Port of Sacramento	full
Solano County Mosquito Abatement District	full

(1)The No Action Plan is generally in compliance with applicable requirements.

C—090726

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Office (SHPO) and the National Park Service (NPS). See Section 4.6 for further discussion. Coordination with SHPO, NPS, and the Advisory Council on Historic Preservation (ACHP) will continue through project construction, if necessary.

Clean Air Act. Full compliance. An air quality analysis was completed in 1983 in response to a request by the Environmental Protection Agency for additional quantification of potential impacts on air quality after review of the 1980 Feasibility Report and EIS. The study, included in Appendix B to this FSEIS, concluded that the project would not create any unanticipated adverse air quality impacts. The Selected Plan is consistent with the Sacramento Air Quality Plan. The air quality analysis in Appendix B shows a beneficial impact in terms of regional effects for all pollutants; however, this may be offset to some extent by increased recreation use and accelerated industrial growth along the channel. The DSEIS has been coordinated with Federal, State, and local air quality authorities. EPA had no further comments pertaining to air quality in their response to the DSEIS. The air quality analysis was further coordinated with state and local air quality authorities in November and December 1985. These agencies concurred with the Corps analysis (see Appendix A; FSEIS).

Clean Water Act. Partial compliance. A 404 (b)(1) evaluation was included in the 1980 Feasibility Report; it indicated that there would be no discharge of dredged material in open water or in associated wetlands. An update of this evaluation is discussed in Section 7.2. Appendix E to the FSEIS provides updated information and mitigating measures for impacts on wetlands, fish, and wildlife. The Corps will obtain water quality certification from the Regional Water Quality Control Board prior to construction; this will bring the project into full compliance.

Coastal Zone Management Act: Not applicable. The project area is not within the California Coastal Zone.

Endangered Species Act: Full compliance. Formal consultation with the U.S. Fish and Wildlife Service (FWS) as required by Section 7(c) of the Act was determined to be unnecessary as explained in paragraphs 4.2 and 5.2. A biological data report and biological assessment were prepared evaluating potential effects and were coordinated with FWS. The assessment concluded that the project would not impact endangered species (Appendix D of the FSEIS).

Federal Water Project Recreation Act. Full compliance. This act defines the basis for sharing of financial responsibilities in joint Federal-non-Federal development, enhancement, and management of recreation and fish and wildlife resources of Federal projects. No local sponsors have submitted letters of intent to participate in recreation. See Sections 1.3 and 4.5 for additional discussion and Appendix C of the General Design Memorandum (GDM). At this time, potential sponsors have indicated interest in recreation development. However, recreational development will be deferred until local sponsors are willing to participate. Wetlands development on lower Sherman Island is under investigation and no construction is planned at this time.

Fish and Wildlife Coordination Act. Full compliance. This Act requires the Corps to consult with the U.S. Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), and California Department of Fish and Game (DFG) on the effects that water resources developments may have on fish and wildlife resources. Coordination with these agencies will continue partially through this FSEIS process to refine mitigation and enhancement measures. A formal habitat evaluation has been jointly performed by the FWS, NMFS, DFG, Port of Sacramento, and the Corps; the results are included in this FSEIS. A traditional analysis was also conducted and the results are in Appendix F of this FSEIS.

Land and Water Conservation Fund Act. Not applicable. No funds provided pursuant to this Act would be involved with the project.

Marine Protection, Research, and Sanctuaries Act. Not applicable. The project will not affect any marine sanctuary.

National Environmental Policy Act. Full compliance. This FSEIS has been prepared in accordance with NEPA regulations issued by the Council on Environmental Quality and with the Corps of Engineers regulations implementing NEPA. This Final SEIS responds to all comments received on the DSEIS. Filing of the Final SEIS and a Record of Decision with the Environmental Protection Agency will complete the process.

Rivers and Harbors Act of 1899. Full compliance. The Selected Plan would improve navigation by larger vessels.

Watershed Protection and Flood Prevention Act. Not applicable according to Corps regulations ER 200-2-2.

Wild and Scenic Rivers Act, President's Environmental Message of August 1979, and CEQ Memorandum for Heads of Agencies dated August 10, 1980. Not applicable. The portion of the Sacramento River within the project area is not being considered for wild or scenic river status.

EXECUTIVE ORDERS, MEMORANDA

Flood Plain Management (Executive Order 11988). Full compliance. This executive order requires Federal agencies to take actions to reduce risk of flood loss, to minimize flood impacts, and to preserve floodplain values in Federal construction projects, management of Federal lands, and activities such as regulation. Agencies are not to undertake actions which directly or indirectly induce growth in floodplains unless there is no practical alternative. Local county governments have established land use programs to control the location of new development. The Selected Plan will not induce unplanned growth in floodplains (See Section 4.4). The 1980 Feasibility Report evaluates in more detail the compliance of the project with EO11988; this evaluation is still valid.

Protection of Wetlands (Executive Order 11990). Full compliance. This order requires Federal agencies to minimize wetland loss or degradation and to preserve and enhance wetland values in all Federal projects and activities. It states that agencies should avoid to the extent possible the long and short term impacts associated with modification or destruction of wetlands. The agency shall also avoid undertaking and providing support for new construction, including dredging, channelizing, filling, diking, and related

activities located in wetlands, unless the agency head finds: (1) no practical alternative, and (2) all practical measures have been taken into account including economic, environmental and other pertinent factors. Fifty-two acres of wetlands along the manmade channel will be affected by the project. In the Selected Plan, there are 5 dredged material disposal sites containing a total of 70 acres of seasonal wetlands; however, not all these wetlands will be disturbed by disposal. Those wetlands affected by the project will only be temporarily impacted. They were not included in the HEP analysis. According to the FWS Habitat Evaluation Procedure (HEP) mitigation analysis, these wetlands are mostly seasonal, and have low wildlife habitat values. Wetland losses will be mitigated through the measures described in Section 6 of this FSEIS and in Appendix E of the FSEIS.

CEQ Memorandum, August 11, 1980, Analysis of Prime and Unique Farmlands in Implementing the National Environmental Policy Act. Full compliance. The Soil Conservation Service was provided with project information to assess impacts on prime and unique farmlands and concluded that the project will not conflict with any SCS programs. All concerns have been adequately addressed including prime and unique farmland and treatment of disposal sites (Appendix A of FSEIS).

STATE POLICIES AND PLANS

Resources Agency Basic Wetlands Protection Policy. Full compliance. This policy recognizes the values of wetlands. Agencies are not to approve projects that fill or otherwise harm wetlands except when (1) the project is water-dependent or an essential transportation, water conveyance, or utility project; (2) there are no less damaging alternatives; and (3) adequate compensation for wetland losses (wetland habitat value replacement) is provided. The mitigating measures for the Selected Plan provide adequate compensation for the loss or disturbance of wetlands. (Appendix E of the FSEIS).

Delta Recreation Concept Plan: Not applicable. There is no recreation component proposed as part of the Selected Plan. Recreation development is to be deferred.

Delta Master Recreation Plan. Full compliance. This 1976 State plan is a guide for preserving scenic, wildlife, and recreation resources in the Delta. It calls for recreation opportunities and preservation of fish and wildlife values to be included in all projects in the Delta. The Selected Plan includes a fish and wildlife mitigation plan. (Appendix E of the FSEIS and Appendices C and I of the GDM).

LOCAL POLICIES AND PLANS

Delta Advisory Planning Council. Full compliance. The Council prepared the Delta Conservation and Development Plan as a guide for future development in the Delta. Pertinent guidelines in the Plan include:

- provide for public recreation areas and increase public access to waterways

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. ensure that salinity intrusion does not degrade water quality

. protect and enhance riparian habitat and mitigate for lost vegetation.

The Selected Plan does not provide for public recreation or access due to lack of local recreation sponsors. The fish and wildlife mitigation plan included as Appendix E of the FSEIS and Appendix I of the GDM will replace lost wetland and riparian habitat. There will be no effects of salinity intrusion on water quality because the State Water Project and the Central Valley Project will be operated to maintain water quality standards. See Sections 4.1, 4.3, 5.1, 5.3 and 6 for discussion of water quality and fish and wildlife habitat.

Solano County Plans and Zoning. Full compliance. Seven of the Selected Plan disposal sites are in Solano County; they are generally zoned and planned for agriculture, open-space, and water-dependent industry (see Section 4.4).

Yolo County Plans and Zoning: Full compliance. Six of the Selected Plan disposal sites are in Yolo County; all but one are zoned and planned for agriculture. Site S-1 in the Port of Sacramento is designated for industrial use. See Section 4.4 for details.

Sacramento County Plans and Zoning. Full compliance. Two of the disposal sites are in Sacramento County; one is designated as open space, the other as agriculture. See Section 4.4.

Port of Sacramento. Full compliance. The Port's Plan (Section 4.4) recognizes Site S-1 as a disposal site. The Corps will coordinate the detailed dredging plan with the Port which will be responsible to acquire all dredged material disposal sites, construct containment facilities and provide a specified share of project costs.

Solano County Mosquito Abatement District. Full compliance. The District has developed specific criteria for mosquito prevention at dredged material disposal sites. The criteria are included in Appendix A. The COE will comply with these criteria.

1.5 Reports Incorporated by Reference. - The following reports are incorporated by reference:

(1) Feasibility Report and Environmental Impact Statement for Navigation and Related Purposes, Sacramento River Deep Water Ship Channel, California. U.S. Army Corps of Engineers, Sacramento District, July, 1980.

(2) General Design Memorandum Sacramento River Deep Water Ship Channel, March, 1986.

2. NEED FOR AND OBJECTIVES OF ACTION

2.1 Introduction. - The existing Sacramento River Deep Water Ship Channel was originally authorized by the River and Harbor Act of July 24, 1946. In July 1980, the Corps of Engineers completed a Feasibility Report and Environmental Impact Statement for Navigation and Related Purposes, Sacramento River Deep Water Ship Channel. This report was prepared in response to resolutions by the Committee on Public Works, House of Representatives, dated July 10, 1968 and December 11, 1969. The purpose of this study was to investigate the need for deep draft channels to the Port of Sacramento to improve commodity transport, improve safety and usefulness of the existing channels, and enhance existing environmental and recreational conditions in the study area. The study area consisted of the Sacramento River Deep Water Ship Channel from Avon to the Port of Sacramento. The study area is shown in Figure 1.

The 1980 Feasibility Report and EIS were filed with EPA on May 8, 1981. The Feasibility Report and EIS were transmitted to Congress on October 4, 1983, by the Assistant Secretary of the Army (Civil Works). The Record of Decision was never filed with the Environmental Protection Agency.

Since the 1980 Feasibility Report, changes have been made in the Selected Plan, involving minor design changes of channel dimensions but primarily changes in the dredged material disposal site locations. The purpose of this Final Supplemental EIS is (1) to examine environmental impacts caused by changes from the 1980 Selected Plan analyzed in the 1980 EIS, and (2) to provide additional information on cumulative and secondary impacts, an air quality analysis and potential effects of contaminants in sediments and dredged material, as requested in comments on the 1980 EIS.

2.2 Authorization. - Under the resolutions of July 10, 1968 and December 11, 1969, the Corps of Engineers has prepared a General Design Memorandum (GDM) on modifications to the Sacramento River Deep Water Ship Channel. The study area is the Ship Channel from New York Slough (Pittsburg) to the Port of Sacramento including portions of Solano, Yolo, and Sacramento Counties (see Figure 1).

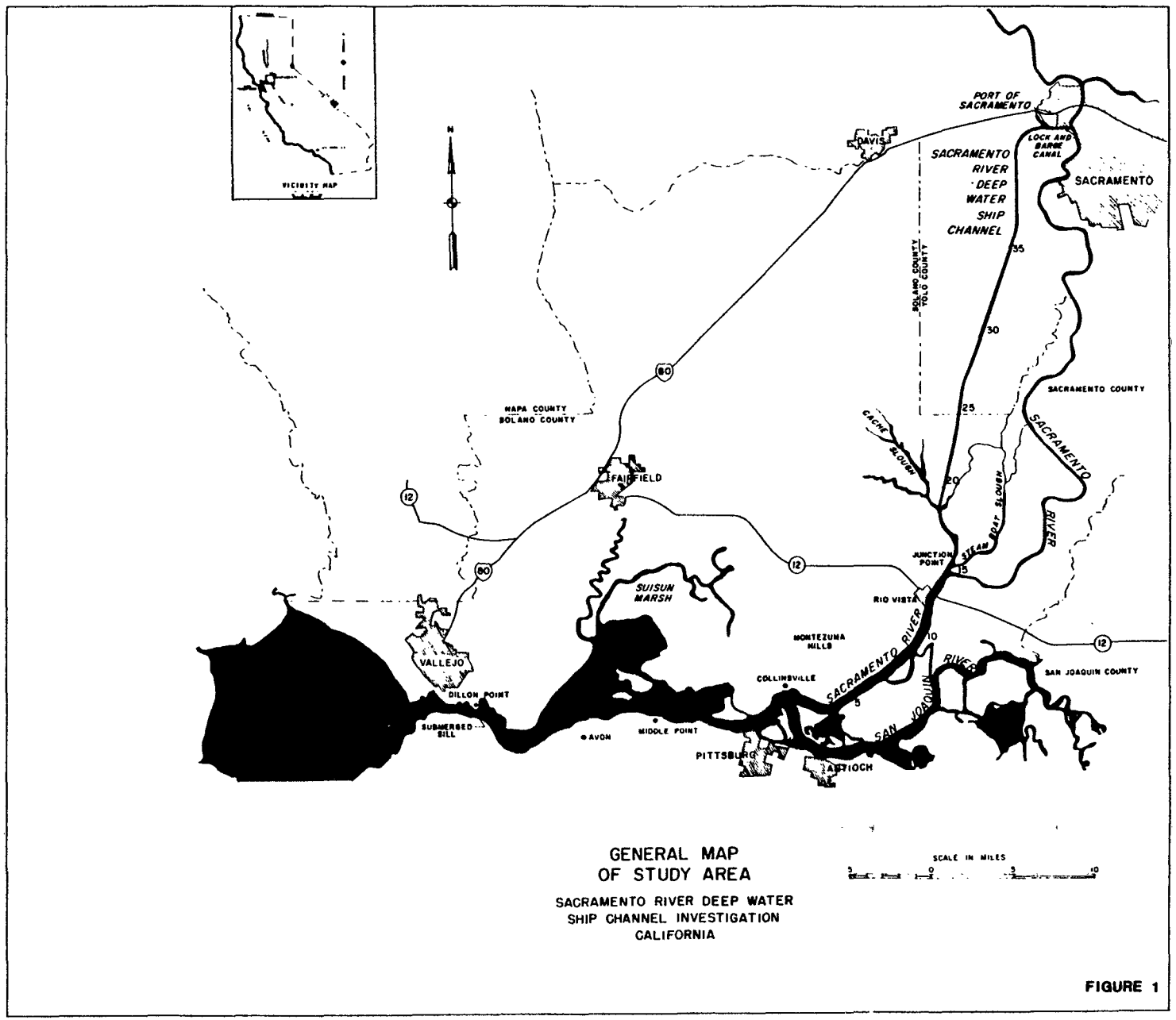
The project was authorized on August 15, 1985 by "An Act Making Supplemental Appropriations for the Fiscal Year Ending September 30, 1985 and for Other Purposes", (Public Law 99-88).

2.3 Public Concerns. - Comments received on the Notice of Intent are included in Appendix A of the GDM. Public and agency concerns focused on water quality impacts during channel dredging, effects on wetlands, fish and wildlife, and secondary and cumulative land use effects.

3. ALTERNATIVES

Two alternatives are considered in this FSEIS: the No Action Plan and the Selected Plan. Other alternatives, including the 1980 Selected Plan, increased use of Lighter Aboard Ships, and intermodal transport of cargo to alternative ports, were analyzed in the 1980 EIS.

The 1980 Selected Plan was similar to the 1985 Selected Plan analyzed in this FSEIS. The 1980 Plan involved deepening and widening the channel as shown in Table 2; the major difference from the 1985 plan is that the proposed width from New York Slough to Junction Point is to be 350 feet instead of 400 feet. About 30 million cubic yards of dredged material would have been excavated. The 1980 Plan involved eight disposal sites totaling about 3,500



GENERAL MAP
OF STUDY AREA

SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL INVESTIGATION
CALIFORNIA

FIGURE 1

FIGURE 1

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Table 2.

Existing and Selected Channel Dimensions in Feet

	1980 Selected Plan				1985 Selected Plan	
	Existing		Proposed		Proposed	
	Width	Depth	Width	Depth	Width	Depth
New York Slough to Junction Pt. (Channel Mile 15.0)	300	30	400	35	350	35
Junction Pt. to Entrance to Manmade Channel (Channel Mile 18.6)	300	30	300	35	300	35
Channel Mile 18.6 to Port of Sacramento	200	30	250	35	250	35

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acres; these sites were S-1, S-12, S-14, S-16, S-19, S-20, S-31, and S-32 (see Figure 2 for locations). These sites are all still included in the Selected Plan, as shown in Table 3. The acreage figures for these eight sites were somewhat different in the 1980 Plan from those in Table 3; a notable example is S-1, which in the 1980 Plan was 400 acres in size.

The 1980 Plan included the potential to deepen the ship channel between Avon and New York Slough if it was not completed under the San Francisco Bay to Stockton project. This reach will be completed by the San Francisco Bay to Stockton project and will not be further discussed as the work was coverd by the project EIS.

The 1980 Plan included a recreation development expansion at Sandy Beach Park. It also included the creation of 45 acres of wetlands on Prospect Island (S-12) and 156 acres of uplands on the disposal sites as mitigation for habitat losses.

Other dredged material sites were considered during the development of the new Selected Plan evaluated in this FSEIS. Some of these were located on agricultural lands along the manmade portion of the channel above river mile 18.6. One site was located on Brannan Island across from Rio Vista, while two others were located in the Collinsville - Montezuma Hills area. The extreme western tip of Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers, was also considered for disposal. Use of some of these sites for disposal would have adversely affected wetlands; after analysis of wetland protection requirements they were not considered further.

3.1 No Action Plan. - With this plan the Corps would not take action to widen or deepen the channel. This plan would provide for a continuation of present shipping practices with no improvements other than normal channel maintenance. The benefits of reduced transportation costs would not be realized. Without the deepening project, the Port also expects to lose future business to other ports with deeper channels. Some limitations of future commodity flow in the study area could be expected with this alternative.

With the No Action Plan, the five sites currently used for periodic maintenance dredging disposal would continue to be used in their entirety for that purpose. These sites are S-14, S-16, S-19, S-31, and S-32 (Table 3).

3.2 Selected Plan. - The 1985 Selected Plan involves widening and deepening the deep water ship channel from New York Slough to the Port of Sacramento. The channel dimensions are shown in Table 2. The channel side slopes will be 1V:4H from New York Slough to Junction Point (Channel Mile 15.0) and 1V:3H from Junction Point to the Port of Sacramento. About 21.5 million cubic yards of dredged material would be excavated using hydraulic suction dredges. The dredged material could be placed on about 4,464 acres of land for disposal with a total capacity of 30 million cubic yards.

The dredged material disposal sites for the 1985 Selected Plan are shown in Figure 2. Acreage, capacity, and ownership are shown in Table 3. Construction of dredged material retention dikes would be the responsibility of the local navigation sponsor, the Port of Sacramento. All disposal sites would be diked and controlled to maintain water quality above standards established by the Environmental Protection Agency (EPA) and the State Water Resources Control Board (SWRCB). Rights-of-way for dredged material disposal, including disposal areas for maintenance dredging, would be provided by the

Table 3

Disposal Site Acreages, Capacities, and Authority

Site	Disposal Depth (ft)	Acreage	Capacity (1000 cu yds)	Authority
S-1*	5	158**	1,800	Port
S-4	5	137	1,100	Private
S-7	5	228	1,800	Private
S-9	5	173	1,400	Private
S-11	5	640	4,300	Private, Port
S-12*	3.7	241	1,400	Port
S-13	5	570	4,500	RB***
S-14*	5	196	1,600	COE, RB
S-16*	5	149	700	COE
S-19*	5	590	4,800	RB, Port, COE
S-20*	5	98	200	Port
S-21	5	160	1,600	RB
S-31*	4	663	2,800	Port
S-32*	3.8	265	1,100	Port
S-35	5	196	1,600	RB, COE
	Total	4,464	Total 30,700	

*These sites were also part of the 1980 Selected Plan.

**This is the northern half of the site shown in the 1980 Feasibility Report; it does not include Lake Washington.

***RB = State Reclamation Board

Note: Disposal depth is based on in-situ channel fill. Actual depth in the disposal areas will vary.

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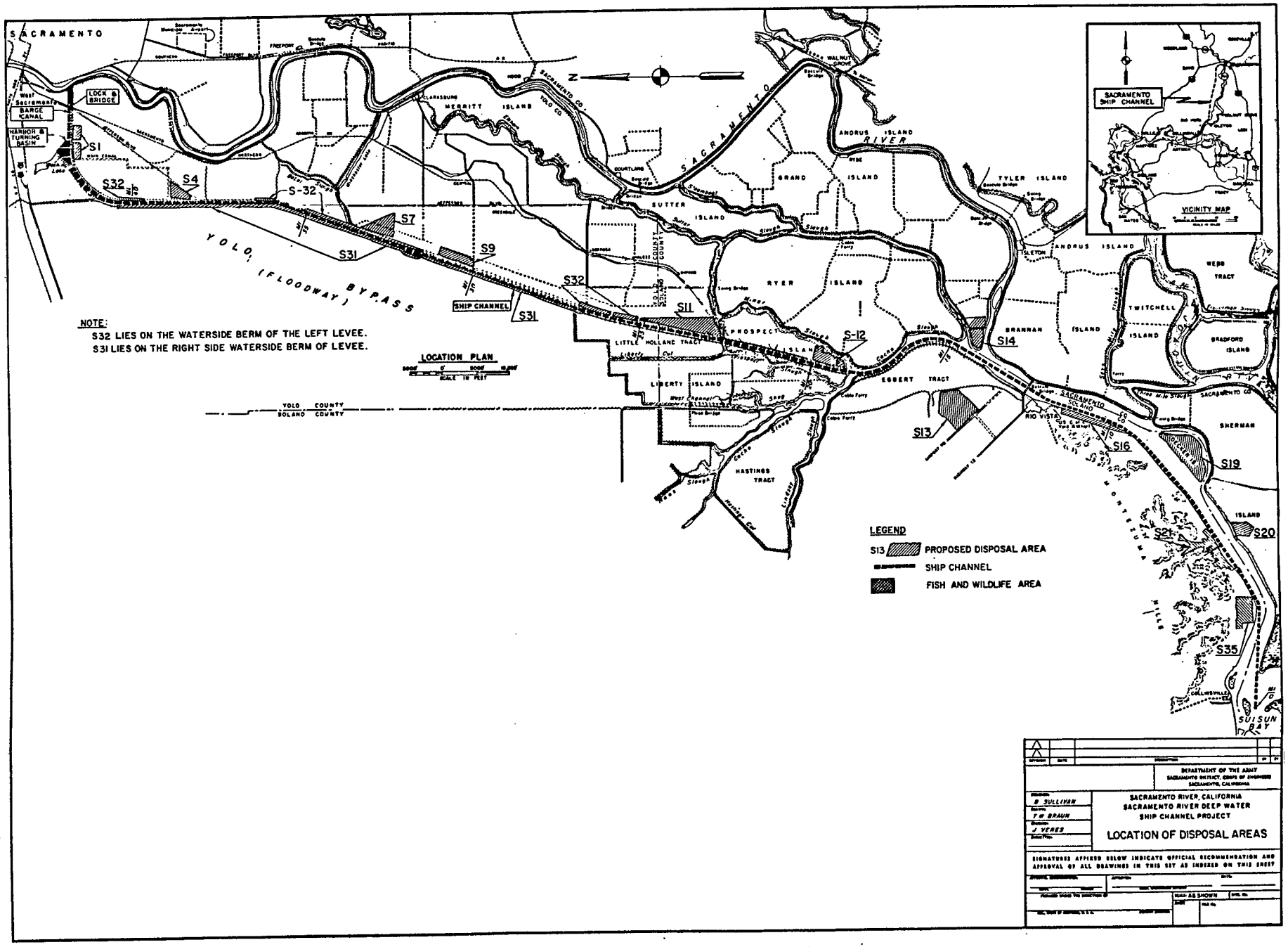

FIGURE 2

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Port of Sacramento. Most of the disposal sites shown in Table 3 are owned by the Port, the Corps, the State Reclamation Board or other public agencies; those in private ownership would either have to be acquired or easements would have to be established in order for disposal to take place.

The 1985 Selected Plan would include fish and wildlife mitigation and recreation development plans but no recreation component due to lack of a local sponsor. The fish and wildlife mitigation plans involve the creation of 63 acres of wetland (open water mudflat or beach bar, emergent marsh and riparian) habitat to compensate for habitat lost in channel widening and any temporary loss of habitat at disposal sites. This mitigation plan is discussed in Section 6.1 and in Appendix E to the FSEIS and Appendix I of the GDM.

In sum, the 1985 Selected Plan differs from the 1980 Plan as follows:

Plan Element	1980 Selected Plan	1985 Selected Plan
Channel Depth	35 feet	35 feet
Channel Width	Same as 1985 Plan except 50 feet wider below Junction Point	see Table 3
Channel Length	Potential deepening and widening from Avon to New York Slough	None. Work being completed under separate authority.
Quantity Dredged	30 mill. cu. yds.	21.5 mill. cu.yds.
Disposal Sites	8, totaling 3500 acres	15, totaling 4,464 acres
Recreation	Expansion Sandy Beach (S-16) 1/	Deferred
Fish and Wildlife Mitigation	45 acres wetland 156 acres upland	63 acres wetland

In the evaluation of the Selected Plan in this FSEIS, plan elements which were part of the 1980 Plan (for example, the 8 disposal sites) were not included in the evaluation except when new or updated information was available (e.g., rare/endangered species, cultural resources), or inclusion of such elements was essential to the integrity of the evaluation (e.g., development of the fish and wildlife mitigation plan).

3.3 Comparative Impacts of Alternatives - The purpose of this section is to display the impacts of the alternatives (the No Action Plan and the Selected Plan) in comparision to the conditions existing now in the project area. This information is presented in Table 4. Note section numbers for discussion of particular impacts.

1/ The proposed recreation development at Sandy Beach was developed by Solano County independently of the project.

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4. AFFECTED ENVIRONMENT

This section provides a description of the environmental conditions of the site area. To prepare a concise EIS supplement, this section has been divided into two parts: significant resources and other environmental considerations. Significant resources are discussed in detail in paragraphs 4.1 through 4.3 and any environmental effects on them are discussed in Section 5. Based on the differences between the 1980 Selected Plan and the 1985 Selected Plan, and on the 1980 EIS and its comments and responses, it was determined that significant environmental resources to be evaluated in this FSEIS include: fish and wildlife; endangered species; and water quality, including heavy metals and salinity intrusion. Other environmental considerations, including land use, secondary impacts and growth inducement, recreation, and cultural resources, are discussed in sections 4.4 through 4.6. Additional information on the potential environmental setting and environmental impacts associated with the project have been described in the documents incorporated by reference into this report.

Significant Environmental Resources -

4.1 Fish and Wildlife - The existing habitat types in the Sacramento River Deep Water Ship Channel (SRDWSC) vicinity have been described in both the Feasibility Report and EIS (1980) and the Sacramento-San Joaquin Environmental Atlas (1979). Upland and wetland habitat types were evaluated across the project area. The major upland habitats are agricultural and grassland. The woodland comprises less than 1% of the total upland area and it will all be cleared and used for dredged material disposal within 3 to 6 years. The barren areas are already used for disposal and are free of any vegetation and will be so in the future. The wetland habitats are riparian and tidal flat in the manmade channel and seasonal marsh and riparian on the disposal sites.

Upland Habitats

The following is a description of primary habitat types on each dredged material disposal (DMD) site. The description of individual disposal site habitats was mostly extracted from baseline habitat data used in the traditional mitigation analysis (Appendix F of the FSEIS). The traditional analysis divided primary habitat types for disposal sites into uplands (agriculture, grasslands, woodlands, and barren), and wetlands (seasonal wetlands and riparian). Whereas, the Fish and Wildlife Service Habitat Evaluation Procedures (HEP) mitigation analysis (Appendix E of the FSEIS) categorized primary habitat as either agriculture, grassland or woodlands. Due to the relatively small acreage within the disposal sites and low wildlife habitat values of these wetlands, seasonal wetlands were not included in the HEP analysis. Most of the wetlands will either be avoided by the project or only temporarily impacted.

Agricultural habitat comprises the total habitat type of five DMD sites and most of two other sites and is the most common habitat of the disposal areas. It is characterized by flat, plowed land in various stages of farming. Some of the fields are being plowed and disked, burned, or planted; others are bearing crops. Agricultural crops observed on the disposal areas include corn, safflower, sugar beets, and winter wheat. Some of the agricultural lands in the study area contain orchards, although no orchards exist on the disposal sites in the selected plan.

Table 4. Comparative Impacts of Alternatives

	Upland Habitats			Wetland Habitats		Endangered	
	Agriculture	Grassland	Woodland	Riparian	Marsh	Species	Water Quality
Baseline (existing)	2,239 acres	2,029 acres	196 acres	25 acres	27 acres (includes 9 acres of tidal mud flat and 18 acres tidal marsh)	No impacts	High total dissolved solids in turning basin related to salt water ballast discharges; salinity in lower river.
No Action Plan	No change	No change	loss of 196 acres	No change	No change	No impacts	Unchanged from baseline.
Selected Plan	Temporary loss of 2,239 acres	Temporary loss of 2,029 acres	loss of 196 acres	temporary loss of 25 acres along manmade channel(estimated recovery of 15 acres of riparian habitat 10 years following construction)	temporary loss of 27 acres along manmade channel (estimated recovery of 10.8 acres of tidal marsh 7 years following construction; little or no tidal mudflats will be recovered)	No impacts	No definable impact on firm water yield of SWP and CVP. State operation studies indicated up to 35,000 acre-feet per annum average impact on firm water yield. A salinity monitoring program will determine impacts, if any. Little or no effect on dissolved solids.
Comments	See Section 5.1 and 6.	See Section 5.1 and 6.	See Section 5.1 and 6.	See Section 5.1 and 6.	See Section 5.1 and 6.	Presence or absence of species to be determined before construction. See Sections 5.2 and 6.0.	See Sections 5.3 and 6.

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Grasslands cover most of the remainder of the disposal site area. They are dominated by annual forbs and grasses including wild oats, common foxtail, cheeseweed, and Italian rye grass. Commonly, these habitats are used for sheep grazing for part of the year, then burned and allowed to revegetate again. Cattle and sheep graze on Decker Island (S-19), in the Collinsville-Montezuma Hills area (S-35, S-21), on the Rio Vista airport site (S-13), and along the manmade channel.

Woodland is present on disposal site S-14. This site is an active dredged material disposal site and the entire site will be cleared and filled as needed and will provide for maintenance dredging disposal in the future. The trees are immature deciduous trees and there is a thick understory of shrubs and herbs. The woody growth is approximately 15 to 20 years old.

Wetland Habitats

Tidal Marsh refers to the habitat which is periodically flooded by waters of the channel. These marshes are primarily found along the margins of the islands in the Delta of the Sacramento and San Joaquin Rivers, in narrow bands along the levees, or near the Port of Sacramento in the manmade channel. The freshwater marshes are dominated by tules, cattails, and soft rush. A number of flowering herbs are also associated with the standing water or along the water's edge. These include smart weed, water hyacinth, and pondweed. Along the west side of the channel, there are a few brackish water marshes where a mixture of salt marsh and freshwater marsh species exist side by side. Salt marsh species (i.e. saltgrass, pickleweed, and fat hen) are interspersed with grasses, cattails, and rushes along the low elevation areas of the Collinsville area.

Seasonal Marsh is found on some upland disposal sites in swales at low elevations. Existing levees can effectively block water flow in and out of the site and storm runoff water ponds on these sites throughout the wet season of the year. The water eventually drains or evaporates and a flora specific to that type of water regime emerges. Saltgrass, fat hen, soft rush, and other water tolerant plants are found growing in these areas.

Riparian habitat is very limited and only occurs on one disposal site (S-19). It is healthy and diverse where it exists. Riparian habitat is also along the manmade channel where most of it is found along the levees and banks shoreward of the marsh sites. The tree vegetation consists of immature willow, cottonwood, alder, and valley oak. Shrubs are blackberry, wild rose, and blue elderberry. The diversity of shrubs, forbs, and grasses characterize this habitat as excellent for wildlife species and aesthetic appeal.

Tidal mudflat exists only along the upper reaches of the manmade channel. This habitat is exposed at low tide and it is virtually free of vegetation. It provides feeding habitat for a variety of shorebird species and is important to the integrity of the wetland ecosystem.

Dredged Material Disposal Sites - Eleven of the fifteen proposed sites are entirely upland habitat. Of these eleven, five (S-7, S-9, S-11, S-12, and S-31) are used exclusively for agriculture and two (S-21 and S-32) are strictly grassland type habitat. S-1 and S-4 are a mixture of grassland and agricultural uses. Of the remaining two upland sites (S-14 and S-16), S-14 is a mixture of grassland, woodland and barren area, while S-16 contains barren sand dunes and sparse grass.

The majority of the upland disposal areas are located along the manmade channel. The sides of the manmade channel are bounded by linear-shaped habitat on both the east and the west. These lands are flat or gently sloping, recently cultivated, and usually crossed by irrigation canals and ditches. The region's natural gas industry is evident in the numerous gas works found in many of the fields. A variety of songbirds and birds of prey, amphibians, and small mammals use the vegetation and water along these canals for feeding and resting. Numerous raptors, primarily red-tailed hawks and American kestrels, can be observed on the power lines and foraging in the fields.

Most of the grassland habitats on the disposal sites are of low value to wildlife. S-32 is in pasture use along the south floodplain of the channel and it is typically flat, linear habitat. For these reasons, it is of relatively low habitat value. S-20 is a small, flat parcel on Sherman Island that contains some shrub vegetation; it has a low habitat value apparently as a result of overgrazing. Site 20 contains a small amount of seasonal wetlands. S-13 is pasture located in the relatively flat lands northeast of Rio Vista on the Airport Road. It is gently rolling hills and low grass and shrub mix vegetation and is currently being used for sheep grazing. The site contains some topographical relief that suggests vernal pool habitat in addition to the grasslands. On the basis of the 1984 aerial photos and ground truthing, S-13 is considered upland (grassland and bare soil) and therefore of relatively low habitat value.

Decker Island (S-19) is mostly grassland fringed with agricultural and riparian habitat. It is currently used as a maintenance dredged material disposal site; however, it is valuable to wildlife from the standpoint of a diversity of life requirements, food, cover and breeding areas.

Disposal site S-14 on Grand Island, is presently used for maintenance dredged material disposal and consists of disturbed grassland, and woody/shrub vegetation. The perimeter of the island along the waterside of the levees is lined by mature riparian vegetation that will not be affected by the Selected Plan. Stands of large shrubs (i.e., willow, wild rose, elderberry, cottonwood, wild grape) and patches of grass and forbs are the primary vegetation in the wooded areas of this site. This disposal site will be cleared of both woodland and grassland vegetation for use as a disposal site with or without the Selected Plan. This is one of the most diverse vegetative habitats in the ship channel region in its present condition.

Prospect Island (S-12) is all agricultural fields. It is extensively farmed and grazed; however, there are a few marsh acres on the south end that provide diverse transitional vegetative habitat. These marsh areas of the south end are an excellent habitat for fish and wildlife because of their

proximity to the waterways and the mosaic of habitat types. The southern 63 acres of this site is proposed as a wetland development area to compensate for the loss of wildlife habitat associated with the project.

There are five proposed disposal sites that contain small portions of wetland habitat (S-13, S-19, S-20, S-21, and S-35). Most of the wetlands of the proposed disposal sites border lakes and sloughs; they are not as abundant along the levees. There are some extremely small linear-shaped areas of marsh type vegetation along the irrigation canals and in the ship channel; however, tiny, discontinuous marshes of this type were considered in the traditional and HEP analyses to be part of the greater adjacent habitat type.

Decker Island (S-19) has a fringe of mature riparian cottonwood trees along portions of the shoreline. These areas will not be affected by the Selected Plan. On both the west and east shores of the island, there are narrow bands of emergent marsh composed primarily of tules. These narrow marshes form a kind of border around the upland farmlands. The value of these marshes to wildlife is high, for they provide a diversity of habitats in combination with the upland and open water habitats and they form an interface or ecotone between habitats.

The most valuable fish and wildlife habitats in the DMD areas are the larger, non-linear wetlands and riparian areas. They are diverse vegetated areas with a variety of plant forms and species that provide food, cover, and breeding areas for fish and wildlife. Other valuable sites are those with a mosaic of different habitats including both wetlands and uplands. Collinsville-Montezuma Hills (S-35 and S-21), and Decker Island (S-19) are good habitats that could be improved if they were managed for wildlife.

4.2 Rare, Threatened, and Endangered Species

A revised list of Federally listed endangered, threatened and candidate species dated December 20, 1985 provided by the Fish and Wildlife Service Endangered Species Office (ESO) was used to analyze potential project impacts to these species. The list included one endangered species (salt marsh harvest mouse), and seven candidate species (Suisun shrew, California black rail, Suisun aster, Suisun thistle, California hibiscus, delta tule pea, and Mason's lilaeopsis).

Two other species, the threatened valley elderberry longhorn beetle and the rare Sacramento anthicid beetle were also investigated, although they were not listed by the ESO as being of concern due to the project. See Appendix D of the FSEIS.

4.3 Water Quality. - The 1980 Feasibility Report and EIS addresses water quality and the information in that report is incorporated by reference. Water quality in the Port of Sacramento may be somewhat better today than reported in the 1980 EIS in terms of total dissolved solid (TDS) levels (Christian, 1985); this is because the TDS levels relate to saltwater ballast discharges that mainly come from wood-chip ships. It is Port policy to

encourage ships to recirculate their saltwater ballast with brackish water in the lower Delta to lessen the TDS levels near the Port. In addition, the Port of Sacramento has recently updated its "Pilot's Report", to include written information on whether or not ships en route to Sacramento follow the Port's saltwater ballast recirculation policy (Christian, 1986). The Pilot's Report is furnished to the Port for each ship traveling to Sacramento and provides a written record of which ships are in compliance with this policy. Regulation of the TDS standards is a responsibility of EPA.

In the 1980 EIS, the Corps of Engineers stated that it would conduct additional studies on salinity intrusion and on potential heavy metals in bottom sediments. Salinity studies were to further define impacts of channel deepening (COE 1980), while studies of the bottom sediments were to determine potential impacts of dredging on the water column and on the quality of effluent from dredged material disposal sites. The Corps of Engineers has conducted some of these studies (COE 1984 a, b), with elutriate tests on the lower portion of the channel. The results of these tests are discussed in the water quality assessment in this FSEIS. Additional elutriate, modified elutriate, and column settling tests will be completed in mid-1986. This additional testing will be conducted over the entire project area and will provide detailed information on the potential effects of dredged material disposal on the water quality in the project area. The new test results will be completed before project construction begins and will aid in dredged material disposal area design.

Impacts of heavy metals in the water column due to dredging the channel and the disposal of material were addressed in the 1980 Feasibility Report and EIS and that discussion is incorporated by reference. That assessment was based on chemical analyses of six bottom sediment core samples, 2.5 inches in diameter, taken during November 18 and 19, 1974, from the channel over the 41 miles between Collinsville and Sacramento. Each core sample was divided into depths, for a total of 22 samples. Concentrations of zinc in some sediment samples exceeded 1971 EPA criteria.

The 1980 EIS stated that more tests of bottom sediments would be conducted during advanced studies to determine impacts to the water column and to determine effluent quality from dredged material disposal sites. The Corps conducted standard elutriate tests for heavy metals in four bottom sediment samples collected from the channel between Collinsville and Rio Vista during 1983. The tests were limited to this area of the project, as it was believed that samples obtained here would be most likely to exhibit signs of potential contamination. This is due to several reasons: 1) this area is part of the older, natural channel and has been subject to more deposition than the 20-year old manmade portion; 2) it is near the river's confluence with the Delta, which because of a larger surface area, causes a decrease in velocity and greater deposition of materials; and 3) it is relatively close to industrial sources of potential contaminants. The results of both the 1980 tests and the 1983 standard elutriate tests are presented and discussed in this FSEIS. Examination of the test results indicated that further studies are required to adequately address the dredging effects on the water quality in the project area. This will be completed in mid-1986. A description of the additional testing procedures is presented in this FSEIS.

The recent salinity intrusion studies by the Corps of Engineers addressed the repeatability of the Bay-Delta hydraulic (water quality) model under conditions with and without the proposed channel deepening (COE 1984 a,b). The study involved repeated runs of the model to simulate steady-state salinity conditions at several locations. These runs were made under base and plan conditions, i.e., 30-foot existing channels and deepening to 35 feet, respectively. Sets of runs were made for low Delta outflow and both low and high export flows, for both base and plan conditions. The number of runs made under each condition is as follows:

Exports	Conditions	Runs
Low	Base 1	7
Low	Plan 1	7
High	Base 2	2
High	Plan 2	7

Modeled flow conditions are as follows:

	Study Flow Rates (cfs)	
Flows	Low Exports	High Exports
Inflows:		
Upland Rivers	12,800	19,800
Ag Drain	1,200	1,200
Withdrawals:		
Export Pumping	5,000	11,000
Gross Channel Depletion	4,600	4,600
Delta Net Outflow	4,400	5,400

Salinity was measured at several model locations once steady state was reached in each run. Repeated runs resulted in several measurements, which were analyzed for statistical significance of base-plan salinity differences. Results are discussed in Section 5.3, Water Quality.

Two mathematical modeling methods were use by DWR to assess potential salinity impacts on the firm yield of the State Water Project (SWP) and the Central Valley Project (CVP). These results are also discussed in Section 5.3, Water Quality.

Other Environmental Considerations -

4.4 Land Use - This section covers land use on the disposal sites and around the channel, land use plans and proposals for future development, and transportations systems, principally roads, which may be affected by future growth and land use change. The 1980 EIS analyzed future industrial

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growth related to the ship channel and that analysis is incorporated by reference. Comments on that EIS indicated the need for an analysis of secondary impacts (land use, transportation) related to future growth. The focus of this section is on discussion of secondary and cumulative impacts.

Current land uses on the disposal sites are mostly agriculture (grazing or row crops such as safflower) or open space. Six of the sites are currently used for maintenance dredging deposition. Land uses throughout the study area on both sides of the channel are mostly agriculture, open-space, and recreation development. The only industrial activity other than in the Port of Sacramento is the natural gas fields in the area south of Rio Vista.

The 1980 Feasibility Report described lands near the Port of Sacramento and in the Collinsville-Montezuma Hills area which were zoned and/or planned for future industrial growth; the following discussion updates that information. At the Port of Sacramento, the 600-acre Port of Sacramento Industrial Park, located northwest of the harbor, provides for development of water-oriented heavy industry. About 2000 acres south of the channel are planned for future industrial growth in Yolo County's Southport Area Plan.

The Port of Sacramento has current plans for expansion within the context of the types of commerce discussed in the 1980 Feasibility Report and EIS. The Port's expansion plans assume the widening and deepening of the channel and include upgrading existing facilities (i.e., increased conveyor capacities in the bulk and rice facilities, improved weighing capabilities, and automation of the grain elevator). Long-term plans include new facilities to handle bulk cargo, a coal terminal, berths, quasi-bulk areas, transit sheds, container barge service, warehouse storage, bulk liquids, and expansion of the World Trade Center. The Port's Plan is flexible and the timing is highly dependent upon market demands for such facilities. The Port's Plan recognizes site S-1 as a disposal site; however, it recommends limiting the disposal of dredged material to an area about 1,500 feet south of the center line of the existing barge canal between the turning basin and the Sacramento River. In November 1984, the Port submitted a permit application to fill Lake Washington and a portion of the turning basin; however, the permit application has been withdrawn.

Yolo County's Southport Plan calls for water-dependent industrial uses along the channel and light industry set back from the channel. The Plan includes alternative locations for a bridge over the channel and the general location of rail lines and roadways. There are currently no specific development plans in the Southport area; however, the plan would facilitate industrial development for specific proposals.

All of the disposal sites in Yolo County not evaluated in the 1980 Plan EIS (S-4, S-7, S-9, and part of S-11) are zoned and designated for agriculture.

Yolo County's Southport Plan anticipates a strong demand for new and replacement housing as a result of industrial growth in the Southport area. The ability to subdivide residentially designated lands is linked to the issuance of industrial building permits to encourage the availability of nearby housing for new employees.

In the Collinsville-Montezuma Hills area, Solano County has established a redevelopment agency to encourage industrial development in a 10,350-acre area along the north side of the Sacramento River, not including the towns of Collinsville and Birds Landing. The land is mostly owned by large corporations such as Dow Chemical, PG&E, and Southern Pacific, which lease it to farmers for livestock (sheep) and grain production.

Disposal sites S-35 and S-21 are within the redevelopment area. S-35 is in the area planned for water-dependent industrial uses in the immediate future, while S-21 is in the industrial reserve area. The reserve designation could be removed once the rest of the industrial area in the redevelopment area is developed. There are no current proposals for development in this area; however, the plan is a 20-year plan, and proposals could be considered by the County at any time.

The other disposal sites in Solano County not considered in the 1980 Plan EIS are S-13 and part of S-11; both are zoned and designated for agriculture.

Solano County's General Plan encourages and directs residential development to the urbanized areas. The County's redevelopment area does not provide for residential uses on adjacent property but rather is intended to maintain agricultural uses adjacent to the redevelopment area. It is expected that employees working in the redevelopment area would commute to outlying urbanized areas where adequate housing and/or vacant residentially zoned land exists.

Both Yolo and Solano County Plans include transportation elements to accommodate industrial growth in the Southport and Collinsville areas. Yolo County's Plan also anticipates residential traffic. The plans call for roadway connections from future industrial areas to existing roadway networks as part of future development. Developers would be required to accommodate traffic demands as part of project approval. Some improvements may be financed by one or more developers through assessment districts or through other joint funding mechanisms.

The disposal sites in Sacramento County were evaluated in the 1980 Feasibility Report and EIS, incorporated by reference; their status is unchanged.

Both Yolo County and the Port of Sacramento have based their planning efforts on the assumption that the channel would be widened and deepened. The No Action Plan is not consistent with this assumption. Solano County anticipates industrial growth in the redevelopment area including Sites S-21 and S-35 regardless of whether the channel is widened and deepened. The No Action Plan alternative could in effect limit future industrial growth by limiting the types of vessels to those presently using the channel. However, some growth is expected even with the No Action Plan.

The Selected Plan is consistent with land use growth and change projected by the Port of Sacramento, Yolo County, and Solano County. Only a slight increase in the number of vessels using the channel is projected for the first 20 years, so traffic using bridges in the project area should not be

significantly adversely affected. Disposal on the sites in the Selected Plan is compatible with existing and planned future uses. Dredged material might be used to enhance levees, as requested by the Emergency Delta Task Force in its letter supporting the project. A limited amount of this was done with the deepening of the Stockton ship channel. However, the Port of Sacramento is responsible for providing disposal sites, so levee owners would need to make arrangements with the Port. There are no current plans to use dredged material to enhance levees. Reclamation District 501 (Ryer Island) is concerned that the existing ship channel rock along Cache Slough has slipped due to ship channel traffic. The rock along Cache Slough was placed by the Corps as part of the existing channel project and turned over to non-Federal interests for maintenance. This problem was analyzed only a few years ago and it was determined that rock slippage was not due to the deep water ship channel traffic.

The Selected Plan might affect the timing of new development along the channel by enhancing the marketability of the area and making it attractive to a larger market (therefore speeding up development). However, no significant change in the types of industrial development along the channel is projected.

The major concern of the local governments regarding the disposal sites is the timing of the disposal and whether or not the sites would be used for long-term maintenance dredging disposal. The maintenance dredging sites will be those which are currently used for that purpose by the Corps (S-14, S-16, S-19, S-31, S-32, and S-1). This use is compatible with the plans of the Counties (with the exception of Solano County's desire to expand the recreation area into the Corps maintenance dredging area at S-16). The Corps will coordinate the timing of the disposal with local governments.

4.5 Recreation - The Delta Recreation Concept Plan (DRCP) (California Department of Water Resources, 1981) examined recreation use of the Delta, projected future recreation use, and identified existing recreation sites and potential future public recreation sites. The DRCP identifies existing commercial and public recreation facilities along or near the channel. Recreation use of the Delta was projected to increase from 11.0 million recreation days in 1977-1978 to 13.6 million in 1990. The report divided the Delta into nine areas; the ship channel study area is in Areas 1, 2, 3, and 5. In these areas, the most popular recreation activities are fishing, driving for pleasure, sightseeing, and relaxing, with camping, picknicking, and motorboating also popular.

The Corps of Engineers completed a Draft Feasibility Report and Draft EIS for the Sacramento-San Joaquin Delta in October, 1982. The report proposed rehabilitation of levees throughout the Delta and the potential development of numerous recreation facilities. Studies on this investigation are continuing.

Park representatives for Yolo, Sacramento, and Solano Counties were contacted with regard to existing or planned public recreation facilities along the deep water ship channel. The existing, planned, or potential recreation resources are summarized below for each county.

Yolo County. Yolo County has no existing commercial or public recreation facilities along the ship channel. The County's recreation management in this area is done by the East Yolo Community Services District (CSD). The focus for recreation facilities has been on small community parks. The CSD is interested in a regional park to serve the East Yolo community located near the Lake Washington area at the Port of Sacramento. The DRCP identified three potential public recreation sites in Yolo County along the ship channel: two fishing access points and one conservation area.

Sacramento County. In Sacramento County, there are eight commercial recreation areas (all marinas except one) and three public recreation areas near the ship channel (DRCP, 1981). The public areas include two fishing access points and Brannan Island State Recreation Area. Sacramento County planners indicated that the County has only small public picnic and boat launch sites in the Delta. In the ship channel area, the County has a preliminary plan for a recreation area at Grand Island. The DRCP identified three potential public recreation areas in Sacramento County along the ship channel at Grand Island, Lower Sherman Island, and Brannan Island (an extension of the State Recreation Area).

Solano County. On or near the ship channel from Collinsville to Yolo County, Solano County has seven commercial recreation areas (all marinas and resorts). There are three public areas at Rio Vista, including the existing Sandy Beach County Park (DRCP, 1981). The County's 1983 Park and Recreation Plan identifies needs for camping, picnicking, fishing, and boating, among others, and gives a high priority to the development of camping facilities at Sandy Beach Park. The 1983 Plan also mentions Decker Island and the Collinsville area as having potential for future recreation development. The DRCP identified Decker Island, four sites near the tip of Prospect Island (including conservation and fish/wildlife areas), and a fishing access point near Rio Vista as potential public recreation sites. With the No Action Plan, recreation facilities in the ship channel area will not be affected.

During the preparation of the GDM, the Corps coordinated extensively with recreation planners for the three counties and the CSD (see Appendix C to the GDM). The Selected Plan will not contain a recreation element as none of these agencies submitted letters of intent to act as local recreation sponsors. Therefore, recreation is deferred.

Solano and Sacramento Counties and the CSD did submit letters of interest in future recreation development at some of the disposal sites (S-1, S-14, S-19, S-21, and S-35) (see Appendix C to the GDM). The Corps will consider adding recreation as a project purpose if and when the Counties or the CSD are ready to participate as local recreation sponsors. Again, since there are no local recreation sponsors, recreation will be deferred at this time. The Selected Plan will not affect any existing developed recreation area. Casual recreation use of the banks of the manmade channel may temporarily decrease due to the removal of riparian vegetation which currently makes this area more attractive; however, there is at present very little recreation in this area, according to the results of the 1980 Delta Outdoor Recreation Survey.

4.6 Cultural Resources - The 1980 Feasibility Report describes the prehistoric and historic resources of the study area and is incorporated by reference. An intensive cultural resource survey and literature review for the ship channel project area in Yolo and Solano Counties was completed in January, 1985 (Werner, 1985). Field investigations of all the disposal sites except S-14 and S-20 in Sacramento County were conducted. S-14 is already a highly disturbed site. No prehistoric or historic cultural resources were found within the project area. The only prehistoric archaeological site found near the project was CA-YOL-42; it is just south of disposal site S-1. It would not be affected by either the No Action Plan or the Selected Plan. Werner noted that buried archaeological sites could be located anywhere within sites S-1, S-4, S-7, S-9, or S-11. The National Park Service concurs that there are no cultural resources in the project area and considers it unlikely that unknown cultural resources would be found during implementation of the Selected Plan.

5. ENVIRONMENTAL CONSEQUENCES

5.1 Fish and Wildlife -

(a) Aquatic Environment - The impacts on fish, plankton, and benthic organisms of the dredging necessary to widen and deepen the channel were analyzed in the 1980 EIS. This analysis is still valid for both alternatives because the proposed modifications to the channel are much the same as in the 1980 EIS, the only difference being a reduction of dredging in the downstream portion of the project due to the selection of a channel width of 350 feet instead of 400 feet.

Comments on the 1980 EIS expressed concern that salinity changes caused by channel deepening would adversely affect aquatic organisms, including fish, plankton, and benthics. The question of the combined effects on salinity and aquatic organisms of deepening both the Stockton and Sacramento channels was raised. The additional salinity modeling completed for this FSEIS is described in Section 4.3 and 5.3. Model tests show no changes in salinities under normal or average dry flow conditions. Under a "worst case" scenario, salinity changes resulted from the simulated deepening. These differences are small enough that no significant adverse effects on aquatic organisms would be expected.

(b) Terrestrial Environment - The impact on wetland and upland habitats has been evaluated using the HEP as described in Appendix E of this FSEIS. The Appendix summarizes the results of the HEP investigation and discusses the potential changes that would occur under each alternative as follows:

No Action Plan (Without Project) - The multi-agency evaluation team determined the following changes would occur:

- Permanent elimination of 196 acres of woodland habitat on site S-14 due to clearing and use for maintenance dredged material disposal which is the current authorized use of the site.

- Temporary destruction of habitat on the maintenance dredged material disposal at approximately 2 to 3 year intervals on parts of sites S-14, S-16, and S-19 and at about 7-8 year intervals on portions of S-1, S-31, and S-32; total area affected by the disposal is 2,001 acres.

- Gradual changes in habitat along the channel such as the maturing of tidal marsh and riparian habitat. The ecological value would increase as the existing riparian habitat matures to a stratified, diverse riparian zone.

Selected Plan (with project) - The potential adverse impacts associated with the construction include:

- Temporary loss of approximately 9 acres of tidal mudflat, 18 acres tidal marsh, and 25 acres immature riparian habitat along the sides of the channel between Channel Mile 18.6 and Channel Mile 42.0 (Port of Sacramento).

- Temporary burial of up to 4,268 acres of upland habitat ("worst case" scenario) in the disposal sites due to the eight years of construction dredged material disposal.

The 1980 Feasibility Report identified several other potential sites that contained large areas of wetland, but the project has been modified to avoid filling extensive wetland areas. There may be little or no recovery of the 9 acres of tidal midflats along the manmade channel. Recovery of marsh and riparian habitat along the manmade channel is estimated to be 60 percent of the original acreage or 10.8 acres of marsh and 15 acres of riparian. Tidal marsh habitat will be recovered to pre-project conditions 7 years following project construction. Riparian habitat will be recovered in 10 years to pre-project conditions following construction. Seasonal wetlands on the DMD sites will return to pre-project conditions 2 years following construction.

The upland habitats on the dredged material disposal sites used for one-time disposal during construction should return to the baseline conditions within two years post-construction. For agricultural sites, the DMD will temporarily remove these lands from production.

Maintenance dredging impacts associated with the Selected Plan would be the same as those with the No Action Plan, since the channel improvement will not increase maintenance dredging requirements.

There will be more benthic habitat created by channel widening. However, deeper draft ships will tend to keep the channel bottom in a turbid condition; similiar to the present condition. There will be no significant change in the quality of subtidal habitat in the man-made channel.

5.2 Endangered Species - No adverse affects will occur under either alternative. A Biological Assessment (January 1986) was prepared based on the Endangered Species Biological Data Report (September 1986) and Addendum (January 1986). The assessment concluded that the Selected Plan will not impact the salt marsh harvest mouse, the only Federally listed endangered species. Also, the project will avoid or minimize impacts to two candidate species, the delta tule pea and Mason's lilaeopsis. Accordingly, the Fish and Wildlife Service Endangered Species Office determined that formal consultation pursuant to Section 7 of the Endangered Species Act was not necessary. See Appendix D of the FSEIS.

5.3 Water Quality - This section focuses on results of updated salinity studies associated with channel deepening, and on standard elutriate test results provided by sampling and analysis in 1983. Additional modified elutriate, standard elutriate, and column settling tests that will be completed in mid-1986 are also descirbed in this section. In regard to salinity, the focus will be on salinity increases as opposed to no changes or decreases since salinity intrusion in the Delta is a major concern.

No Action Plan - With the No Action Plan, the influence of the ship channel on water quality would remain unchanged, including salinity, TDS, heavy metals, and pesticides.

Selected Plan - The impacts of the Selected Plan are discussed in three subsections: impacts on the Port area, salinity studies, and heavy metal tests.

Impacts on the Port Area - With the Selected Plan, larger vessels could use the Port of Sacramento and might discharge larger amounts of saltwater ballast, resulting in higher associated TDS levels in the Port area. However, the amount of ballast discharged is more dependent on the type and shape of vessel than on its size (Christian, 1985). Certain vessels require more ballast than others due to their design and type of cargo carried. For example, woodchip ships require a greater volume of ballast to maintain navigational control than do other vessels, because of the bouyancy of their cargo and large vessel size. The Port of Sacramento has a policy encouraging ships to recirculate their ballast water in the lower Delta in an attempt to lessen the TDS levels in the port area. To encourage compliance, the Port recently sent policy letters to all pilots who use the port and has updated the pilot's report (completed for all vessels calling at the port) to determine which vessels are following the policy. Effects on TDS levels, if any, are expected to be small. A copy of the pilots report is in Appendix A of this FSEIS.

An increase in ship traffic could mean more discharges of sanitary wastes into Port waters. A small increase in ship traffic is expected in the next 20 years, so there should not be a significant increase in the discharge of sanitary wastes. In addition, all vessels are required to contain Marine Sanitation Devices (MSD's). MSD's are designed to minimize the impacts of sanitary waste and are regulated by the U.S. Coast Guard (33 USC 1322). The Coast Guard inspects all MSD's whenever a boarding inspection is conducted to ensure they are in compliance with the regulations. MSD's must meet certain effluent standards for fecal coliform bacteria, visible solids, and suspended solids. The severity of the standards is dependent on the age of the vessel. Details of the regulations can be examined in the Coast Guard Regulations (33

CFR Part 159). The increased Port activity with the Selected Plan should not result in increased stormwater pollution because the Port has runoff control facilities (Christian, 1985). There have been only minor problems with spills or leaks to date mainly because there is no petroleum traffic to the Port. No petroleum traffic is expected with the Selected Plan.

Salinity Studies - The results of salinity model studies are presented in more detail in Chapter V and Appendix E of the GDM. Previous salinity model test results were also presented in the 1980 Feasibility Report and are still valid. More recent salinity tests are a refinement of previous studies.

Statistically significant increases and decreases for the low net Delta outflow (4,400 cfs) low export (5,000 cfs) "critically dry" condition for the Sacramento-San Joaquin Delta were developed in tests at the S.F. Bay - Delta Model. Statistical comparisons of steady-state plan (deepened channels) vs. base (1980 existing channels) are given in Tables V-1 and V-2 of the GDM. An increase was noted for the Sacramento River near Decker Island. Small statistical decreases were also noted for many stations in the central and south Delta. Salinity results for low net Delta outflow (5,400 cfs), high export (11,00 cfs) flow condition show essentially no statistically significant changes throughout the Sacramento-San Joaquin Delta. However, a statistical decrease is noted at the Sacramento River near Decker Island for this somewhat higher net Delta outflow. Thus, small increases in net Delta outflow causes the possible impact at this location to disappear.

Analysis of Model Test Results - The steady-state physical model tests show no significant adverse salinity effects throughout the Sacramento-San Joaquin Delta for average or dry flow conditions. Physical model tests for the critically dry (steady-state) condition show no adverse impacts in the Delta except for a small increase on the Sacramento River near Decker Island. The impact noted in the test only identifies a potential impact since the steady-state flow conditions will not occur in nature. Furthermore, as shown by the low net Delta outflow (5,400 cfs), high export (11,000 cfs) test, this impact disappears with small increases in flows. Thus, impacts, if they should occur, would be limited to very infrequent critically dry flow conditions.

State DWR Firm Yield Operations Studies - The results of physical model tests were coordinated with the State Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (USBR). Both agencies indicated the need to estimate potential reductions in firm water yield to the State Water Project (SWP) and the Central Valley Project (CVP) due to making releases in order to meet salinity based water quality standards. The water project firm yield is that amount of water which can be delivered to users during the critical dry period. The computed firm yield is used by the State and USBR to determine the amount of water that each agency can sell on a long term basis.

DWR conducted these firm yield operation studies which are described in Chapter V of the GDM. The studies addressed a worst case condition to determine a potential maximum impact to the SWP and CVP firm yield. Results of these studies shows a maximum potential average impact of 35,000 acre-feet per annum loss in firm yield. This amounts to a potential impact of less than 1/2 percent of the firm yield of the CVP and SWP. Different, somewhat less

conservative but more realistic and reasonable assumptions than the worst case assumptions utilized would reduce the firm yield impact. Discussions with DWR and USBR indicate that the potential impact is not clearly definable at this time.

Summary and Conclusions of Salinity Studies - The results of a worst case analysis show a potential decrease in firm water yield because of the requirement to release water from storage to meet water quality standards. Based upon reasonable estimates to date, the impact to the firm yield of the SWP and CVP could vary from zero to as much as 35,000 acre-feet. Discussions with DWR and USBR personnel indicate the impact is not clearly definable at this time. Studies to date have shown that any potential impact is small (or could be none) and it would only occur in very dry years. To insure preservation of current water quality, a salinity monitoring program conducted prior to, during, and after completion of project construction was determined to be the best method for conclusive definition of project impacts. Refer to paragraph 6.2 for discussion of future actions on the salinity issue.

Heavy Metal Tests - The 1980 EIS (pages 3-10) discussed the potential of release of sediment-associated pesticides and heavy metals and their uptake by aquatic organisms; that discussion is incorporated by reference. Studies done in the Dredged Material Research Program by the Corps Waterways Experiment Station reveal: (1) that heavy metals and pesticides which are adsorbed to the particles in lightly contaminated sediments tend to be released only slowly or slightly into the water during disturbance from dredging; and (2) that a high percentage of heavy metals are adsorbed onto soil particles and removed by settling in disposal areas (Engler, 1977), and are thus not discharged into the receiving waters.

In this FSEIS, the impacts of sediment-associated heavy metals on water quality are further assessed using applicable criteria and the results of 1983 standard elutriate tests completed on channel sediments. Current sediment testing requirements and applicable criteria are discussed and compared against the observed 1975 concentrations of heavy metals found in bottom sediment bulk analysis tests. Observed heavy metal levels from the 1983 standard elutriate tests, simulating open water disposal, are discussed in relation to EPA water quality criteria. The limitations of the sampling and testing procedures used in both 1975 and 1983 are described in some detail, along with additional testing and disposal site design that will take place prior to any construction.

As reported in the Feasibility Report and EIS (COE 1980), a bulk analysis on 22 samples taken from 6 sites between the turning basin and Collinsville was completed in 1975. The results of these tests indicated that at 3 of the 6 sites only zinc exceeded 1971 EPA maximum limits. Tests for zinc elsewhere in the region indicated that natural levels of this metal also exceeded EPA standards. All other detections of heavy metals fell well below the then existing EPA limits. These tests indicated that certain heavy metals are in the material to be dredged but do not indicate what impacts dredging and the discharge of the return-water will have on the water column. Studies at the time indicated that heavy metals adsorb to the soil particles and that a high percentage settle out in the disposal areas, but further analysis was committed to advanced design stages of the project.

As part of Continued Planning and Engineering, additional sediment samples were collected in 1983 and standard elutriate tests were conducted on sediment samples obtained from the lower reaches of the Sacramento River and Cache Slough. No tests were run on soil samples that were taken from the manmade portion of the ship channel because there is no reason to believe the material to be dredged contains other than traces of naturally occurring elements. The soils in the manmade portion of the ship channel are sand, clay and fine gravel with silt on the channel bed. There are no industrial developments along the channel which could introduce contaminants into the aquatic ecosystem.

Sediment Testing Requirements - Both the California Department of Health Services (DHS) and the State Water Resources Control Board (SWRCB) require characterization of bottom sediments to be dredged. Representative sediment samples from various locations and depths should be evaluated as outlined in the DHS Assessment Manual for Hazardous Waste (CHSC 1984). The Soluble Threshold Limit Concentration (STLC) values used as a first cut assessment for hazardous wastes are shown in Table 5, Column 1. If observed, pesticides and heavy metal concentrations exceed any of these STLC values, then additional testing, including the waste extraction test and toxicity evaluation, would be required. In addition to the above requirements, all dredged material disposed of on land must be classified by the SWRCB as either Group 1, hazardous waste, or Group 2, non-hazardous waste, based on an ASTM extraction method analysis for total dissolved solids (TDS), conductivity, and chromium VI.

Applicable Sediment Criteria - Applicable criteria for heavy metal concentrations are shown in Table 5, Columns 1 and 2. The STLC values in Column 1 are the current applicable criteria established by DHS (CHSC 1984). Proposed EPA criteria (EPA, 1984) are shown in Column 2 for both acute and chronic exposures (see the discussion of EPA water quality criteria below).

Sediment Testing Results - Table 5 shows a comparison of observed heavy metal levels in 1975 bottom sediment samples against the various criteria. The observed heavy metal concentrations (Table 5, Column 4) do not exceed the DHS STLC criteria (Column 1), and the sediments would therefore not be considered hazardous wastes by DHS. According to this comparison, proposed EPA criteria (Column 2) may be exceeded by the observed levels of lead and mercury (Column 4).

In the case of lead, the observed levels only slightly exceed the proposed 1984 EPA chronic criteria in two of the samples collected within the depths that will be dredged. The exceedence is insignificant (2% higher) in comparison to the range of values between chronic and acute criteria. For mercury, the level of detection for the testing of the 1975 bottom sediment samples was 0.1 ug/g. A majority of the samples tested to the 0.1 ug/g limit. This indicates the actual values are at or below this level. Several of the samples exceeded the proposed 1984 EPA acute criteria by only 0.02 ug/g. The values for mercury and lead are well below the DHS STLC criteria. Additional sediment samples will be taken at roughly the same locations as the 1975 collected samples in conjunction with the additional water quality testing to be done as described in the following paragraphs. This additional sediment testing is designed to current testing procedures and criteria, and will further clarify the 1975 test results.

In addition, for disposal sites to be used or returned to agricultural uses after disposal, the Waterways Experiment Station (WES) suggested comparing the heavy metal concentrations of the dredged materials to EPA maximum recommended concentration for sludge-ammended soils 1/. With the exception of nickel, the 1975 samples show concentrations of heavy metals well below the maximum recommended values (see Table 5). For nickel, two locations showed concentrations above the recommended maximum levels with the remaining samples within the recommended limits. The nickel levels reported for these two sites are suspect as the reported vlaues are abnormally high and above what has been found in other Port or ship channel conditions 2/. However, preliminary results from the additional testing mentioned above, indicate nickel concentrations for one of the two locations is well below the maximum criteria. This value is within recommended criteria and is more in line with nickel concentrations found in the other 1975 samples and with the median concentration values in average surface soils in U.S. croplands 1/. A similar lower value is expected as a result of the current testing for the other 1975 sample location that showed high concentrations of nickel. Based on this information, no significant impacts to the agricultural uses of the disposal sites are expected. In the unlikely event that the additional testing does show a potential impact to agricultural uses, then actions such as mixing of the dredged material with the existing soils could be taken to bring the soils within recommended criteria. In a worst case situation, the use of the proposed disposal sites, of which the Port of Sacramento owns or leases a major portion, could be restricted or eliminated for agricultural use after the disposal action.

The 1975 test results and the additional testing to be completed will also assist in evaluating the use of dredged material for the creation of potential wetland enhancement areas as described in paragraph 7. As dredged material will not be placed on the mitigation area at Prospect Island, there is no concern of impacts at this site due to dredged material quality.

Another consideration evaluated is that subsurface drainage from the confined upland disposal sites may reach adjacent groundwater aquifers or subsurface waters. However, the changes to subsurface water quality can be expected to be insignificant since the soil tests described above indicate the soils generally meet sediment criteria. Although unlikely, if the additional tests being completed indicate a potential problem, actions are available to prevent the transport of drainage from the disposal sites to the adjacent groundwater aquifers or subsurface waters. Such measures were not evaluated as there is no reason to expect these actions will be necessary.

1/ Environmental Protection Agency, FDA, USAD, 1981. "Land Application of Municipal Sewage Sludge for the Production of Fruits and Vegetables. A Statement of Federal Policy and Guidance," U.S. Environmental Protection Agency Joint Statement SW - 9005.

2/ "Management of Bottom Sediments Containing Toxic Substances," Vol 7 Number 2, Environment International, A Journal of Science, Technology, Health, Monitoring and Policy.

TABLE 5

Heavy Metal Concentrations in Bottom Sediments

	STLC 1/ mg/kg (mg/kg)	1984 EPA 2/ Proposed Approach Acute (ug/g)	Chronic (ug/g)	EPA max. Recommended For AG uses (ug/g)	High-Low of 1975 3/ Samples (10-4% of dry wt.)
Arsenic	50	36.4	18.7	--	3.1 - 0.4
Cadmium	10	2.6	2.6	2.7	0.8 - 0.1
Chromium	560	--	--	--	134 - 29
Copper	250	285.6	197.2	144	71 - 11
Lead	50	190.0	7.6	511	13 - 3 5/
Mercury	2	0.18	0.03	--	0.3 - 0.1 6/
Nickel	200	--	--	82	178 - 46 7/
Zinc	2500	1,190	310	304	79 - 27

1. California Health and Safety Code, Section 25141, Article 11, January 11, 1984.

2. Calculated from equilibrium partitioning approach for developing sediment criteria proposed by Pavlou and Weston (1984). Water Quality Criteria * Koc Conversion Factor * % TOC = Sediment Criteria (Assume TOC = 2 percent in Sacramento River bottom sediments).

3. Twenty-two discrete samples from six holes with depths ranging from 31.5 ft to 46.5 ft below MLLW. Actual depths to be dredged are to 36 ft below MLLW (including allowable overdepth dredging).

4. Note: (mg/kg) = (ug/g) = (10-4 percent of dry wt).

5. Highest value within depth to be dredged is 10 ug/g.

6. One or more samples exceed one of the presented criteria or lowest level of detection for chemical analysis method used is greater than calculated criterion. Highest values within depths to be dredged is 0.2 ug/g.

7. Additional bulk sediment tests will be conducted to further clarify the nickel levels observed in the 1975 sediment samples. Preliminary results from these tests show nickel levels lower then the 1975 levels and within EPA criteria.

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Additionally the review of the details of the 1975 sediment sampling (results of 22 samples summarized in Table 5) showed that heavy metal concentrations for the test holes were generally highest in the top layers of bottom sediments. Therefore, removal of these sediments through dredging may expose less contaminates to the aquatic environment in the channel than under existing conditions or with the No Action Plan.

Elutriate Test and Limitations - The standard elutriate test run on the samples collected in 1983 is designed to determine the potential for contaminant release to the water column (including heavy metals) from open water disposal of dredged material from a suction dredge pipeline. In the standard elutriate test, bottom sediments are processed to simulate suction dredging and open water disposal of dredged material. Because planned disposal will be at contained upland disposal sites, these tests do not reflect what specific impacts will occur to the water column, but provide additional information that indicates areas of potential impact. Standard elutriate test results would be a conservative approach when used to evaluate upland disposal. A modified elutriate test would normally be used to simulate the characteristics of the return effluent from confined disposal sites. However, no such tests were performed on the sediment. The modified elutriate test differs from the standard elutriate test in that it allows for a solids settling time (which is approximately equal to the retention time of the disposal site) prior to testing the supernatent. However, both of the tests have limitations. Monitoring of heavy metal concentrations associated with suction dredging and confined upland disposal usually occurs at the edge of a mixing zone. Both Federal and State water quality regulations allow for a mixing zone in the receiving water body before water quality standards are applicable. The mixing zone is a zone in which the effluent is diluted by receiving waters. The standard elutriate tests are usually considered worst-case tests because (1) no dilution by receiving water in a mixing zone is included, (2) sediment samples are aerated during the mixing process, and (3) only a minimum retention time is allowed before analysis. Because of these features of the standard elutriate tests, a comparison of its results with water quality criteria is just the first step in a complete assessment of impacts. Therefore, to assess specific impacts of dredging and the discharge of the return-water on the water column, and to facilitate final design of the disposal sites to minimize or eliminate impacts, additional sampling and testing will be completed in preparation of project plans and specifications prior to construction.

EPA Water Quality Criteria - EPA water quality criteria for heavy metals (Table 6) were established to protect aquatic life based on bioassays on selected species of fish, invertebrates, and plants. The freshwater quality criteria values presented in Table 6 were calculated from a formula developed to protect the most sensitive species. Usually, one fish species is the most sensitive, so establishing a criteria level to protect that fish species also protects less sensitive species such as aquatic plants.

The formula to calculate freshwater quality criteria includes a term to take into account the hardness of the water. Most heavy metals are more toxic to aquatic life in soft water than in moderate or hard water. For Table 6, a hardness of 50 mg/1 as $CaCO_3$ was assumed based on information on the Sacramento River (COE, 1980). If the actual hardness value is greater than 50 mg/1, then the criteria values would also increase, allowing for a higher burden of heavy metal input.

Some cautions should be observed before using the EPA water quality criteria. Water quality criteria are established for two levels of exposure, acute and chronic. The acute and chronic values were developed based on results obtained from 96-hour toxicity tests. The levels assume 100% of the contaminent is available to the most sensitive organism. The chronic values also assume 100% of the contaminent is available to the organism over a lifetime chronic exposure. In fact, contaminents exist in a variety of forms only some of which are available to affect aquatic life. The concentrations of contaminents is usually highly variable as a function of flow, load, time of day, day of week, season of year etc. Hence, the criteria are worst case criteria.

Also, some additional considerations in applying the criteria to dredging should be noted. First, a dredged material discharge is usually rapidly diluted following disposal and is normally a short-termed event; therefore, the dissolved constituent concentrations approximated by the Elutriate Test must also be reduced by dilution in order to simulate as closely as possible what is actually happening in the field. Since the time required for this dilution will be short (generally minutes) compared to the 96-hr time period implicit in the water qulaity standards, Elutriate Test concentrations should not be compared directly to water quality criteria for assessment of the possible environmental effects of the discharge. Elutriate concentrations should be modified to reflect the dilution or dispersion characteristics at the proposed discharge site prior to comparison with water quality criteria or standards. Second, dredging operations are intermittent usually lasting for a relatively short time (a few hours to a few days) and since the discharge point is frequently changed it is virtually impossible for organisms to receive a chronic lifetime exposure of the contaminent of concern. Third, it is well known, as discussed by Lee et al, that acquatic organisms can be exposed to concentrations at levels in excess of chronic safe levels for short periods of time without experiencing adverse impacts.

Table 6

Heavy Metal Concentrations in Standard Elutriate From Bottom Sediments

	EPA Water Quality Criteria 1/ (mg/1)		Elutriated Samples of Four 1983 Sediment Cores 4/ (mg/1)				
	Acute	Chronic	SF-1-B	SF-2-B	SF-3-B	SF-4-B	
Arsenic 2/	0.1400	0.0720	0.030	0.022	0.026	0.022	
Cadmium 2/	0.0020	---	0.0027	0.0029	0.0051	0.0002	5/
Chromium 2/	0.0110	0.0072	0.015	0.022	0.023	0.006	5/
Copper 2/	0.0084	0.0058	0.046	0.157	0.327	0.012	5/
Lead 2/	0.0250	0.0010	0.001	0.001	0.173	0.001	5/
Mercury 2/	0.0011	0.0002	0.0025	0.0025	0.0025	0.0025	5/
Nickel 3/	1.10	0.0560	0.015	0.021	0.041	0.006	
Zinc 3/	0.1800	0.0470	0.073	0.122	0.164	0.039	

1 Assume hardness = 50 mg/1 as $CaCO_3$ for calculating freshwater quality criteria.

2 EPA proposed 1984 criteria - chronic = 30 day average (EPA, 1984).

3 EPA promulgated 1980 criteria - chronic = 24 hour average (EPA, 1980).

4 Four composite samples from four holes with depths ranging from 34 ft to 44 ft below MLLW.

5 One or more samples (SF-1-B to SF-4-B) exceed acute water quality criteria or the level of detection for the analytical method exceeds the calculated criterion.

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Standard Elutriate Test Results - Four bottom sediment samples were taken from the channel between Collinsville and Rio Vista for standard elutriate tests completed in 1983. The 1983 sediment samples for each hole were composited over the dredging depth for the elutriate tests. Since the hydraulic cutterhead is normally operated to cut to full design depth (including a portion of allowable overdepth) in one sweep, the composition of samples is representative of the actual field conditions and dredge operations. However, as was stated before, the standard elutriate tests run on the 1983 collected samples do not model conditions of confined upland disposal as is planned but result in a conservative assessment of conditions. Additionally, tests completed in the 1983 analysis did not completely follow standard testing procedures for heavy metals. The elutriate samples were centrifuged but not filtered. This is an undesirable step for heavy metals testing since even small quantities of fine grained sediment after centrifugation can add considerably to the apparent dissolved heavy metal concentration. It may be that if the elutriate samples had been filtered, the heavy metal concentration would have been low enough (without considering a mixing zone) to meet EOA water quality criteria. These elutriate tests results are shown in Table 6. As noted in the EPA water quality criteria section, direct comparisons of test results should not be done to assess actual impacts. Direct comparison however has been done to indicate the need for further analyses. The observed heavy metal concentrations, when compared directly with the water quality criteria, exceed 1984 EPA acute criteria (EPA, 1984) for cadmium, chromium, copper, lead, and mercury in one or more of the samples. Arsenic, nickel, and zinc criteria are not exceeded. The elutriate test procedure used was for open water disposal (i.e., when disposal occurs directly into the waterway). However, the dredged material will actually be placed into upland disposal areas that are designed to retain the water for several hours. This will allow the suspended particulates to settle out of the water before the return effluent is released into the waterway where it will mix with the river waters. As a result, the actual concentrations will likely be much less. Studies done for the Dredged Material Research Program (DMRP) show a high percentage of heavy metals are removed by settling in disposal areas because they are bound to the sediment particles. Dredged material disposal areas will be sized in accordance with DMRP guidelines for Designing, Operating and Managing Dredged Material containment areas during preparation of contract plans and specifications. Since properly designed dredged material disposal areas allow up to 95 percent of the fine grained solids to settle out of the water column, it is unlikely the return effluent concentrations predicted from the open water elutriate tests would still be above EPA guidelines for the five metals. DMRP studies also concluded that copper, lead, and cadmium generally showed no releases to the water in elutriate tests due to being bound to the sediment particles.

Additional Testing - Because tests completed to date on sediment samples indicate potential areas of concerns on water quality, additional testing will be done prior to any initiation of construction to confirm if disposal site design should be modified to alleviate impacts. A sampling and testing program has been designed to assess specific impacts that may occur with the confined disposal which will maximize the retention time of the effluent before discharge back to the channel. Tables 7 and 8 summarize a preliminary schedule for this additional testing which will include sample collection along the entire project reach.

Modified elutriate tests (Test A in Table 8) will be run to determine worst case impacts due to the discharge of the return water from the confined disposal sites. Additional standard elutriate tests (Test B in Table 8) will be run on samples collected in the reach from channel mile 0.0 to channel mile 15.0 to further evaluate potential impacts related to open water disposal which may be proposed in the future for disposal on lower Sherman Island as part of the potential wetlands enhancement. (Current project plans do not include this as a disposal site and no work is scheduled.) Background water samples will also be collected and tested (Test C in Table 8) to determine existing contaminent levels in the water column.

In the event the results of modified elutriate tests exceed the established water quality limits, additional analyses will be done to assess water quality impacts. We will calculate appropriate mixing zones and dilution factors which are allowed before water quality criteria apply 1/. In the unlikely event the contaminent still exceeds the criteria after allowing for mixing and dilation further measures will be considered. One inexpensive method would be to schedule the work for the area of concern during the winter or spring when high flows rapidly dilute the discharge. Another option, again relatively inexpensive, is to allow intermittent dredging into the site or constructing interior dikes to increase the retention time to allow for settling. Other methods such as chemical additives for flocculation and filters (or silt screens) could be implemented, if necessary, to increase settling of solids before the return water is allowed to reenter the channel. Column settling tests (Test D) will also be run on selected samples to evaluate in more detail the required retention times with respect to the materials being dredged. This will assist in completing final designs for the selected disposal sites to maximize settling of suspended solids. Return effluent from the disposal areas will be monitored, and if required water quality criteria are exceeded, discharge will be stopped and appropriate modifications to the dredging and disposal site will be made so as to comply with all of the water quality requirements.

Additional Soil Tests (Test E and F) will be taken for construction contract information purposes.

1/ Bodies of receiving water into which dredged material is discharged are dynamic and diverse, and each has its own ability to assimilate discharge containing contaminants by a variety of physical, chemical, and biological mechanisms. A mixing zone is that portion of the receiving water where the discharge is mixed and diluted, utilizing this natural assimilative capacity.

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TABLE 7

Additional Soil Explorations and Testing

	River Mile	Water and Mod. Elutriate Sample	Background Water	Water and Std. Elutiate Sample	(Column Settling) Sedimentaion Sample	Grain Size Analysis *	Soils Classifcation Tests *
1	42.8	X (Sed. Test)	X		X - Test 1	X	X
2	42.3				X - Test 1	X	
3	41.8				X - Test 1	X	X
4	41.3	X			X - Test 2	X	
5	40.8				X - Test 2	X	X
6	40.3				X - Test 2	X	
7	39.8					X	X
8	39.3					X	
9	38.8	X	X		X - Test 3	X	X
10	38.3				X - Test 3	X	
11	37.8				X - Test 3	X	X
12	37.3				X - Test 4	X	
13	36.8				X - Test 4	X	X
14	36.3				X - Test 4	X	
15	35.8	X				X	X
16	35.0				X - Test 5	X	
17	33.0	X (Sed. Test)	X		X - Test 6		
18	31.5				X - Test 7		
19	28.5	X	X		X - Test 8		
20	24.3	X			X - Test 9		
21	21.75	X	X		X - Test 10		
22	19.5				X - Test 11		
23	18.0	X	X		X - Test 12		
24	16.2	X			X - Test 13		
25	14.3				X - Test 14		
26	13.0	X % (Sed. Test)	X			X	X
27	11.0	X				X	X
28	9.0	X (Sed. Test)			X - Test 15		
29	7.0		X		X - Test 16		
30	5.0	X		X	X - Test 17	X	
31	3.0		X	X	X - Test 18	X	
32	1.0	X (Sed. Test)		X		X	
TOTALS	32 Sites	16 (5 Sed. Tests)	10	3	18	42	20

* Two tests for each site
% Two tests for this site

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Table 8

Additional Soil Explorations and Testing

SAMPLE REQUIREMENTS

Symbol	TYPE OF TEST	NO. OF TESTS	SAMPLE COMPONENTS	REQUIREMENTS
A.	Modified Elutriate (Sediment Tests- no addition sampling required)	16 (5)	soil water	2 - 3 inch dia. Osterberg samples at each site 4 - 1 gallon samples each site
B.	Standard Elutriate	3	soil water	2 - 3 inch dia. Osterberg samples at each site 4 - 1 gallon samples each site
C.	Background Water	10	water	4 - 1 gallon samples at each site
D.	Column Settling	18	soil	6 - 5 inch dia. Osterberg samples at each site (unless otherwise specified)
E.	Grain Size	42	soil	2 - 3 inch dia. Osterberg samples at each site
F.	Soil Classification Tests	20	soil	Taken from Grain Size samples

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6. MITIGATION

6.1 Fish and Wildlife - The mitigation concept plan is based on the results of the Habitat Evaluation Procedures (HEP) conducted jointly by the Corps, Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, and the Port of Sacramento (Appendix E of the FSEIS).

Mitigation features outlined in the 1980 Selected Plan included: creation of new wetland and upland habitats in unspecified locations within the dredge disposal areas and fish and wildlife wetland habitat on Prospect Island.

Fish and wildlife mitigation features included the creation of 45 acres of wetland habitat and 156 acres of upland habitat. The wetland habitat would have been created on a former disposal site at Prospect Island (site S-12, Table 3) by constructing levees to protect the remainder of the island, grading the disposal site to mean sea level, breaching the exterior levees to allow tidal action, and establishing wetland plants in the area. The upland habitat would have been created on disposal sites by seeding all or part of the sites and dedicating them to wildlife conservation. The locations for upland habitat creation were not specified in the 1980 Feasibility Report and were to be identified during advanced studies.

Potential fish and wildlife enhancement involved the creation of wetland habitat at Donlon Island if such creation was not carried out as part of the Stockton ship channel deepening. However, Donlon Island was developed in 1984 for wildlife enhancement as part of the Stockton ship channel project. It is no longer under consideration for enhancement purposes for the Sacramento Deep Water Ship Channel deepening and widening project.

Mitigation requirements for the Selected Plan based on the HEP analysis include 63 acres of wetland/riparian (Appendix E of FSEIS). A 1985 HEP analysis was conducted to re-examine the 1980 mitigation proposal and to further clarify mitigation requirements for this project. The results of the HEP are given below and explained in the FWS Coordination Act Report (Appendix E of the FSEIS). The major changes in project design and mitigation features from the 1980 plan to the Selected Plan are outlined in Table 9. The FWS determined that 63 acres of wetland and woody riparian development would effectively compensate the habitat loss associated with this project. These requirements were used to prepare a mitigation plan for wetland development at Prospect Island.

Wetland Development - Prospect Island (63 acres) will be developed as a mitigation area for the habitat and fish and wildlife resources impacted by the ship channel improvement and dredged material disposal.

Prospect Island is currently used for agricultural purposes. During extreme high tides, the entire island floods to an average of 5 feet of water. Wildlife use includes species such as black-shouldered kites and pheasants; it is also a feeding area for egrets, herons and blackbirds during the fall and winter.

Table 9.
Comparison of 1980 and 1985 Plans
Project Design and Mitigation Features

Project Design Features	1980 Plan	1985 Plan
Navigation Channel (New York Slough to Sacramento)		
Length	46.5 miles	46.5 miles
Depth, below mllw	35 feet	35 feet
Bottom Width		
Avon to New York Slough	600 feet	350 feet
New York Slough to mile 15.0	400 feet	350 feet
Channel mile 15 to 18.6	300 feet	300 feet
Channel mile 18 to Port of Sacramento	250 feet	250 feet
Overdepth	1 foot	1 foot
Side slopes		
Pittsburg to Channel mile 15.0	1V on 4H	1V on 4H
Channel mile 15.0 to Port of Sacramento	1V on 3H	1V on 3H
Dredging Quantity	30 M cy	21.5 M cy
Disposal Areas	3,500 Ac	4,464 Ac
Mitigation Features		
Requirements		
Wetland	45 Ac	63 Ac
Upland	156 Ac	0 Ac
Restoration		
Wetland	none proposed	63 Ac
Upland	156 Ac	
Compensation		
Wetland	45 Ac	
Upland	none proposed	
Enhancement		
Wetland	none proposed	Under investigation
Upland	none proposed	

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The objective of the mitigation plan would be to convert irrigated cropland to tidal wetlands and woody riparian habitat. The plan is to convert 63 acres at the southern end of Prospect Island to a mosaic of tidal mudflat (beach bar), emergent marsh, and open water with associated shrubs and small trees in the riparian area (Appendix I of the GDM).

Plan features include: 1) construction of a north retention levee to separate the proposed wetland area from the remainder of DMD site S-12; 2) site sculpting and surface earthwork to create the appropriate surface elevations for each proposed habitat; 3) creation of open water channels excavated to below MLLW; 4) planting riparian plant species; 5) breaching the existing levee and flooding the site; and 6) periodic field checks to determine the success of the wetland development.

Future Industrialization. - For full disclosure purposes, an estimate of mitigation needed for future industrialization induced by the project channel deepening is provided. The industrialization would be provided by other private developers or as joint ventures or under lease or license, etc., with local agencies such as the counties or port authorities. Others would also provide the appropriate mitigation determined necessary via the coordination process of the environmental impact reporting procedures required by applicable environmental statutes. Paragraph 4.4 on land use describes 2,000 acres planned for industrial growth at the Port of Sacramento. The 2,000 acres adjacent to the Port of Sacramento intended for future expansion of the port is assumed to be developed by industries that would locate there because of the existing ship channel and by industries that would only locate there if the channel were deepened to 35 feet. The percentage of land developed, or expanded, by each was estimated based on tonnages of cargo shipped. An estimated additional 1,955,000 tons will be shipped on the channel by the year 2037 because of future industrialization that would take place based on the existing channel. An estimated increase of 2,675,000 tons of shipping will occur because of the channel being deepened to 35 feet. Of the 2,675,000 tons of induced cargo, 1,600,000 tons would be a result of future industrialization that would occur only if the channel is deepened to 35 feet. Therefore, the percentage of increased cargo due to deepening the channel is:

$$\frac{1{,}600{,}000 \text{ tons}}{1{,}955{,}000 \text{ tons} + 1{,}600{,}000 \text{ tons}} = 45\%$$

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It is assumed that development of land is directly related to the percentage increase in cargo hauled. Therefore, the acres of land developed for future industrialization as a result of deepening the channel is 0.45 x 2000 = 900 acres. This land will be developed over time at the same rate as the increase in cargo, divided into three time periods as indicated in the tabulation shown below.

Number of Acres Developed About Year:

Port	2000	2020	2040	Total
Sacramento	350	350	200	900

It is expected that the earliest developments will be sited closest to the waterfront and as industrial development proceeds it will fill in the unoccupied space further back from the waterfront. The area to be developed at the Port of Sacramento extends from dredged material disposal site S-1 to S-4 west of the Main Canal (see plate 1, sheet 1, of the General Design Memorandum). This area is an intensively farmed agricultural area. No detailed estimate of impact or mitigation has been prepared. A preliminary estimate has been prepared based on a general comparison of the HEP studies and mitigation planning done for the dredged material disposal areas (Appendixes E and F). Preliminary estimates of mitigation areas for project induced future industrialization are as follows:

Number of Acres Habitat Development/Improvement
(Mix of Upland, Riparian, Wetland)

Port	2000	2020	2040	Total
Sacramento	10	10	0	20

It is anticipated that in response to environmental laws, a mitigation plan of this kind will be implemented by the industries as each develops increments of the overall area. A small acreage of mitigation could suffice if it would provide a high value trade-off, e.g., provide wetland to mitigate loss of upland. HEP studies will be needed to more closely estimate mitigation needs as industrial development plans come to fruition. (In addition to the project induced development, it is expected that similar mitigation plans and developments would be provided for the remaining industrialization which is not project induced.)

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6.2 Endangered Species.

No mitigation is proposed for endangered species as no significant effects will occur to these species due to the proposed action (Appendix D and E of the FSEIS).

6.3 Water Quality.

Port Water Quality. - The Port of Sacramento encourages ships using the Port to recirculate and exchange salt water for fresh water in the lower areas of the Delta, rather than discharging saltwater ballast in the Port area (Christian, 1985). This is helpful since the saltwater ballast is dispersed quickly at the point of discharge due to the mixing induced by the larger surface area of the Delta, and the exchange ballast water is less saline and does not significantly increase TDS levels at the Port when discharged.

Salinity Mitigation Alternatives - Detailed analysis has not identified a definable project impact. To insure preservation of current water quality, a salinity monitoring program conducted prior to, during, and after completion of project construction was determined to be the best method for conclusive definition of potential project impacts. If a significant and measurable increase in salinity is identified, a submerged sill or alternative mitigation features would be constructed. Mitigation could consist of temporary or permanent barriers in the Sacramento River or the release of CVP water or other alternatives. If mitigation is needed, technical feasibility, environmental factors, and economics will determine the best mitigation technique. Concurrent with the monitoring program, studies and/or modeling tests will be conducted to identify acceptable mitigative measures.

Heavy Metals and Pesticides. - Prior to construction the Corps of Engineers will undertake additional standard elutriate, modified elutriate, and column settling tests to help evaluate dredging impacts on the water column and impacts of disposal site effluent return flow. These analyses and evaluations will be conducted according to current procedures, regulations and criteria of the responsible agencies. The evaluation will address dilution and mixing zone characteristics of discharge points of any selected disposal sites showing a potential of contaminated effluent return flows. Appropriate clearances under the Clean Water Act will be obtained from the State Regional Water Quality Control Board prior to project construction.

7. **POTENTIAL WETLAND ENHANCEMENT MEASURES** - The disposal of dredged material on lands which are below mean sea level elevation provides the opportunity for creating wetlands for enhancement of the fish and wildlife resources of the project area. Section 150 of the Water Resources Development Act of 1976 (PL 94-587) directs the Corps of Engineers to consider establishment of wetland areas, where appropriate, in connection with dredging required for water resource development projects, with all costs up to $400,000 borne by the United States. Establishment of wetland areas was considered for several locations in the 1980 EQ plan.

Wetlands development on lower Sherman Island has recently been proposed by FWS and DFG as an enhancement measure for the SRDWSC widening and deepening. If it is desirable to pursue the enhancement, a 404(b)(1) evaluation on the added open water disposal of dredged material will be prepared and coordinated as required by Section 404 of the Clean Water Act. Although this feature is not a part of the Selected Plan, it does have potential for development and will be studied in more detail prior to dredging in the area.

Lower Sherman Island which is now submerged could be converted to wetland habitat by filling the interior of the island to elevations varying from slightly below sea level to +5 feet (MSL). A mosaic of habitats from open water through marsh and riparian woodland could be created to provide a substantial increase in fish, wildlife, and aesthetic resource values. The site is owned by DFG and is a designated waterfowl management area.

Portions of lower Sherman Island have historically been used as an open water disposal area and portions of the site near the boat launch and areas downstream have revegetated as high quality tidal marsh. The value of the existing open water area to juvenile striped bass has been investigated extensively by DFG and NMFS. It may be an important rearing/nursery area. The enhancement benefits will be carefully weighed against the costs to the aquatic resources in the area during future investigation coordinated with the fish and wildlife agencies.

8. **PUBLIC INVOLVEMENT**

Extensive public and agency coordination was completed during preparation of the Final EIS in July 1980. The previous coordination detailed in that report is incorporated by reference into this supplement.

8.1 Public Involvement Program - A Notice of Intent to prepare the DSEIS was published in the Federal Register on November 19, 1984. Responses to the

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Notice of Intent were used to help determine the scope of concerns to be addressed in the supplemental EIS.

The DSEIS was completed and distributed for public and agency review in August 1985. The DSEIS was formally filed with the Environmental Protection Agency at that time and a Notice placed in the Federal Register on September 13, 1985. The report was provided to those parties listed in Section 7.3 as well as numerous additional individuals who requested a copy in response to the Notice of Availability. The public review period for the DSEIS extended to October 28, 1985. Comments received on the DSEIS are displayed in the comment-response section in Appendix A of the General Design Memorandum. Data gathered in response to these comments and information provided in the comments have been incorporated into this FSEIS.

This FSEIS is being coordinated with those groups and individuals who received copies of the DSEIS. Agencies and the public may send comments on the FSEIS to the Corps of Engineers. All comments received will be responded to by the Corps and will be used in preparing the Record of Decision.

The Record of Decision will be prepared and sent to all parties known to have an interest in the project.

8.2 Required Coordination - Extensive coordination with other agencies, as required by Corps regulations, has been accomplished in this FSEIS.

Coordination will be continued with involved agencies throughout the design and construction phases of the project to assure compliance with pertinent environmental laws. Coordination accomplished to date is summarized below.

The Corps coordinated with the U.S. Fish and Wildlife Service (FWS), the National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (DFG) to evaluate the impacts of the project on the biological resources of the study area, including endangered species, as required by the Fish and Wildlife Coordination Act and the Endangered Species Act. As part of this coordination, Habitat Evaluation Procedures (HEP) were conducted jointly by the Corps, FWS, NMFS, DFG, and the Port of Sacramento to assess impacts and develop the mitigation plan. Also, a Biological Data Report, required by Section 7(c) of the Endangered Species Act, was prepared and used to complete a Biological Assessment of the impacts on endangered species. This information is discussed in detail in Appendices D, and E of this FSEIS. Coordination has also been initiated and is continuing on the potential for using dredged materials to develop wetland areas at the State Waterfowl Management Area at lower Sherman Island. Participants in this study include DFG, FWS, NMFS, Corps, and EPA.

The NMFS expressed concern about the potential for salinity intrusion due to the project and related impacts on fish populations. The salinity question, including results of modeling studies conducted as part of this study, are discussed in Sections 5.3 and 6.3 of this FSEIS and Chapter V and Appendix E of the GDM.

The Corps is continuing to coordinate on water quality issues with the Environmental Protection Agency (EPA) and the Regional Water Quality Control Board. The Clean Water Act requires the evaluation of the effects of the discharge of dredged materials into waters of the United States, including consideration of the Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Materials. Waters of the United States are defined by that Act to inlcude wetlands. A Section 404 Evaluation was completed in 1980 as part of the Feasibility Report, and is incorporated by reference. Discussions of the changes necessary to reflect the Selected Plan are provided in sections 5.3 and 6.3 and Appendix C of the FSEIS.

Extensive coordination with potential local recreation sponsors and the California Department of Parks and Recreation was completed during the preparation of this FSEIS and is discussed in Section 4.5 of this FSEIS and Appendix C of the GDM. Potential local recreation sponsors included Sacramento County, Solano County, Yolo County, and the East Yolo Community Services District. While much interest was expressed in developing recreation in the project area, none of the parties contracted was able to provide the necessary assurances of local cooperation which included cost sharing requirements. Therefore, recreation has been deferred as a project purpose.

Coordination was also conducted with the Environmental Protection Agency, the Yolo-Solano Air Pollution Control District, the Sacramento County Air Pollution Control District, and the State Air Resources Control Board to assess potential impacts on air quality due to both construction activity and transportation activities within the project area. As part of this coordination the Corps conducted an air quality emissions analysis in 1982. That report and subsequent coordination concluded that the project would not have a significant impact on air quality in the northern California analysis area. See Appendix A of this FSEIS for recent correspondence and Appendix B for the air quality emmisions analysis.

Coordination on cultural resources was completed with the National Park Service (NPS) and State Historic Preservation Office (SHPO) during preparation of this FSEIS, based on an intensive cultural resources survey and literature review for the project area. Correspondence may be found in Appendix A of the FSEIS.

Coordination with the Soil Conservation Service was also accomplished in the preparation of this FSEIS to determine impacts on prime and unique farmlands. See Appendix A of the FSEIS.

8.3 Statement Recipients -

Federal Agencies

U.S. Fish and Wildlife Service
National Marine Fisheries Service
Environmental Protection Agency
Soil Conservation Service
National Parks Service
U.S. Geologic Survey
Federal Highway Administration

California State Agencies

Resources Agency
Department of Fish and Game
Department of Parks and Recreation
State Water Resources Control Board
Regional Water Quality Control Board, Central Valley Region
Air Resources Board
Department of Health Services
Department of Transportation
Department of Economic and Business Development

Local Agencies

Reclamation District No. 999
Sacramento County
Solano County
Yolo County
East Yolo Community Services District
Contra Costa County
City of Rio Vista
City of Sacramento
City of West Sacramento
City of Isleton
Port of Sacramento
Solano County Mosquito Abatement District
City and County of San Francisco
Association of Bay Area Governments

Others

Reclamation District No. 999
Reclamation District No. 501
Emergency Delta Task Force
California Waterfowl Association

8.4 Public Views and Responses - Public views were expressed in the 1980 Feasibility Report and EIS and are incorporated by reference. The scope of this FSEIS was developed in response to concerns and questions expressed in the 1980 report and during the initial scoping process in preparation of the GDM and FSEIS. Public views expressed during the public review period for the DSEIS and have been responded to in this Final Supplemental EIS.

9. LIST OF PREPARERS

The following people were primarily responsible for preparing this FSEIS:

Name and Expertise	Experience	Role in Report
Corps Staff		
Howie Aubertin (Project Engineer) Civil Engineering Planning and Design	3 years water resources planning and design studies, Sacramento District	Project design
Marcia Geidel Recreation Planner	4 years, recreation/ environmental planning Sacramento District; 10 years recreation research and programs	Report review and editing
Jeffery W. Groska Water Resources Planner	7 years water resources planning studies, 7 months EIS studies	Report review and editing
Fred Kindel Wildlife Biologist	21 years, environmental planning studies, Sacramento District 8 years, state and private wildlife management studies	Report review and editing
Scott Morris Civil Engineering Planning and Design	3 years water resources planning and design studies, Sacramento District	Report review and editing
Jim Veres Civil Engineering Planning and Design	11 years water resources planning and design studies, Sacramento District	Project design
Mike Welsh General Biologist/ Environmental Planner	10 years, EIS studies Corps of Engineers	Report review and editing
Consultants		
Ellen LaPorte Environmental Planner (TRS Consultants,Inc)	7 years, socioeconomic studies and EIS preparation	Land use analysis

Nancy Olmsted Terrestrial Ecologist (TRS Consultants,Inc.)	7 years, botany, wildlife endangered species analysis	Natural resource manager
Jill Shapiro, Ph.D. Environmental Planner (TRS Consultants,Inc.)	13 years EIS analysis and preparation	DSEIS Project Manager
Rick Sitts, Ph.D. Water Quality, Fisheries (Envirosphere Company)	12 years, water quality, fisheries studies	Water quality

10. REFERENCES

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ER 1105-2-50 (Change 3) Planning Environmental Resources (Change 2: July 2, 1982). Appendix A: Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies

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C—090777

C-090777

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL,
CALIFORNIA

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A

PERTINENT CORRESPONDENCE

LIST OF PERTINENT CORRESPONDENCE

AIR QUALITY

1. 19 November 1985 letter to Sacramento County Air Pollution Control District providing air quality analysis report and request of confirmation that dredging complies with rules and regulations.

2. 28 January 1985 letter from Sacramento County Air Pollution Control District stating receipt of previous letter and compliance of dredging with rules and regulations.

3. 11 December 1985 letter to Yolo-Solano Air Pollution Control District providing air quality analysis report and request of confirmation that dredging complies with rules and regulations.

4. 28 January 1986 letter from Yolo-Solano Air Pollution Control District stating no significant project impacts expected.

CULTURAL RESOURCES

5. 6 March 1985 letter from Mr. Gordon of Interagency Archelogical Services in San Francisco transmitting comments on draft cultural resources survey on DMD sites.

6. 3 September 1985 postcard from State Historic Preservation Office stating project does not involve National Register or eligible sites.

LAND USE

7, 8, 9. 25 June 1985 letters to Soil Conservation Service offices in Dixon, Sacramento and Woodland California requesting status of prime and unique farmland within project area.

10. 9 October 1985 letter from Soil Conservation Service stating project does not conflict with programs or prime and unique farmland status.

MOSQUITO ABATEMENT

11. 17 December 1984 letter from Solano County Mosquito Abatement District enclosing a copy of mosquito prevention criteria.

SALINITY

12. 14 February 1986 letter from Department of Water Resources stating potential salinity impacts not clearly definable at this time; request implementation of monitoring program, and propose possible mitigation alternatives.

13. 10 January 1986 letter from Port of Sacramento to control salt water ballast discharge in port area.

C-090779

C-090779

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

November 19, 1985

Environmental Resources Branch

Sacramento County Air Pollution Control District
3701 Branch Center Road
Sacramento, California 95827

Dear Sir:

The Sacramento District, U.S. Army Corps of Engineers, in cooperation with the Sacramento-Yolo Port District, proposes to deepen the existing Sacramento River Deep Water Ship Channel between New York Slough and the Port of Sacramento from 30 to 35 feet. We anticipate using a diesel hydraulic suction dredge for this work.

In response to the Sacramento District's 1980 feasibility report and environmental impact statement (EIS) for this deepening project, the EPA requested further quantification of potential impacts on air quality. As a result, a private consultant for the Sacramento District conducted a more comprehensive air quality emissions analysis in 1982. This analysis was subsequently included as an appendix to the draft supplemental EIS (Enclosed). The consultant concluded that the "with project" alternative would have little significant impact on air quality in the northern California analysis area.

Diesel dredge emissions during construction and future maintenance phases of the project are not specifically addressed in the 1980 feasibility report/EIS or the 1982 consultant's study. However, we believe that emissions will have minor impact in the project area for the following reasons: (1) a diesel dredge is a mobile source of pollution; (2) the construction phase is short-term (5 years); and (3) the Corps will specify in the contract documents that the contractor's dredges are to be in compliance with air quality emissions according to Federal, State and local requirements. Periodic maintenance dredging will occur at the current frequency and will be required mainly in the reach between New York Slough and River Mile 18.0. Therefore, we feel that any potential impacts on air quality from this project are only short-term and basically insignificant.

We request confirmation from you that our proposed construction work is in compliance with air pollution standards for such mobile dredges in your area.

We would appreciate your action on this request by December 4, 1985. If you need additional information, please contact Mr. Howie Aubertin at (916) 551-2051.

Sincerely,

Wayne J. Scholl
Colonel, Corps of Engineers
District Engineer

COUNTY OF SACRAMENTO
AIR POLLUTION CONTROL DISTRICT

NORM COVELL
AIR POLLUTION CONTROL OFFICER
9323 Tech Center Drive, Suite 800
Sacramento, California 95826
(916) 366-2107

January 28, 1985

Colonel Wayne Scholl
Department of the Army
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, Ca. 95814

Dear Colonel Scholl:

The Air Pollution Control District received a letter from you dated November 19, 1985 regarding a project to dredge the Sacramento River Deep Water Ship Channel between New York Slough and the Port of Sacramento. In your letter, you asked for confirmation that your proposed construction work is in compliance with our air pollution standards. The Sacramento County Air Pollution Control District does not regulate mobile dredging and, therefore, the project should comply with our rules and regulations.

If you have any questions, please call me at 366-2107.

Sincerely,

Aleta S. Kennard

ALETA S. KENNARD
Air Pollution Control Engineer

ASK:rs

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

December 11, 1985

Environmental Resources Branch

Yolo-Solano Air Pollution Control District
P.O. Box 1006
Woodland, California 95895

Dear Sir:

The Sacramento District, U.S. Army Corps of Engineers, in cooperation with the Sacramento-Yolo Port District, proposes to deepen the existing Sacramento River Deep Water Ship Channel between New York Slough and the Port of Sacramento from 30 to 35 feet. We anticipate using a diesel hydraulic suction dredge for this work.

In response to the Sacramento District's 1980 Feasibility Report and Environmental Impact Statement (EIS) for this deepening project, the EPA requested further quantification of potential impacts on air quality. As a result, a private consultant for the Sacramento District conducted a more comprehensive air quality emissions analysis in 1982. This analysis was subsequently included as an appendix to the Draft Supplemental EIS (Enclosed). The consultant concluded that the "with project" alternative would have little significant impact on air quality in the northern California analysis area.

Diesel dredge emissions during construction and future maintenance phases of the project are not specifically addressed in the 1980 Feasibility Report/EIS or the 1982 consultant's study. However, we believe that emissions will have a minor impact in the project area for the following reasons: (1) a diesel dredge is a mobile source of pollution; (2) the construction phase is short-term (5 years); and (3) the Corps will specify in the contract documents that the contractor's dredges are to be in compliance with air quality emissions according to Federal, State and local requirements. Periodic maintenance dredging will occur at the current frequency and will be required mainly in the reach between New York Slough and River Mile 18.0. Therefore, we feel that any potential impacts on air quality from this project are only short-term and basically insignificant.

We request confirmation from you that our proposed construction work is in compliance with air pollution standards for such mobile dredges in your area.

We would appreciate your action on this request by December 20, 1985. If you need additional information, please contact Mr. Howard Aubertin at (916) 551-2051.

Sincerely,

Wayne J. Scholl
Colonel, Corps of Engineers
District Engineer

YOLO SOLANO AIR POLLUTION CONTROL DISTRICT

James A. Koslow
Air Pollution Control Officer

P.O. Box 1006, Woodland, CA 95695
(916) 666-8146

January 28, 1986

Wayne J. Scholl
Colonel, Corps of Engineers
District Engineer
650 Capitol Mall
Sacramento, CA 95814

Sir:

The following comments are submitted relative to your letter dated December 11, 1985 with emissions analysis concerning air quality impacts from the deepening of the Sacramento River Deep Water Ship Channel.

1) There is no significant air quality impact expected from use of the diesel engine dredgers above the existing use of diesels or other source of vehicle emissions at the Port or in the general area of the lower Sacramento Valley. However, the diesel engine(s) should be maintained and operated properly to prevent violation of the District's 40% opacity regulation. Though such units can be exempted from permits, there is still a need to conform to good emission control practices. It is taken from your letter that contractors will be required to comply with any Federal and State requirements on diesel engines.

2) The District office should be notified when dredging operations are in progress.

3) The emissions analysis report addresses the possibility of the deepened channel promoting more rapid industrialization of the Port area as well as areas towards the Bay. The deepening of the channel will not diminish or change the responsibility or authority of the Yolo-Solano APCD to consider and/or permit any industrial projects in terms of existing air quality or air quality impacts.

Sincerely,

James A. Koslow

James A. Koslow, P.E.
Air Pollution Control Officer

JAK:es
cc: Melvin Shore, Port Director

United States Department of the Interior

NATIONAL PARK SERVICE

WESTERN REGION

450 GOLDEN GATE AVENUE, BOX 36063

SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO:

H24 (WR-RRA)

March 6, 1985

George C. Weddell (SPKED-D)
Chief, Engineering Division
U.S. Army, Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814

Dear Mr. Weddell:

We have received and reviewed the draft report entitled "Intensive Cultural Resource Survey and Literature Review for the Sacramento Deep Water Ship Channel Project, Yolo and Solano County [sic], California" by Roger H. Werner.

The prefield research and field survey together constitute an adequate effort to identify and locate cultural resources within the described project area. No cultural resources were identified within the project area although one archeological site, CA-Yol-42, was located outside of Parcel 1 (pg 39 and Map 3 of the report).

We concur that the project, as described, will not affect any cultural resources listed in, eligible to, or potentially eligible to the National Register of Historic Places (NRHP). Should changes in project specifications result in potential impacts to CA-Yol-42, we request that the site's NRHP eligibility be evaluated and treated in accordance with 36 CFR 800.4.

In the unlikely event that unknown cultural resources are discovered in the course of project implementation or operation, please contact the Departmental Consulting Archeologist of the National Park Service at Tel. (202) 343-4101.

Sincerely,

Garland J. Gordon

Garland J. Gordon
Chief, Interagency Archeological Services
Division of National Register Programs

cc:

California State Historic Preservation Officer
Roger H. Werner

State of California — The Resources Agency
OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
P.O. Box 2390
Sacramento, CA 95811
(916) 445-8006

Date: 3 September 1985

Project No.: COE 8502253

TITLE: SACRAMENTO DEEP WATER CHANNEL DREDGING

The item cited above was received in this office on 29 August
Thank you for consulting us pursuant to 36 CFR 800.

We concur in your determination that this undertaking:

- [x] does not involve National Register or eligible properties.
- [ ] will not affect National Register or eligible properties.

The provisions of 36 CFR 800.7 apply if previously unidentified National Register or eligible resources are discovered during construction.

Contact Nicholas Del Cioppo of our staff if you have any questions.

Kathryn Gualtieri

Kathryn Gualtieri
State Historic Preservation Officer

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814-4794

REPLY TO
ATTENTION OF

June 25, 1985

Environmental Resources Branch

Mr. Walt Cheechov
U.S. Department of Agriculture
Soil Conservation Service
117 West Main Street
Suite 21
Woodland, California 95695

Dear Mr. Cooper:

We are preparing a general design memorandum and environmental impact statement for the Sacramento river Deep Water Ship Channel, California project. Please advise us whether any prime and unique farmlands in your area of responsibility would be affected by the project. This project is also being coordinated with the Sacramento and Dixon offices of your agency. Enclosed is Form AD-1066, Farmland Conversion Impact Rating for your completion.

To assist you in preparing your comments, I am also enclosing a set of maps showing the disposal sites and the overall project. The selected plan calls for deepening the existing navigation channel between Pittsburg (New York Slough) and the Port of Sacramento to 35 feet below mean lower low water and widening the channel for ship maneuverability. Material dredged from the channel will generally be placed in confined disposal areas as shown and listed in the enclosures. The capacity of the disposal sites is 34 million cubic yards, but only 25 million cubic yards is expected to be deposited within the 4,464 acres of mainly agricultural and grassland areas. We estimate that approximately 2,300 acres of agricultural land (field and row crops) and approximately 2,000 acres of grassland will be disturbed by the project.

If there area any questions concerning this application, contact Mr. Michael Welsh (916) 551-1861 or FTS 460-1861. We would appreciate a reply within 30 days.

Sincerely,

Albert E. McCollam, Jr.
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

Enclosures

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

June 25, 1985

Environmental Resources Branch

Mr. Warren Cooper
U.S. Department of Agriculture
Soil Conservation Service
Park Plaza
805 North Lincoln
Suite D
Dixon, California 95620

Dear Mr. Cooper:

We are preparing a general design memorandum and environmental impact statement for the Sacramento river Deep Water Ship Channel, California project. Please advise us whether any prime and unique farmlands in your area of responsibility would be affected by the project. This project is also being coordinated with the Sacramento and Dixon offices of your agency. Enclosed is Form AD-1066, Farmland Conversion Impact Rating for your completion.

To assist you in preparing your comments, I am also enclosing a set of maps showing the disposal sites and the overall project. The selected plan calls for deepening the existing navigation channel between Pittsburg (New York Slough) and the Port of Sacramento to 35 feet below mean lower low water and widening the channel for ship maneuverability. Material dredged from the channel will generally be placed in confined disposal areas as shown and listed in the enclosures. The capacity of the disposal sites is 34 million cubic yards, but only 25 million cubic yards is expected to be deposited within the 4,464 acres of mainly agricultural and grassland areas. We estimate that approximately 2,300 acres of agricultural land (field and row crops) and approximately 2,000 acres of grassland will be disturbed by the project.

If there area any questions concerning this application, contact Mr. Michael Welsh (916) 551-1861 or FTS 460-1861. We would appreciate a reply within 30 days.

Sincerely,

Albert E. McCollam, Jr.
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

Enclosures

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

June 25, 1985

Environmental Resources Branch

Mr. Dave Simpson
U.S. Department of Agriculture
Soil Conservation Service
65 Quinta Court
Suite C
Sacramento, California 95823

Dear Mr. Cooper:

We are preparing a general design memorandum and environmental impact statement for the Sacramento river Deep Water Ship Channel, California project. Please advise us whether any prime and unique farmlands in your area of responsibility would be affected by the project. This project is also being coordinated with the Sacramento and Dixon offices of your agency. Enclosed is Form AD-1066, Farmland Conversion Impact Rating for your completion.

To assist you in preparing your comments, I am also enclosing a set of maps showing the disposal sites and the overall project. The selected plan calls for deepening the existing navigation channel between Pittsburg (New York Slough) and the Port of Sacramento to 35 feet below mean lower low water and widening the channel for ship maneuverability. Material dredged from the channel will generally be placed in confined disposal areas as shown and listed in the enclosures. The capacity of the disposal sites is 34 million cubic yards, but only 25 million cubic yards is expected to be deposited within the 4,464 acres of mainly agricultural and grassland areas. We estimate that approximately 2,300 acres of agricultural land (field and row crops) and approximately 2,000 acres of grassland will be disturbed by the project.

If there area any questions concerning this application, contact Mr. Michael Welsh (916) 551-1861 or FTS 460-1861. We would appreciate a reply within 30 days.

Sincerely,

Albert E. McCollam, Jr.
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

Enclosures

United States Department of Agriculture

Soil Conservation Service

2828 Chiles Road
Davis, CA 95616-4999
(916) 449-2853

October 9, 1985

Wayne J. Scholl
District Engineer
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Scholl:

We acknowledge receipt of the Draft General Design Memorandum and Supplemental Environmental Impact Statement for the Sacramento River Deep Water Ship Channel. We have reviewed the draft and find no controversial items within the realm of Soil Conservation Service's expertise and responsibilities. We find no conflict with any SCS programs or projects. We feel all of our concerns have been adequately addressed including prime and unique farmland and treatment of disposal sites.

We appreciate the opportunity to review and comment on this project.

Sincerely,

Gene Andreuccetti

EUGENE E. ANDREUCCETTI
State Conservationist

The Soil Conservation Service is an agency of the United States Department of Agriculture

☆U.S. Government Printing Office: 1983—420-839/1578

MELVIN FROHRIB, President - Vallejo
ALLAN WITT, Vice President - Fairfield
GUIDO E. COLLA, Secretary, Suisun
RAYMOND CHURCH, Trustee at Large

William J. Lawrence XXXXXXXXXX

E.W. KLIEWER, Dixon
MILTON WALLACE, Rio Vista
XXXXXXXXXX, Benicia
C.J. GOLOMB, Vacaville

Solano County Mosquito Abatement District

DENNIS D. BEEBE, MANAGER
P.O. BOX 304, SUISUN, CALIF. 94585
Telephone (707) 425-5768

Meetings: Second Monday Every Month
Mosquito Bldg., Suisun Plaza: 7:30 p.m.

December 17, 1984

Marcia Geidel
Department of the Army
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

RE: Draft Supplement To The Final Environmental Impact Statement; Sacramento River Deep Water Ship Channel.

Dear Ms. Geidel:

Enclosed is a copy of the Solano County Mosquito Abatement District's criteria for mosquito prevention you requested.

If you have any questions, please feel free to call me.

Sincerely,

Dennis D. Beebe

Dennis D. Beebe
Manager

DDB:mjg
Encl: 1

C-090792

C-090792

SOLANO COUNTY MOSQUITO ABATEMENT DISTRICT
CRITERIA FOR MOSQUITO PREVENTION IN
DREDGE MATERIAL DISPOSAL SITES

Background Statement

In many instances land disposal of dredge material creates mosquito breeding sources. Due to the initial high water content and characteristics of the dredged material, shrinkage cracks occur in the drying process. These shrinkage cracks provide ideal habitat for the production of mosquitoes. Experience by mosquito abatement agencies has shown the use of chemicals to kill mosquito larvae in the cracks is very inefficient and generally not practical. Solutions lie in the water management and periodic manipulation of the surface of the deposited material. Disking the spoil material fills and closes the cracks. Drainage of storm water and keeping the elevation of the ground water below the shrinkage cracks also prevents mosquito problems.

Disposal Site Management

1. Provide ditches and/or water control structures for drainage of surface water. An engineering survey may be necessary.

2. Disking of the area may be required to close shrinkage cracks.

3. Provide access roads that are capable of supporting maintenance, inspection and mosquito control equipment.

4. Areas designated for permanent water should be constructed and managed for mosquito prevention as necessary for the specific site. Generall, dense aquatic vegetation, algal mats and shallow water bring on mosquito problems.

5. Areas designated for wetland development (saltwater marshes) need ditches to promote and enhance tidal water circulation and/or water control structures (tide gates) to provide water management capabilities. The outboard levee system should be retained until sufficient drying has occurred and all necessary grading and ditching has been finished.

6. Retention of outboard levees and tide gates may be necessary or desirable for water management to prevent excessive production of mosquitoes.

7. Plan and fund a maintenance program for the area to provide for:

   a. Maintenance of ditches and water control structures
   b. Disking as necessary
   c. Maintenance of levees and access roads
   d. Occasional mosquito control with pesticides and/or a biological agent such as mosquito fish

STATE OF CALIFORNIA—RESOURCES AGENCY

GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF WATER RESOURCES
P.O. BOX 388
SACRAMENTO
95802

Colonel Wayne J. Scholl
District Engineer
Sacramento District
U. S. Corps of Engineers
Department of the Army
650 Capitol Mall
Sacramento, CA 95814

February 14, 1986

Dear Colonel Scholl:

This letter is in response to your request for clarification of our comments of October 24, 1985, on the General Design Memorandum and Supplemental Environmental Impact Statement for the Sacramento River Deep Water Ship Channel Deepening Project.

We are still concerned that additional salinity intrusion near Emmaton could occur during times of low Delta outflow. Our concern is supported by recent Dutch studies (Flume Study on Salinity Intrusion in Estuaries, Delft Hydraulics Laboratory, M896-X), which show that an increase in depth increases the potential for salinity intrusion. However, we agree with your staff that the impacts are not clearly definable at this time.

Our computer modeling studies, based on empirical salinity-outflow and gradient relationships, produced an average maximum reduction of the combined Central Valley Project (CVP) and State Water Project (SWP) firm yield by 35 TAF per year. This maximum impact could vary from as high as 55 TAF to as low as 15 TAF per year. However, we agreed that these are only projections and the actual impact could differ, particularly when the potential impacts are so small compared to total annual Delta outflow. This is the reason we requested that you implement a monitoring program agreeable to the State and the Corps.

We feel that after several years of monitoring, we can more accurately define any impacts caused by the deepening project. We concur with your decision to evaluate mitigation alternatives concurrently with the salinity monitoring program and mitigate for any reduction in CVP and SWP firm yield that is defined. If the monitoring indicates that the impacts are small, low cost mitigation, such as temporary placement of sand sills in the Sacramento River during drought years, may be sufficient.

If you have any questions, please have your staff call James U. McDaniel at (916) 445-5631.

Sincerely,

David N. Kennedy
Director

PORT OF SACRAMENTO

California's Capital Port

SACRAMENTO-YOLO PORT DISTRICT WORLD TRADE CENTER WEST SACRAMENTO, CALIFORNIA 95691 TWX 910-367-3581 TEL (916) 371-8000

January 10, 1986

File No. 5030.1

Your File No. SPK-ED

Colonel Wayne J. Scholl
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Attn: Mr. Scott Morris

Gentlemen:

Mr. Morris has requested any comments we may have on various comments made on the Sacramento Deep Water Ship Channel Deepening Project GDM, regarding ship's salt water ballast and how it may contribute to salinity in the harbor and upper channel.

Many years ago, we had orally requested ships to recirculate ballast water on the passage up the channel, thus reducing salt concentrations. Recently, we have instituted stricter, more decisive measures aimed at controlling the ballast discharge. I enclose a copy of a letter, dated December 6, 1985, sent to each of our licensed pilots, who accompany every ship visiting the Port. At the same time, we modified our official Pilot's Report, adding the questions, "Informed Captain of salt water ballast problem" and "Did vessel comply with this request, yes or no". I enclose a coy of this new Pilot's Report.

Another factor working to reduce salt water ballast quantities is the reduction of wood chip tonnage handled at the Port. Our experience has been that the majority of salt water ballast

PORT OF SACRAMENTO

was brought in by woodchip carriers. Our woodchip tonnage has declined as shown by the following statistics:

Year	Woodchip Tonnage
1975	603,783 tons
1978	534,137 tons
1980	804,862 tons
1982	313,170 tons
1985	231,123 tons

I have not seen results of any recent salinity tests in the channel, but I feel they would reflect the decrease in salt water ballast discharges.

Sincerely,

John T. Christian

John T. Christian
Chief Engineer

JTC/ns

Enclosure

December 6, 1985

Captain R.W. Atthowe
891 Dolores Street
San Leandro, CA 94577

Dear Captain Atthowe:

WE REQUIRE YOUR COOPERATION!!!

As you know, the harbor here at Sacramento is fresh water. The discharging of salt water ballast by numerous ships has tended to increase the salinity content of the water to levels beyond that which is desired. Your help in reducing this salinity is requested with regard to informing vessels of the problem.

We request that you please ask the vessel to discharge salt water ballast to the maximum extent possible, in the San Francisco Bay. We further request that they substitute any remaining needed ballast with brackish water, which is normally encountered above New York Point, during their transit up to the Port of Sacramento. This will help in reducing the salinity content of the ballast water they will inevitably have to discharge during their loading operation while here, and ultimately help us in reducing the overall salinity content of the water here in the harbor.

Your help will be greatly appreciated.

Sincerely,

William O. Griffith
Operations Manager

WOG/ns

SACRAMENTO-YOLO PORT DISTRICT

PILOT'S REPORT

Vessel_____ Date_____

Owner and/or Agent_____

Berths (From_____ (To)_____

Captain_____ Overall Length_____

Departure Draft Fwd_____ Aft_____ Extreme Breadth_____

Arrival Draft Fwd_____ Aft_____ Time Departed_____

Destination or Origin_____ Time Arrived_____

Weather on departure_____ Arrival_____

Informed Captain of salt water ballast problem_____

Did vessel comply with this request /___/ yes /___/ no

Buoys out of position_____ Navigational lights out of operation, list number_____

Shoalings, together with the heading of the vessel and location_____

Groundings, together with the heading of the vessel and position_____

Remarks: Delays, if any, and cause thereof:_____

_____

_____

_____

_____

_____

Signed_____

Radio No._____ Excellent_____ Good_____ Fair_____ Poor_____

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL,
CALIFORNIA

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B

AIR QUALITY EMISSIONS ANALYSIS

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CALIFORNIA

APPENDIX B
AIR QUALITY EMISSIONS ANALYSIS

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FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CALIFORNIA

APPENDIX B
AIR QUALITY EMISSIONS ANALYSIS

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1. INTRODUCTION

The Sacramento River Deep-Water Ship Channel currently is unable to efficiently accommodate larger vessels that call at the Port of Sacramento. The loaded draft of these vessels well exceeds the 30-foot channel depth between Avon and the Port. Deeper-draft vessels must therefore carry less than capacity loads, wait for favorable tides, and experience potentially unsafe clearance through the channel. Partially loaded ships must make another stop to top off at Bay Area ports with the top-off dry bulk goods shipped to the Bay Area by less efficient trucks or trains.

To improve transportation efficiency and reduce cost, the U.S. Army Corps of Engineers evaluated several alternatives and recommended deepening the channel to 35 feet. This proposed improvement project will contribute significantly to the Port's ability to double its predicted cargo movement (mainly agricultural products and wood chips) from over 2 million tons to over 4 million tons annually within the next decade. The details of the proposed plan are documented in a comprehensive feasibility report and environmental impact statement (EIS) completed in 1980.

The EIS noted that the proposed project will generate regional air pollutant emissions reductions by moving cargo more efficiently, which will create a corresponding ambient air quality benefit. This benefit will be offset to some extent by the local concentration of additional emissions sources within the Port of Sacramento and by the increased levels of recreational use of water-oriented improvements planned in conjunction with the channel deepening. Because of the difficulty in assessing the simultaneous effects of changing transportation modes and the displacement of emissions sources throughout the region, the EIS discussed these emissions changes only in general terms. Since the Sacramento Valley and Bay Area Air Basins are non-attainment areas of the Federal standards for photochemical air pollutants, the Corps of Engineers has commissioned an air quality emissions analysis to better quantify the air quality implications of the proposed project. Specific objectives of this study included an analysis on a regional scale (comparing potential project versus no-project benefits weighed against increased recreational use) and within the Port area itself (to estimate impacts from increased traffic perhaps not anticipated in existing regional air quality plans). This air quality emissions analysis was scheduled for completion in the Fall of 1982, but the transportation modal splits and origin/destination of both Port and diverted cargo were not readily available. These data were ultimately compiled by the Engineering Division of the Port of Sacramento and form the basis for the input assumptions used to construct the following analysis.

2. EMISSIONS ANALYSIS

2.1 Transportation Scenarios

In order to formulate an accurate projection of future transportation-related emission levels, one must define the probable modes and routes of Port cargo. These cargo data, when assigned to their respective modes, will then determine the degree of utilization of ship, truck, and rail systems. The system-tonnage relationship is then used to determine fuel consumption for each mode, and ultimately to estimate the corresponding air pollutant emissions released when that fuel is burned.

Cargo characteristics with and without the project were derived from Sections B and F of Appendix 1 to the Corps Feasibility Study entitled "Resources and Economy of the Study Area." The existing cargo patterns were taken from 1979 cargo traffic data, the last year with complete data prior to the 1980 issuance of the Corps study. The year 1987 was selected as the primary analysis year because it is the first major forecasting increment in estimating future port cargo levels, and is also the current attainment deadline under the Clean Air Act Amendments of 1977.

Table 2.1 summarizes the cargo input assumptions used for the analysis. The essential differences between the project and no-project alternatives are that the average load factor per ship will increase by about 10,000 tons with the deeper channel, and about 200,000 tons of cargo will be shipped through the Port instead of being diverted to other ports with deeper-draft access ("top-off" volume). Another 100,000 tons of cargo will pass through the Port attracted by the availability of more efficient and economical means of shipping ("induced" tonnage). Some top-off occurs at present, but the year-to-year variability is so pronounced and the actual tonnage so uncertain that it was ommitted from existing cargo movement estimates.

Incoming cargo, comprising 20 percent of all Port activity, leaves almost exclusively by truck, with less than 5 percent using rail. Outbound cargo has a higher percentage of rail movement, but still almost all movement into the Port is by truck, with a 15/85 percent rail/truck split. When these splits are applied to the cargo forecasts with and without the proposed project, the resulting cargo movement detail is shown in Table 2.2. For purposes of analysis, the top-off and induced volumes that differentiate the project and no-project assumptions were also calculated at the above outbound rail/truck splits.

2.2 Fuel Utilization

Most compilations of emissions factors for transportation sources are based on the quantity of fuel burned by the engines propelling the source. Since ships, trucks, and trains vary considerably in fuel efficiency, even when comparing one vehicle to another of the same kind, a

Table 2.1 Port of Sacramento cargo characteristics with and without the proposed channel deepening

Input Parameters	Existing Condition	1987 No Project	1987 With Project
Shipping tonnage (tons/year)	2,176,569	4,075,000	4,375,000
Ship movements (vessels/year)	129	200	137
Load factor (tons/ship)	16,875	20,375	31,950
"Top-off" volume (tons/year)	?	200,000	0
"Induced" tonnage (tons/year)	0	0	100,000

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Table 2.2 Cargo movement detail (tons/year) - Port of Sacramento

Cargo Movement	Existing Condition	1987 No Project	1987 With Project
Total cargo	2,176,569	4,075,000	4,375,000
Total outbound	1,741,255	3,260,000	3,500,000
Total inbound	435,314	815,000	875,000
Outbound arriving by truck	1,480,067	2,771,000	2,975,000
Outbound arriving by rail	261,188	489,000	525,000
Inbound leaving by truck	417,901	782,400	840,000
Inbound leaving by rail	17,412	32,600	35,000
Outbound diverted elsewhere	?	200,000	0
Diverted hauled by truck	?	170,000	0
Diverted hauled by rail	?	30,000	0

single prototype vehicle for each class was assumed for fuel consumption analysis. The design ship was specified in the Corps feasibility study. Existing ships in the 25,000 DWT class burn 420 gallons of fuel per hour at sea and about 50 gallons per hour while hoteling and loading. The future design ship in the 35,000 DWT class burns about 460 gallons per hour and uses 60 gallons of fuel while loading to run onboard power systems. At typical channel speeds and load factors, the smaller ship has a fuel efficiency rating of 500 ton-miles per gallon with the efficiency increasing to 650 ton-miles per gallon of fuel with the larger ship. By comparison, trains have an efficiency factor of 200 ton-miles per gallon and trucks deliver only about 60 ton-miles per gallon.

To distinguish between emissions changes around the Port and throughout the region as a whole, three analysis regions were developed in which changing transportation patterns will occur if the project is built. These three areas included the Port (within a 5-mile radius of the Port), the Sacramento Air Quality Management Area (AQMA) which extends to the New York Slough along the ship channel, and a Northern California analysis zone which extends to the Bay Area and within a 100-mile radius of the Port northward into the Sacramento Valley. Fuel consumption analysis elements included ship activities, tugboat assistance, on-road trucks, and train road-haul and switching activities. Minor sources such as forklifts, cranes, or employee vehicles were not included in this scenario development. Ship activities, including berthing/deberthing, tidal delays, queueing if berth space is unavailable, hoteling/loading, and propulsion, were calculated for a prototype 12.5 net ton truck and an 8,000 net ton train. Total fuel consumption is shown in Table 2.3. Based on overall fuel consumption, the "with-project" alternative causes a definite air quality impact near the Port, the two alternatives are within 3 percent of each other within the basin, and once the entire analysis area is considered, the "with-project" alternative becomes decidedly more efficient. Given that much of the "no-project" excess fuel consumption (and hence, air emissions) occurs on roadways to and within Bay Area ports, prevailing meteorological conditions that carry Bay Area air pollutants into the Central Valley will therefore transport any related emissions penalty or benefit back toward Sacramento.

2.3 Emissions Calculations

Published emissions summaries that translate project fuel consumption into corresponding air pollutant emissions can now be applied to the fuel use estimates to determine the transportation-related emissions within the three analysis zones. The emissions factors for ship and train sources were taken from EPA's standard "Compilation of Air Pollutant Emission Factors, AP-42," while the roadway sources were taken from EMFAC6C, the California-specific version of MOBIL2, the Federal roadway source emissions model. Train and ship source emissions were assumed to remain constant between now and 1987, while truck emissions will drop slightly as a result of truck emission standards currently in effect.

Table 2.3 Comparative annual fuel consumption data (thousands of gallons/year)

Consumption Location	Ships: Hotel/Load	Ships: Cruise	Tugboats	Trucks	Trains	Total (10^6 Gal.)
WITHIN THE PORT						
Existing	866.9	45.5	20.6	151.8	7.0	1.09
1987 no project	1,680.0	70.6	32.0	297.9	13.8	2.10
1987 w/project	1,965.6	53.2	21.9	305.2	14.0	2.36
WITHIN THE AIR BASIN						
Existing	866.9	455.1	20.6	1,317.8	67.0	2.73
1987 no project	1,680.0	705.6	32.0	2,603.2	133.0	5.15
1987 w/project	1,965.6	531.7	21.9	2,648.8	134.8	5.30
WITHIN NORTHERN CALIFORNIA						
Existing	866.9	910.2	20.6	1,317.8	67.0	3.19
1987 no project	1,762.6	1,411.2	38.4	2,875.2	148.0	6.15
1987 w/project	1,965.6	1,063.4	21.9	2,648.8	134.8	5.83

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Table 2.4 summarizes the pertinent emission factors. By combining the data from Tables 2.3 and 2.4, the resulting annual emissions burden from Port transportation activities is shown in Table 2.5. The emissions distributions for various pollutant species follow essentially the same pattern as the fuel use estimates, with the project creating higher emission levels for all pollutants near the Port and fewer pollutants regionally. Since the regional pollution benefit will eventually propagate into the Sacramento AQMA in the form of lower background air quality levels, the regional benefit is a positive factor in comparing the project versus no-project alternatives. Table 2.5 shows that Port-related emissions (and resulting impacts) will increase significantly under both channel alternatives, with little substantive difference in air quality impacts under either one.

While the magnitude of the emissions in Table 2.5 would make it appear that port activitues constitute a major source of air pollutants, a better perspective of the port's significance can be derived by comparing these emissions to sub-regional and regional emissions inventories from all pollutant sources. This comparison between port activity emissions and the existing and future port area and AQMA emissions estimates is shown in Table 2.6. The port activity emissions are allocated on a daily basis from Table 2.5 while the non-port sources are abstracted from SACOG gridded emissions maps used for developing the reguinal Air Quality Plan (AQP). Sulfur dioxide and particulate emissions are not tabulated by any local planning or enforcement agencies. These data in Table 2.6 were estimated from California Air Resources Board (ARB) projections made in the mid-1970s and may therefore not be highly accurate. Because the rectangular SACOG grid system does not correspond well to the circular "PORT AREA" definition used to construct the project-related emissions data, the port's contribution to sub-regional emissions is slightly overstated in Table 2.6.

As was to be expected, port activities (ships, trucks, and trains) contribute a sizable fraction of the local port-area emissions, but not much of the inventory on a regional scale. The projected growth of port-related emissions, in conjunction with basinwide reductions of emissions, makes the port a larger future contributor to the regional pollution burden. The deepening of the channel shown under "FUTURE (1987) CONDITIONS" has a measurable effect in increasing local emissions from 0.4% for CO to 6.7% for NO_x. Regionally, the project-related contribution is minimal with SO_2 from ship engines as the only significant difference between project and non-project emission levels. Since SO_2 is not a problem pollutant and since some of the region-wide project benefit from reduced Bay Area emissions will be transported into Sacramento through reduced background levels, the emissions comparisons in Table 2.6 suggest that the channel deepening has a negligible impact on ambient air quality.

Table 2.4 Air pollutant emission factors from transportation sources (pounds/1,000 gallons of fuel)

Code	Source	Carbon Monoxide	Hydro-carbons	Sulfur Dioxide	Nitrogen Dioxides	Suspended Particulates
1	Ship - hotel mode	43.7	59.1	67.5	364.0	20.0
2	Ship - 2/3 power	28.1	25.4	67.5	359.0	20.0
3	Tugboats	92.8	40.6	71.1	306.5	25.0
4	Trains	170.0	63.0	57.0	400.0	25.0
5	Trucks - existing	143.3	23.1	30.9	226.0	21.6
6	Trucks - 1987	132.3	17.6	30.9	149.9	21.6

1. EPA-AP-42, Table 3.2.3-3
2. EPA-AP-42, Table 3.2.3-3
3. EPA-AP-42, Table 3.2.3-3
4. EPA-AP-42, Tables 3.2.2-1, -2 (average of 2-stroke and 4-stroke)
5. California ARB, EMFAC6C, 100% heavy-duty diesel
6. California ARB, EMFAC6C, 100% heavy-duty diesel

Table 2.5 Annual emissions comparisons, existing versus project/no-project alternatives (tons/year)

Emissions Location	Carbon Monoxide	Hydro-carbons	Sulfur Dioxide	Oxides of Nitrogen	Suspended Particulates
IN PORT AREA					
Existing	32.0	28.6	34.1	187.7	11.1
1987 no project	60.1	54.2	65.2	348.4	21.3
1987 w/project	66.1	62.3	74.0	396.3	23.9
IN AIR BASIN					
Existing	126.4	49.1	67.6	404.9	28.5
1987 no project	231.6	86.4	125.7	659.0	54.0
1987 w/project	238.1	92.8	129.8	682.0	55.5
IN NORTHERN CALIFORNIA					
Existing	132.8	54.9	83.0	486.6	33.1
1987 no project	262.9	100.8	157.1	825.1	65.1
1987 w/project	245.6	99.6	147.8	777.5	60.9

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Table 2.6 Sub-regional and regional emissions comparisons between port activities and all other emissions sources

Emissions Sources (Tons/Day)	Carbon Monoxide	Reactive Hydro-carbons	Sulfur Dioxide	Oxides of Nitrogen	Suspended Particu-lates
EXISTING CONDITIONS					
. IN PORT AREA					
Existing port activities	0.087	0.078	0.093	0.514	0.030
Entire port area	5.542	1.196	0.387	2.427	0.803
% due to port activities	1.6%	6.5%	24.0%	21.2%	2.4%
. IN AIR BASIN					
Existing port activities	0.346	0.134	0.185	1.109	0.078
Entire AQMA	634.80	112.22	7.74	112.73	91.98
% due to port activities	0.05%	0.12%	2.39%	0.98%	0.08%
FUTURE (1987) CONDITIONS					
. IN PORT AREA					
Future port activities - no project	0.165	0.148	0.179	0.955	0.058
Future port activities - w/project	0.181	0.171	0.203	1.086	0.065
Increased emissions due to project	0.016	0.023	0.024	0.131	0.007
Port area emissions	4.310	0.968	0.465	1.943	0.801
% due to port activities	3.8%	15.3%	38.5%	49.2%	7.2%
Increase due to project	0.4%	2.4%	5.2%	6.7%	0.9%
. IN AIR BASIN					
Future port activities - no project	0.635	0.237	0.344	1.805	0.148
Future port activities - w/project	0.652	0.254	0.356	1.868	0.152
Increased emissions due to project	0.017	0.017	0.012	0.063	0.004
AQMA emissions	555.51	80.61	9.30	96.07	103.30
% due to port activities	0.11%	0.29%	3.70%	1.88%	0.14%
Increase due to project	<0.01%	0.02%	0.13%	0.07%	<0.01%

Emissions data: "Attainment of National Ambient Air Quality Standards in the Sacramento Area" - SACOG - July, 1982.

3. ANALYSIS OF SIGNIFICANCE

While emissions differences between the project and no-project alternatives are small, there is nevertheless a fairly clear-cut transition between higher emission levels at the Port and lower levels regionally in comparing these two choices. Because the penalty/benefit distribution occurs on two separate scales of motion, it is almost impossible to determine if one choice outweighs the other. It would theoretically be possible to apply the Sacramento Area Council of Governments (SACOG) Simulation Model for Ozone Generation (SMOG) to this spatial emissions pattern, but neither the precision of the input data nor the complexity of extending this model from the ocean to the mountains and up and down the valley warrants such an action.

3.1 Localized Impacts

To a large extent, the emissions data for the Port area and AQMA have already been incorporated into the SMOG model. Basically, the current Sacramento Air Quality Plan (AQP), in incorporating the "with-project" Port development plans and cargo projections through 1987, has determined that Port growth will not affect the Sacramento AQMA any more adversely than any other growth. The area is not projected to meet the hourly standard for photochemical oxidants by the 1987 deadline with Port growth, as part of overall area growth, contributing incrementally to that inability to meet the standard. Emissions around the Port from cargo activities will approximately double as cargo levels double in the next decade with or without the project. The movement of an additional 300,000 tons of cargo per year is seen in Table 3.1 to add about 0.02 ton of hydrocarbons, the primary precursor to smog, to the daily AQMA emissions burden. With 80+ tons of hydrocarbons predicted to be emitted each day in the airshed, the with or without-project alternatives make little regional difference. The Clean Air Act requires that Federal actions be consistent with local and regional plans. Since the "with-project" alternative was used in the Port activity planning input into the AQP, the proposed channel deepening is thus consistent with the AQP and will therefore not create any unanticipated, adverse air quality impacts.

3.2 Regional Impacts

Table 3.1 shows a regional benefit for all pollutants when the extra truck and rail transportation of goods and the extra "top-off stop" for outbound vessels are considered. Table 3.1 also shows, however, that much of the regional benefit is negated by the increase in regional recreational traffic induced by project-related recreational improvements. Because the project-related benefit is concentrated in the Bay Area while the recreational users may come from all over, it is impossible to derive a real "bottom line" to the question of whether the project represents a positive or negative impact. Compared to areawide emissions, the project

Table 3.1 Emissions penalty (+ data) or benefit (- data) of the project versus no-project alternatives (tons/year)

Emissions Location	Carbon Monoxide	Hydro-carbons	Sulfur Dioxide	Oxides of Nitrogen	Suspended Particulates
In Port area	+ 6.0	+8.1	+8.8	+47.9	+2.6
In air basin	+ 6.5	+6.4	+4.1	+23.0	+1.5
In No. California	-17.3	-1.2	-9.3	-47.6	-4.2
Recreation-induced	+92.4	+7.1	+1.0	+10.5	+1.6

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and its related activities represent such a small fraction of the area pollution burden that any impacts will be insignificant in any event, but it is difficult to even state whether the small impact on air quality will be positive or negative.

Within the regional perspective, one further consideration acknowledged by the Corps feasibility study, but not quantified, is that the deeper channel may promote more rapid industrialization of the Port area as well as the Montezuma Hills than without the project. The EIR on the Southport Industrial Park covering 670 acres on the south bank of the channel is currently being circulated and indicates that major industrial growth and waterway commerce-oriented development is predicted to occur near the Port. Major plants requiring waterway access such as the proposed U.S. Gypsum plant are also being considered. Much of that growth may occur without the channel deepening, but it certainly is a potentially contributing factor. As noted in the feasibility study, any onsite emissions from industrial sources are strictly controlled by local air pollution control agencies and would therefore not cause any adverse impact. As with Port activity growth, however, new industrial development will have considerable transportation-related emissions contributing to the regional emissions burden. The AQP is quite specific in detailing what projects were <u>not</u> included in the AQP, viz.,

> "- A new, expanded industrial park at the Port of Sacramento," and
>
> "- Any major new industrial growth in the planning area." AQP, SACOG, 1982, p. VI-5

If the 35-foot channel contributes to the Southport Industrial Park or to any unanticipated industrial growth, then it may have an unfavorable impact on future attainment of clean air standards in the Sacramento area.

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL,
CALIFORNIA

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX C

SECTION 404 (b)(1) EVALUATION

APPENDIX C

Section 404(b)(1) Evaluation

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SACRAMENTO RIVER DEEP WATER SHIP CHANNEL DEEPENING PROJECT

Section 404(b)(1) Evaluation

Section I

Introduction

The Sacramento River Deep Water Ship Channel deepening project will involve the placement of dredged material into waters of the United States. In accordance with Section 404(b)(1) of the Clean Water Act (33 USC 1344), and other pertinent laws and regulations, the placement of dredged fill material into waters of U.S. or their associated wetlands requires an evaluation of water quality considerations associated with the section. This evaluation was accomplished to qualify the project for an exemption or certification from the State of California in accordance with Section 401 of the Clean Water Act and ER 1105-2-50 (paragraph - 436b(1)).

Section II

Project Description

1. Project Location

The existing Sacramento Deep Water Ship Channel is located in the Sacramento-San Joaquin Delta region in northern California. This navigation channel extends approximately 47 miles between New York Slough (Pittsburgh) and the Port of Sacramento in eastern Yolo County.

2. Authorization

This study was prepared in response to resolutions by the House of Representatives Committee on Public Works, adopted on 10 July 1968 and 11 December 1969. The Board of Engineers for Rivers and Harbors (BERH) was requested to review reports pertinent to the Sacramento River, California, and determine whether any modification of the existing navigation project is advisable, particularly to the channel from New York Slough to the Port of Sacramento.

A Feasibility Report and Environmental Impact Statement (EIS) for Navigation and Related Purposes were completed in July 1980. The final EIS was filed with EPA on May 8, 1981. The Office of the Chief of Engineers (OCE) approved the report on November 20, 1981 and sent a draft Record of Decision to the Secretary of the Army on December 17, 1981. The Feasibility Report was transmitted to Congress for information on October 4, 1983. The project was authorized by Congress in August 1985 by "An Act Making Supplemental Appropriations for the Fiscal Year Ending September 30, 1985 and for Other Purposes", PL 99-88.

3. Completed Project

The deepening of the channel will be accomplished as a local cooperation navigation project. The Corps of Engineers is to dredge the channel and the U.S. Coast Guard will relocate the navigational aids along the channel. The

Port of Sacramento, as the project sponsor, will provide lands, easements and rights-of-way required for initial construction and subsequent maintenance of the channel, provide suitable disposal areas and provide lands for fish and wildlife mitigation and participate in cost-sharing. The project will be divided into four contract reaches and all work will be performed under eight seperate yearly contracts.

The first contract will deepen the channel to 35-feet and widen the two curves 50-feet from channel mile 35.0 to the Port of Sacramento.

The second contract will deepen to 35-feet and widen 50-feet from Collinsville (channel mile 0.0) to Junction Point (channel mile 15.0).

The third contract will deepen the channel between Junction Point (channel mile 15.0) to channel mile 27.0.

The fourth contract will deepen between channel mile 27.0 and channel mile 35.0.

The fifth contract will construct the Prospect Island mitigation site.

The sixth contract will widen the channel from 200 to 250-feet between channel mile 35.0 and the Port.

The seventh contract will widen the channel from 200 to 250-feet between channel mile 18.6 and channel mile 27.0.

The eighth contract will widen the channel from 200 to 250-feet between channel mile 27.0 and channel mile 35.0.

4. General Description of Dredged Material

The material to be disposed of is naturally occurring sands, silts and inorganic clays. Past elutriate tests in the project area have shown that the dredged material is generally not contaminated, although certain heavy metals are present in other than trace amounts (see Chapter 6 of the FSEIS, table 5 and 6).

5. Description of Proposed Disposal Sites

A total of 15 disposal sites totalling 4,464 acres will be needed to contain the material dredged from the channel. The disposal areas are located in upland areas near the ship channel which are presently being used for agricultural crop (2300 acres) or grassland (1800 acres) purposes, or are existing diked disposal areas. The crop and grassland areas will be diked to contain the dredged material for the construction phase of the project. Upon completion of the dewatering/drying process, these areas will be allowed to revert to their preproject uses. To insure sufficient retention time in the sites, the disposal areas will be designed with internal training dikes to increase the flow distance between the dredge pipeline and the discharge weir. Detailed descriptions of the 15 disposal sites can be found in Appendix D of the General Design Memorandum.

6. Description of Disposal Method

Dredged material will be removed from the channel by a hydraulic cutterhead dredge and transported to the site by pipeline to the closest disposal area for containment.

Section III

Factual Determinations

1. Physical Substrate Determinations.

a. Is the dredged or fill material similar to the material existing at the site where the material will be placed? The dredged material is predominately sands, silts and inorganic clays. The disposal sites will be located in upland areas near the excavation site and will be composed of mainly sands, sandy silts, silts and inorganic clays. There will be no differences in the disposal sites.

b. Will there be any significant effects in the surrounding area (erosion or lateral displacement) as a result of the change in bottom elevation or contours? The disposal activities will have no effect because the dredged material will be contained by earthen dikes in the upland disposal sites and not allowed to return to the aquatic environment. The areas will be sloped to drain after disposal.

c. Will the dredged or fill material stay in the area where it would be placed? Yes. (At some dredging sites the fill could be sold and removed.)

d. Is the site where the material would be placed confined to the smallest practicable area? Yes. The disposal sites are restricted to the smallest area which will insure stability of the levee (dike) side slopes and also not overload the levees and insure proper settling times to meet Water Quality criteria.

e. Are there any actions proposed to minimize adverse effects on the physical substrate (containment of fill, bank protection, design features)? The dredged material would be deposited in diked disposal areas with weir structures constructed to contain the dredged material and return effluent will be controlled and tested to meet Water Quality criteria.

2. Water Circulation, Fluctuation, and Salinity Determinations

a. Will the discharge significantly affect current patterns, circulation, and normal water fluctuations? The discharge activities will have no impact on these factors since the upland disposal sites are separated by levees from the river, and the return effluent flow is very small compared to river flow.

b. Will the discharge significantly affect salinity? The proposed discharge from the disposal sites will have no impact on salinity.

c. Will the discharge divert or obstruct flow? No, the dredged material would be contained in diked upland disposal areas and the effluent is a very small percentage of normal flow and would have no appreciable effect.

d. Will the discharge activities destroy or isolate flood plain areas that serve the function of retaining natural high waters or flood waters? No, the disposal sites are separated by levees from flood plain areas.

e. Are there any actions proposed to minimize adverse effects on circulation, fluctuation, or salinity (minimum flows, bypass structures, etc.)? No, because no adverse impacts were identified on circulation, fluctuation, or salinity.

3. Suspended Particulates/Turbidity Determinations

a. Will the discharge result in unacceptable levels of turbidity? No, a water monitoring program will be conducted at the discharge point for each site before water is released back into the river. The discharge will be clarified to 2 ml per liter per hour of settleable solids through the use of a system of internal dikes designed to increase the retention time of the dredged effluent.

b. Are there any actions proposed to reduce turbidity (turbidity screens, working in the dry, cofferdams, etc.)? The dredged material would be contained in upland diked disposal areas with internal training dikes and then discharged through a weir structure into the river. If the turbidity exceeds allowable limits, the work will cease until turbidity limits are met. The retention times will be designed to settle out most solids, thereby reducing turbidity.

4. Contaminants Determinations

a. Will the discharge result in the introduction of contaminants or other materials adversely affecting water quality? Previous elutriate testing showed the dredged material had slightly elevated zinc concentrations which were not inconsistant with soils in the project area. The impacts to water quality would be minimal due to dilution in adjacent waters and the sufficient retention time in the diked area allowing most solids to settle out.

b. Are there any measures proposed to avoid introduction of contaminants (using clean material, sealing off any contaminated material, etc.)? The dredged material will be contained in upland diked disposal areas which will isolate it from wetlands and the aquatic environment. Most contaminents bind to soil particals. Therefore, an increase in settling time should eliminate high concentrations of contaminants if encountered, but this is not expected to occur.

5. Aquatic Ecosystem and Organisms Determinations

a. Will the discharge jeopardize the existence or modify the habitat of a threatened or endangered species? The proposed disposal sites have been surveyed for the presence of threatened or endangered species and the study results provided to the Endangered Species Office in accordance with Section 7 of the Endangered Species Act. Threatened or endangered species were not discovered at any disposal sites. Portions of disposal sites (S-21, S-35) where an endangered species could potentially exist have been redesigned so impacts will not occur. At other sites, actions will be taken to minimize or eliminate impacts to rare or canidate species. The endangered species consultation coordination is described in Appendix D of the FSEIS.

b. Will the discharge significantly disrupt the food chain including alteration or decrease in diversity of plant and animal species? The proposed disposal of dredged material at the upland disposal areas will temporarily disrupt the upland food chain in the vicinity of the individual site. However, the impacts will be minor because the areas have been disturbed by past use for grazing of livestock, and plowing and planting for row crops.

c. Will the discharge activities significantly inhibit the movement of animals, especially into and out of feeding, spawning, breeding, and nursery areas? The proposed dredging and disposal activities will not disrupt movement of animals into feeding or breeding areas, and no known spawning or nursery areas are located within the area to be dredged.

d. Will the discharge significantly affect shellfish populations, benthic life, fisheries, spawning cycles, or nursery areas? The proposed dredge and disposal activities will have no impacts to shellfish populations because there are no known shellfish beds in the project area. The benthic populations in the area to be dredged are not well established because the passing of ships churns the substrate on the channel bottom, the populations along the side slopes will quickly repopulate with the same population composition and diversity. The project could result in a slight increase in benthic habitat due to the dredging area.

e. Will the discharge have an adverse impact on wetlands - if so, how many acres? No, the sites were located in upland areas and designed to avoid impacting wetland areas. Sparse seasonal wetlands on several disposal sites will be temporarily impacted but are expected to return 1-2 years following disposal.

f. Will the disposal have a significant adverse impact on vegetated shallows? No, the disposal sites are located in upland areas, and there are no vegetated shallows in the area to be dredged.

g. Are there any measures to reduce or avoid significant impacts to the aquatic ecosystem (restoration or improvement of wetlands, avoiding critical areas, etc.)? The disposal sites were selected to avoid wetlands and critical upland habitat areas. A 63-acre mitigation area will be constructed on Prospect Island to mitigate for any loss of wetland and impact to fish and wildlife habitat.

6. <u>Proposed Disposal Site Determinations</u>

a. Will the discharge have a significant effect on municipal water supply intakes? No, the proposed discharge will have no effect on any municipal water supply intakes because there are none in the project area.

b. Will the discharge significantly degrade aesthetic, recreational, or economic values? The dredged material will temporarily change the landscape and may present a view that is less natural. The disposal sites will be returned to their preproject uses within two growing seasons and at some sites the material could be removed and sold so there will be no long term impacts to aesthetics. The proposed work will not prohibit the use of the area for recreation; however, recreation will not be enhanced. The use of

agricultural areas will not significantly impact economics because landowners will be compensated in the form of lease or easement agreements. The deeper channel will have a beneficial economic impact to the Sacramento Valley area by improving and increasing shipping access.

c. Is the proposed discharge site the least environmentally damaging practicable alternative? Yes, the economic costs of pumping have been balanced with putting the material in the least critical habitats so that the least environmentally damaging alternative will be used.

d. Are there any measures to avoid significant effects as a result of disposal (reseeding, revegetation, method of disposal, etc.)? The dredged material sites will return to their former use. This will avoid long term impacts to sites. A water quality monitoring program will be conducted to maintain effluent discharge within established water quality standards.

7. Cumulative Effects Determinations

a. Will the disposal when combined with other existing or future activities have a cumulative effect that would result in a major impairment of the water resources and interfere with the aquatic ecosystem? Because all effects, both individual and cumulative, described in this evaluation are temporary, minor, within acceptable limits, or mitigated for, the project work will result in no significant impacts to water resources, and no adverse impacts to the aquatic ecosystem.

b. Will the discharge result in significantly increased surface runoff or leaching of undesireable wastes associated with residential or commercial development? No increased surface runoff or leaching of undersirable wastes will result from the project. Dredged material will be contained by earthen dikes in upland areas. The material to be dredged is similiar to the soils at the disposal sites.

c. Are there any measures proposed to avoid or reduce secondary effects on the aquatic ecosystem (minimum flow releases, treatment of runoff etc.)? No special measures are needed. Primary settling of material prior to effluent discharge into the waterway will avoid significant impacts to the aquatic ecosystem.

FINDINGS OF COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

An evaluation of the proposed discharge has been made following the evaluation guidance in 40 CFR Part 230, December 24, 1980. Appropriate measures have been identified and incorporated in the proposed plan, as outlined in the EIS, FSEIS this 404 evaluation to minimize adverse effects on the aquatic environment as a result of the placement of dredged material. In addition, consideration has been given to the need for the placement of fill material, the availability of alternative actions, methods of placement that are least damaging to the environment, and such water quality standards as are appropriate and applicable by law. Other sites are not applicable.

It is expected that the Selected Plan will comply with applicable State water quality standards and that there will be no significant adverse impacts: to human health and welfare; on life stages of aquatic life and other wildlife dependent on aquatic ecosystems; on aquatic ecosystem diversity, productivity and stability; or on recreational, aesthetic and economic values. On the basis of the guidelines, the proposed dredged material disposal sites for the discharge of dredged material and the return of water from the sites are specified as complying with the requirements of these guidelines.

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL,
CALIFORNIA

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX D

ENDANGERED SPECIES COORDINATION

Appendix D

Endangered Species Coordination

List of Correspondence

1. Fish and Wildlife Service — D-1
Revised list of endangered and threatened species
March 19, 1985

2. Corps of Engineers — D-2
Information requested on endangered or threatened species
December 6, 1985

3. Fish and Wildlife Service — D-3
Revised list of endangered and threatened species
December 20, 1985

4. Corps of Engineers — D-4
Addendum to Endangered Species Biological Data Report, January 1986, and Endangered Species Biological Data Report, September 1985.

5. Corps of Engineers — D-5
Transmittal letter, January 22, 1986 and
Biological Assessment, January 1986

6. Fish and Wildlife Service — D-6
Concurrance with Corps of Engineers
Biological Assessment, January 24, 1986

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

MAR 19 1985

In reply refer to: 1-1-85-SP-24
1-1-85-SP-243

Mr. George C. Weddell, Chief
Sacramento District
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Subject: Reanalysis of a List of Endangered and Threatened Species for the Sacramento River Deep Water Ship Channel, California

Dear Mr. Weddell:

As requested on 14 March 1985 by Mike Welsh of your staff, we are providing the Corps with a revised list of endangered, threatened and candidate species at the proposed work sites (see Attachment A). Please contact Jack Williams of my staff at 916/484-4935 if you have further questions.

Sincerely,

Gail C. Kobetich

Gail C. Kobetich
Project Leader

Attachment

cc:
Chief, Endangered Species, Portland, OR (AFA-SE)
Field Supervisor, Ecological Services, Sacramento, CA (ES-S)

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
SESO # 1-1-85-SP-243

Listed Species

Mammals

Salt marsh harvest mouse, Reithrodontomys raviventris (E)
(found in downstream sites, e.g., S-33, 34, 35, 21 and 22)

Insects

Delta green ground beetle, Elaphrus viridis (T)
(possible occurrence only at parcel S-13)

Plants

Solano grass, Orcuttia mucronata (E)
(possible occurrence only at parcel S-13)
Antioch Dunes evening primrose, Oenothera deltoides subsp. howellii (E)
(possible occurrence only at parcel S-15)

Proposed Species

None

Candidate Species

Mammals

Suisun shrew, Sorex ornatus sinuosus (2)

Birds

California black rail, Laterallus jamaicensis coturniculus (2)

Plants

Suisun aster, Aster chilensis var. lentus (2)
Suisun thistle, Cirsium hydrophilum var. hydrophilum (1)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

Candidate Plants Continued

California hibiscus, Hibiscus californicus (2)
Delta tule-pea, Lathyrus jepsonii subsp. jepsonii (2)
Mason's lilaeopsis, Lilaeopsis masonii (2)

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

December 6, 1985

Environmental Resources Branch

Mr. Gail Kobetich, Project Leader
U.S. Fish and Wildlife Service
Endangered Species Office
2800 Cottage Way
Sacramento, California 95825

Dear Mr. Kobetich:

We request information on whether any listed or proposed endangered or threatened species may be present in the current study area for the Sacramento River Deep Water Ship Channel. We had previously received a revised list based on the proposed project sites on March 19, 1985, reference 1-1-85-SP-24 and 1-1-85-SP-243. Since receiving this list, the proposed disposal areas have been slightly revised as shown in the enclosed plates. The selected plan of improvement involves modifications to three lengths of the project reach. (1) New York Slough to Junction Point (Channel Mile 15.0) - This portion of the channel would be deepened from 30 to 35 feet, and the width would increase from 300 to 350 feet. (2) Junction Point to Entrance of Manmade Channel (Channel Mile 18.6) - The width would remain 300 feet in this reach, and the depth would be increased from 30 to 35 feet. (3) Channel Mile 18.6 to the Port of Sacramento - This portion would be deepened from 30 to 35 feet, and the width increased from 200 to 250 feet.

Please contact Mr. Howard Aubertin at 551-2051 for any changes in disposal area location. The endangered species information we are requesting from you will assist us in responding to the Endangered Species Act, as amended, and in our continued studies for the project. We would appreciate a reply within 30 days.

Sincerely,

Walter Yep
Chief, Planning Division

Enclosure

C-090830

C-090830

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825-1846

DEC 20 1985

Mr. Walter Yep, Chief
Planning Division
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, Calfornia 95814

Subject: Revised List of Endangered and Threatened Species for the Sacramento River Deep Water Ship Channel (Case No. 1-1-86-SP-93)

Dear Mr. Yep:

This letter and attached list of endangered and candidate species responds to your request of 6 December 1985 and revised maps of disposal areas for the project. Based on the maps and field survey of 13 December 1985, we no longer believe that the Delta green ground beetle, Solano grass, or Antioch Dunes evening primrose may be affected by this project. The only listed species that now may be affected is the salt marsh harvest mouse on sites S21 and S35. Please contact Pete Sorensen or Jack Williams if we may be of further assistance.

Sincerely,

for Gail C. Kobetich
Project Leader

Attachment

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
SESO Case No. 1-1-86-SP-93

Listed Species

Mammals

Salt marsh harvest mouse, *Reithrodontomys raviventris* (E)
(found in downstream sites, e.g., S21 and S35)

Proposed Species

None

Candidate Species

Mammals

Suisun shrew, *Sorex ornatus sinuosus* (2)

Birds

California black rail, *Laterallus jamaicensis coturniculus* (2)

Plants

Suisun aster, *Aster chilensis* var. *lentus* (2)
Suisun thistle, *Cirsium hydrophilum* var. *hydrophilum* (1)
California hibiscus, *Hibiscus californicus* (2)
Delta-tule-pea, *Lathyrus jepsonii* subsp. *jepsonii* (2)
Mason's lilaeopsis, *Lilaeopsis masonii* (2)

(E)--Endangered (T)--Threatened (CH)--Critical Habitat
(1)--Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)--Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

Addendum to the

Sacramento River Deep Water Ship Channel

Endangered Species

Biological Data Report

January 1986

1. Introduction. - The Biological Data Report (BDR) reflects an analysis of the potential impacts of the Sacramento River Deep Water Ship Channel (SRDWSC) deepening and widening project on Federally listed endangered and threatened species and candidate species. The BDR analysis was based on the project description in the draft SRDWSC General Design Memorandum and Supplemental Environmental Impact Statement dated August 1985. A March 19, 1985, list of Federally listed endangered and threatened species and candidate species was provided by the U.S. Fish and Wildlife Service Endangered Species Office (ESO) and used in the analysis. This March 1985 list included three listed endangered species (salt marsh harvest mouse, Solano grass, Antioch Dunes evening primrose), one threatened species (Delta green ground beetle), and seven candidate species (Suisun shrew, California black rail, Suisun aster, Suisun thistle, California hibiscus, delta tule pea, and Mason's lilaeopsis). Two other species, the threatened valley elderberry longhorn beetle and the rare Sacramento anthicid beetle were also investigated although they were not listed by the ESO.

2. Re-analysis of Impacts to Endangered and Threatened Species. - An updated list of Federally listed endangered and threatened species was received from the ESO on December 20, 1985 (see Attachment). Based on revised dredged material disposal (DMD) sites and a December 13, 1985, field survey attended by Corps and ESO personnel, the Delta green ground beetle, Solano grass, and Antioch Dunes evening primrose were deleted from the December 1985 list. Both the Delta green ground beetle and Solano grass are associated with vernal pool habitat. The BDR reported that only DMD site 13 contained vernal pools. However, on the December 13, 1985, field survey, the ESO determined that DMD site 13 did not contain vernal pools. The March 10, 1985, ESO list had reported possible occurrences of the Antioch Dunes evening primrose at DMD site 15. This disposal site had been eliminated from the project plan earlier, due to economic infeasibility. Field investigations found no evidence of these species at other sites in the project area. Based on all this data it was determined that the project would have no adverse impacts on these species.

Endangered Species

Project boundaries for DMD sites 21 and 35 were realigned to avoid permanent impacts to existing wetlands, much of, but not all of which contain known and potential salt marsh harvest mouse habitat. These wetlands will not be used for DMD disposal or construction activities. Contract plans and specifications will require that the wetland on DMD site 21 be entirely avoided.

Temporary impacts will occur to the wetland adjacent to S-35 where discharge and outlet pipes will be placed for access to the disposal site during the construction period. Contract plans and specifications will require that these pipes be located on areas containing unsuitable salt marsh harvest mouse habitat, if possible. Access to the DMD site will be located on the least environmentally sensitive areas. Prior to construction, field visits and evaluations will be made to identify the best locations for the pipes to cross the wetland. A Corps biologist, in consultation with the ESO will participate in these visits and evaluations. The contract plans and specifications will identify exact locations of pipe placement. A construction inspector and Corps biologist will conduct field investigations during construction to insure compliance with these requirements. Upon completion of the project, the contractor will be required to restore the access locations to preproject conditions. A Corps biologist will a conduct post construction evaluation assessing the contractor's compliance with these environmental requirements, along with a follow-up visit one year after completion of the construction to evaluate natural recovery of the site. If site recovery is not adequate, the biologist will develop a revegetation plan to be implemented by the Corps.

Candidate Species

The BDR reported possible minor impacts to the delta tule pea due to construction and maintenance dredging in the natural channel as a result of the use of pipelines and other machinery at DMD sites at Rio Vista, Sherman Island, and an area downstream of Grand Island. The report also predicted possible minor impacts to Mason's lilaeopsis due to construction activities in the natural channel below Cache Slough, if care is not taken to avoid clay benches with dredge pipelines and other machinery. Areas of specific concern are shoreline near Collinsville, Grand Island, Decker Island, and the mitigation site at Prospect Island.

Construction and access will be designed to avoid or minimize impacts to candidate species. Exact locations of candidate species will be determined by a Corps biologist, in consultation with the ESO, and will be noted in the contract plans and specifications. Discharge pipes and outlet pipes will be located in the least environmentally sensitive areas to avoid or minimize impacts to candidate species. A construction

inspector and Corps biologist will conduct field investigations during construction to insure compliance with these requirements. Upon completion of the project, the contractor will be required to restore the access locations to preproject conditions. A Corps biologist will conduct a post construction evaluation assessing the contractor's compliance with these environmental requirements, along with a follow-up visit one year after completion of the construction to evaluate natural recovery of the site. If site recovery is not adequate, the biologist will develop a revegetation plan to be implemented by the Corps.

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

ENDANGERED SPECIES

BIOLOGICAL DATA REPORT

U. S. Army Corps of Engineers
Sacramento District

September 1985

C-090836

C-090836

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
ENDANGERED SPECIES BIOLOGICAL DATA REPORT

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8.0 APPENDICES

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B. The Federal Program (an explanation of terms and processes for listing endangered species under the Federal Endangered Species Act of 1973)

C. Rare Plant Surveys: Techniques for Impact Assessment by James R. Nelson (endorsed by the California Native Plant Society)

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Plate 7. North end of Grand Island Area I which extends to the right 1/2 mile, a portion shown below.

Plate 8. View to north from midpoint of Area I, Grand Island.

Plate 9. The only remains of sand slip facing on Grand Island.

Plate 10. Vegetation (willow and cottonwood) typical of stabilization areas II and III of Grand Island.

Plate 11. Windswept Sandy Beach study area between Montezuma Hills and Sacramento River as viewed from Brannon Island Recreation Area.

Plate 12. Sandy Beach study area from dike road, mostly void of vegetation.

Plate 13. South end of Sandy Beach study area showing dried mud bed - river at right.

Plate 14. One of two sand slip faces and major vegetation of above study site. Sacramento River shows from this midpoint view.

Plate 15. Grand Island Area III as viewed from NW corner of study site. Elderberry thicket shows in center of dark vegetation.

Plate 16. Site 13 near Rio Vista Airport showing typical grass cover. Northview from midpoint of site.

Plate 17. Site 13, old sand removal area. Southeast view from near midpoint of site.

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SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

ENDANGERED SPECIES
BIOLOGICAL DATA REPORT

1.0 INTRODUCTION

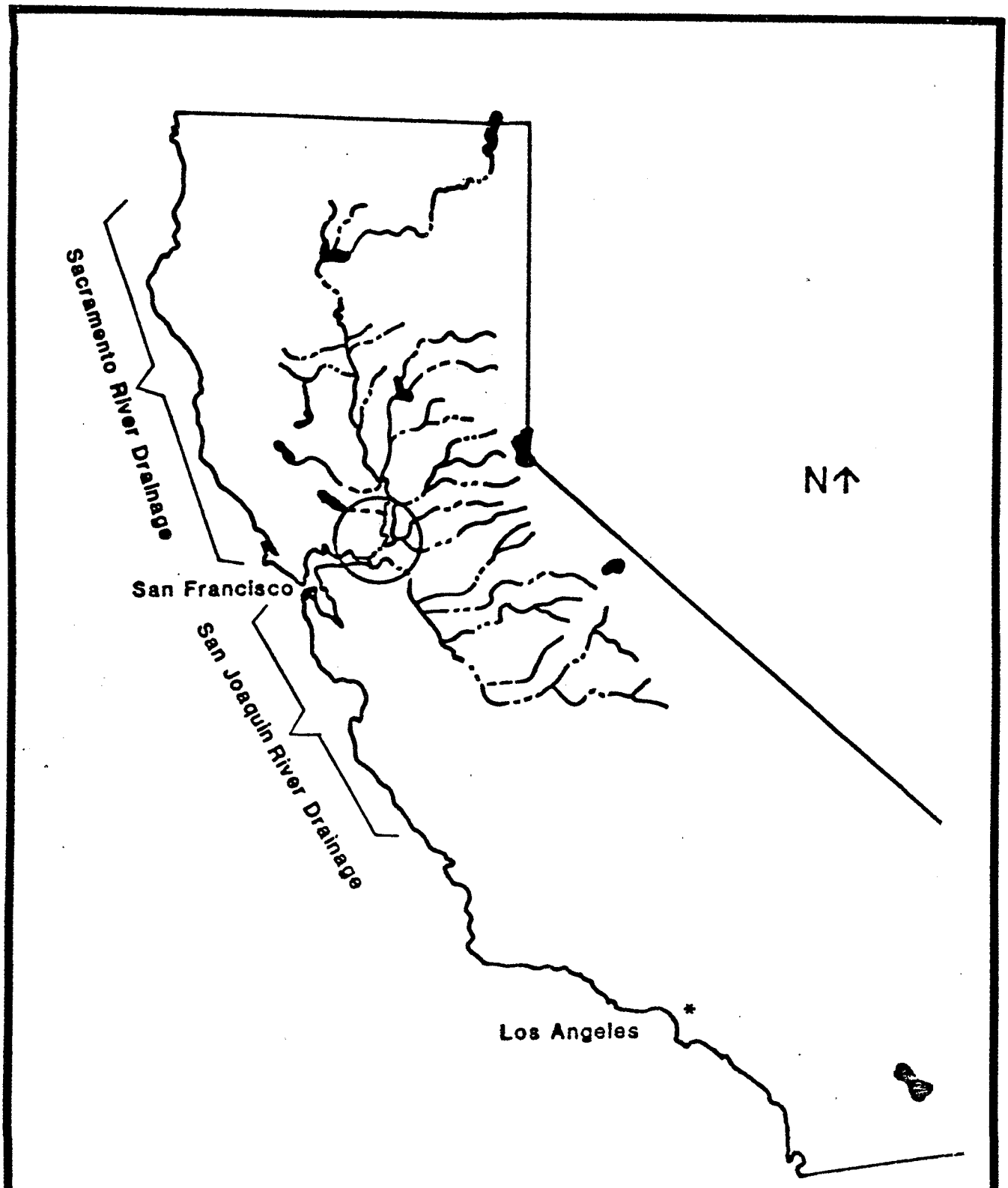
1.1 PURPOSE AND NEED

Pursuant to section 7(c) of the Federal Endangered Species Act (Act), as amended (16 USC 1531-1542), this report documents the results of a biological assessment of the plant and animal species of concern within the area of a construction project proposed by the U.S. Army Corps of Engineers (COE). The proposed project is the deepening and widening of the Sacramento River Deep Water Ship Channel in Sacramento, Solano, and Yolo Counties (Figure 1-1). For this assessment, the COE requested a list of species of concern from the U.S. Fish and Wildlife Service (FWS) - Endangered Species Office (ESO) in October 1984. Since the biological assessment was not initiated within 90 days, a revised list was requested in March 1985 (Appendix A).

Contained within this report are descriptions of all species, current legal status, historic and present distribution, habitat requirements, and status of populations in the study area. Also included in this report are an outline of the methodology, the possible reasons for the decline in the populations, and an analysis of the potential impact of the project on the species of concern.

The Federal species of concern include three listed species with endangered status, one listed species with threatened status, no proposed species, and seven candidate species (Appendix A). Federally listed taxa, legally protected under the Act, require formal consultation with FWS to determine the nature and significance of any project impacts to them and to determine the need and possibility for mitigation. Federally proposed taxa are subject to a full biological assessment because of the potential for their becoming listed and requiring formal consultation. Although candidate taxa hold no legal standing, they are frequently evaluated with the possibility of holding informal consultation with FWS, because of their uncertain or potentially changeable status (Appendix B).

The Act defines the following terms as shown below, and these Federal definitions are used throughout this document. Other definitions of the same terms may be found in other statutes or policies regarding plants or animals of special status such as the California Endangered Species Act of 1970. Non-federal definitions will not be used in this report unless otherwise specified.



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VICINITY MAP

SCALE: 1:10,000,000 FIGURE 1-1.

Candidate - refers to those species currently under review by FWS but neither Threatened nor Endangered.

Category 1 - refers to those candidate taxa for which FWS has sufficient biological information to support a proposal.

Category 2 - refers to those candidate taxa for which existing information indicates that listing it may be warranted, but for which substantial biological information to support a proposed ruling is lacking.

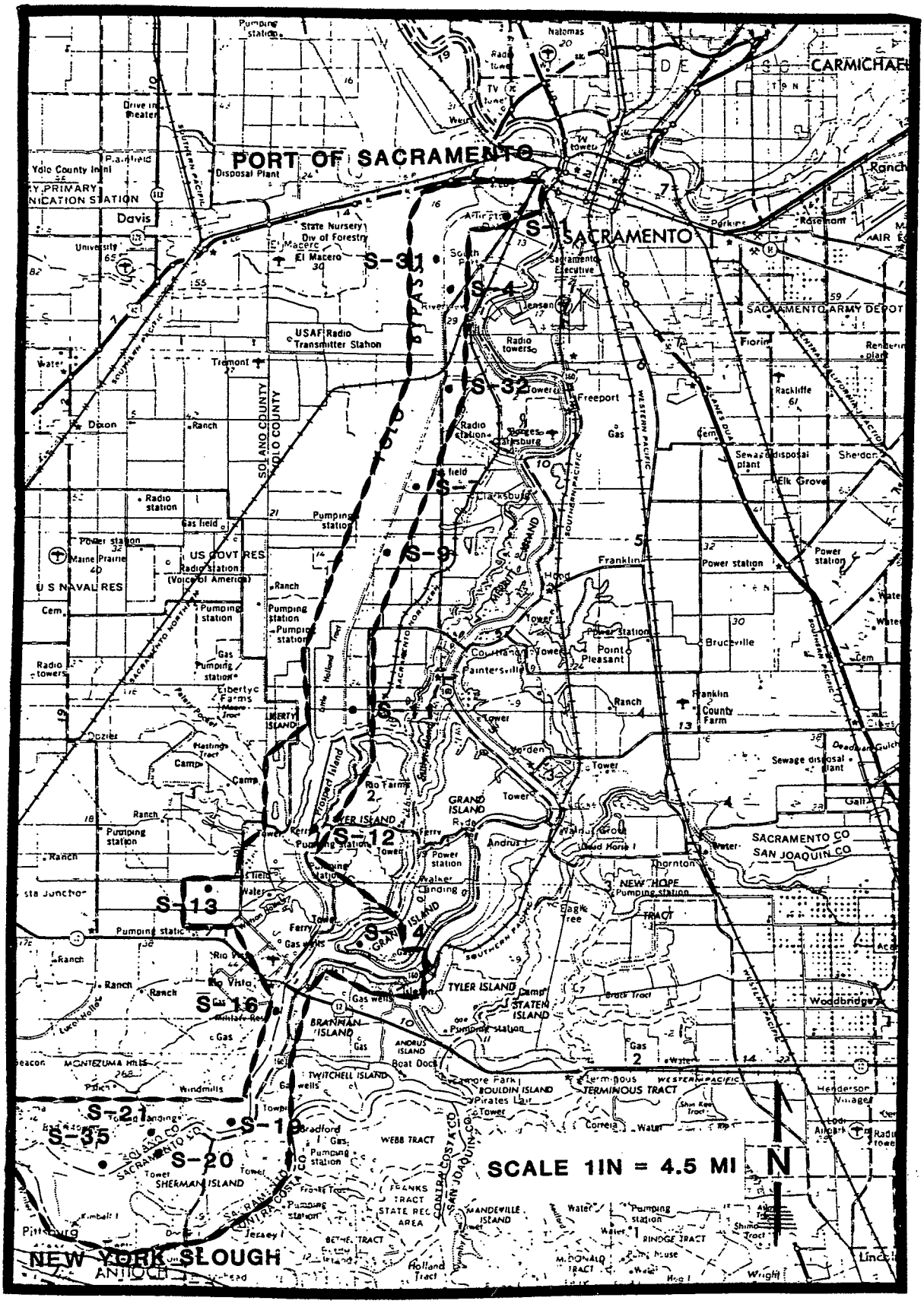
Endangered - refers to any species which is in danger of extinction throughout all or a significant portion of its range, other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man.

Threatened - refers to any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

1.2 STUDY AREA

The Sacramento River Deep Water Ship Channel (DWSC) study area extends from the Port of Sacramento (channel mile 42.0) south to New York Slough. (channel mile 0.0) and approximately one mile east and west of the Sacramento River Deep Water Ship Channel (Figure 1-2). For purposes of this report, the study area includes all the lands within the boundary on Figure 1-2. The project area includes: 1) 25 feet shoreward on either side of the man-made channel between channel miles 18.6 and 42.0, 2) the dredged material disposal sites (DMD), and 3) the mitigation parcel on Prospect Island (S-12) and surrounding shoreline habitats (Figure 1-2). The distinction between study area and project area is important in order to distinguish between status of plants in the study area and actual impacts of the project on a species. For example, a plant that is found in the study area may not be affected by the project activities because it is not within the project area as described above.

Historically, much of the study area was grassland, vernal pool, and riparian habitat (Figure 1-3). With the construction of levees, many of the lands were slowly converted to agricultural uses. The present uses of



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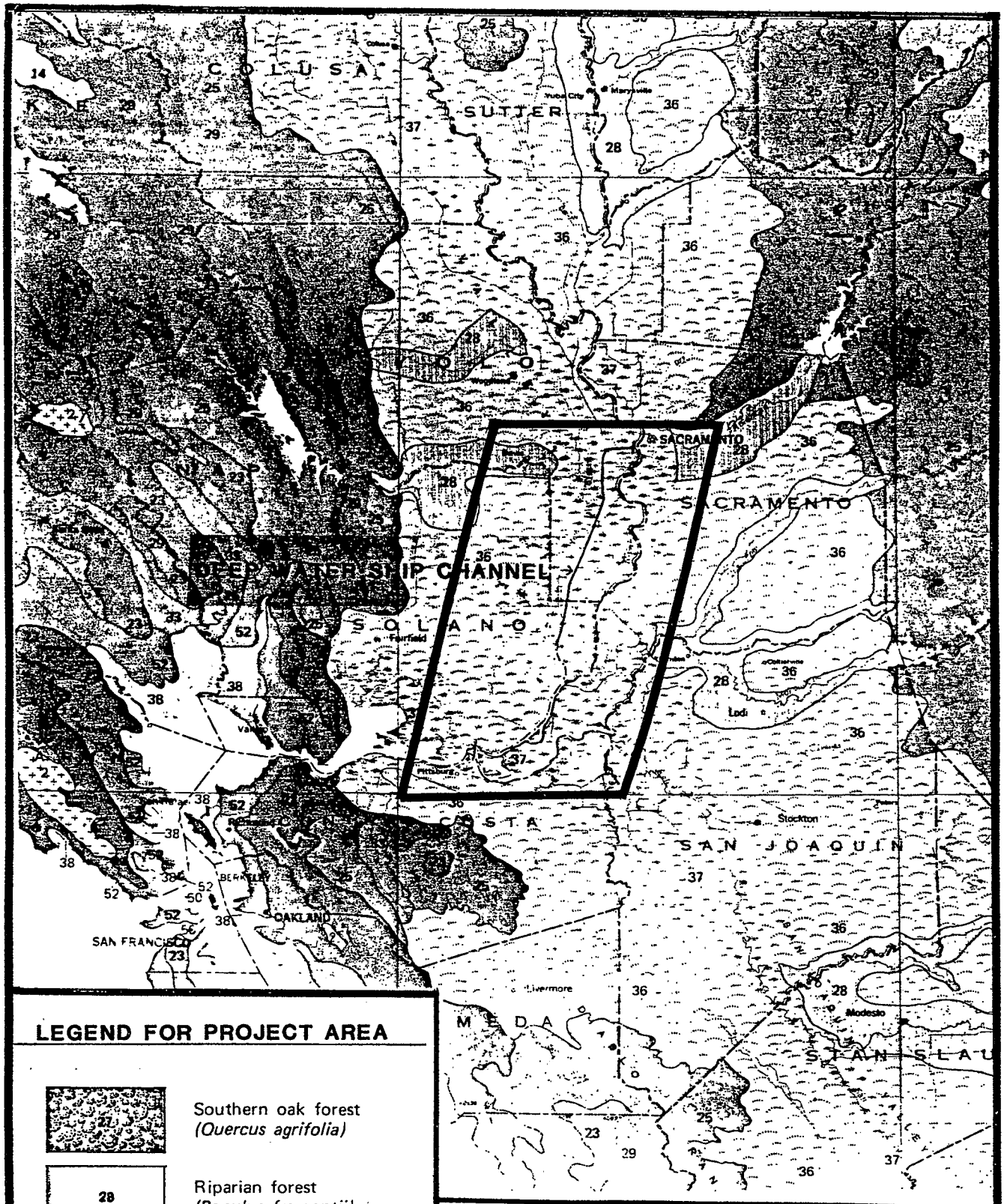
STUDY AREA AND DREDGED MATERIAL DISPOSAL SITES.

FIGURE 1-2.



LEGEND FOR PROJECT AREA

- 27 — Southern oak forest *(Quercus agrifolia)*
- 28 — Riparian forest *(Populus fremontii)*
- 36 — California prairie *(Stipa spp.)*
- 37 — Tule marsh *(Scirpus-Typha)*

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NATURAL BIOTIC COMMUNITIES OF STUDY AREA

SCALE: 1:250,000 FIGURE 1-3.

the lands within the study area are grazing and dry land farming, agriculture, recreation, private docks and marinas, and some residential/commercial uses. The northwest portion of the Grand Island DMD site (S-14) is a permanent sand extraction facility because it is used for maintenance dredged material disposal. Most of the ship channel is tidally influenced, and mudflats and some emergent marshes have developed near Lake Washington (S-1) and on the river banks downstream of Cache Slough. There is a narrow strip of marsh in some areas of the man-made channel where the bank and/or bench has slipped, providing an elevation suitable for marsh development.

1.3 DESCRIPTION OF THE PROJECT

1.3.1 Location

The proposed DWSC project area is located in Sacramento, Yolo, and Solano Counties within, and on lands near the existing deep water ship channel and the Sacramento River from the Port downstream to approximately New York Slough (Figure 1-2). The proposed activities consist of construction dredging, maintenance dredging, mitigation excavation, and dredged material disposal.

1.3.2 Construction Features

Deep-draft navigation improvements would consist of widening and deepening the existing channel from New York Slough (channel mile 0.0) to the Port of Sacramento (channel mile 42.0). Approximately 22 million cubic yards (MCY) of dredged material would be excavated from the navigation channel. The dredged material would be pumped a maximum of 10,000 linear feet to fifteen disposal sites located on both sides of the channel (Figure 1-2). Approximately 4,464 acres of land are being evaluated as potential dredged material disposal sites (DMD), although the entire DMD capacity of these sites (30 MCY) is not required for construction disposal (22 MCY). Most proposed DMD sites have been at least partially used for disposal in the past, either during the original construction of the channel or during subsequent maintenance dredging.

1.3.3 Operation Features

Six DMD sites will be used for periodic maintenance DMD (S-1, S-14, S-16, S-19, S-31, and S-32), although the disposal sequence will be staggered and the sites will not be filled to capacity. Maintenance dredging will be required approximately every two to three years in some portions of the project area, but the channel will be dredged one segment at a time. Other portions may be dredged every seven to ten years or as conditions require.

1.3.4 Mitigation Features

To mitigate the loss of wetland and upland habitat along the channel and within the proposed DMD sites, 63 acres of agricultural land will be converted to wetland habitat at the downstream end of Prospect Island (S-12)

(Figure 1-2). The proposed mitigation wetland will be constructed by building a cross levee across Prospect Island, excavating the existing agricultural land, and breaching the levee thereby flooding the 63 acres. Several islands will be created within the excavated area resulting in a mosaic of low shrub riparian, freshwater marsh, and open water habitat (Figure 1-4). It is assumed that there will be no significant impact to the marsh habitats now existing along Miner's Slough and in the man-made channel along Prospect Island.

2.0 METHODOLOGY

2.1 LITERATURE REVIEW

The initial source of information was the FWS (J. Bartell, 1984). From the FWS list (Appendix A) and the reports on file at the agency, a set of possible data sources was compiled.

Local libraries and herbaria were consulted for pertinent references and historic records on the species of concern. Recently published documents on endangered species within the Sacramento-San Joaquin watersheds were relied on to provide a base of information on many of the species and then a data request was made to the Natural Diversity Data Base in Sacramento. Other sources of information, literature, and maps are listed in the reference section of this report.

2.2 PERSONAL INTERVIEWS

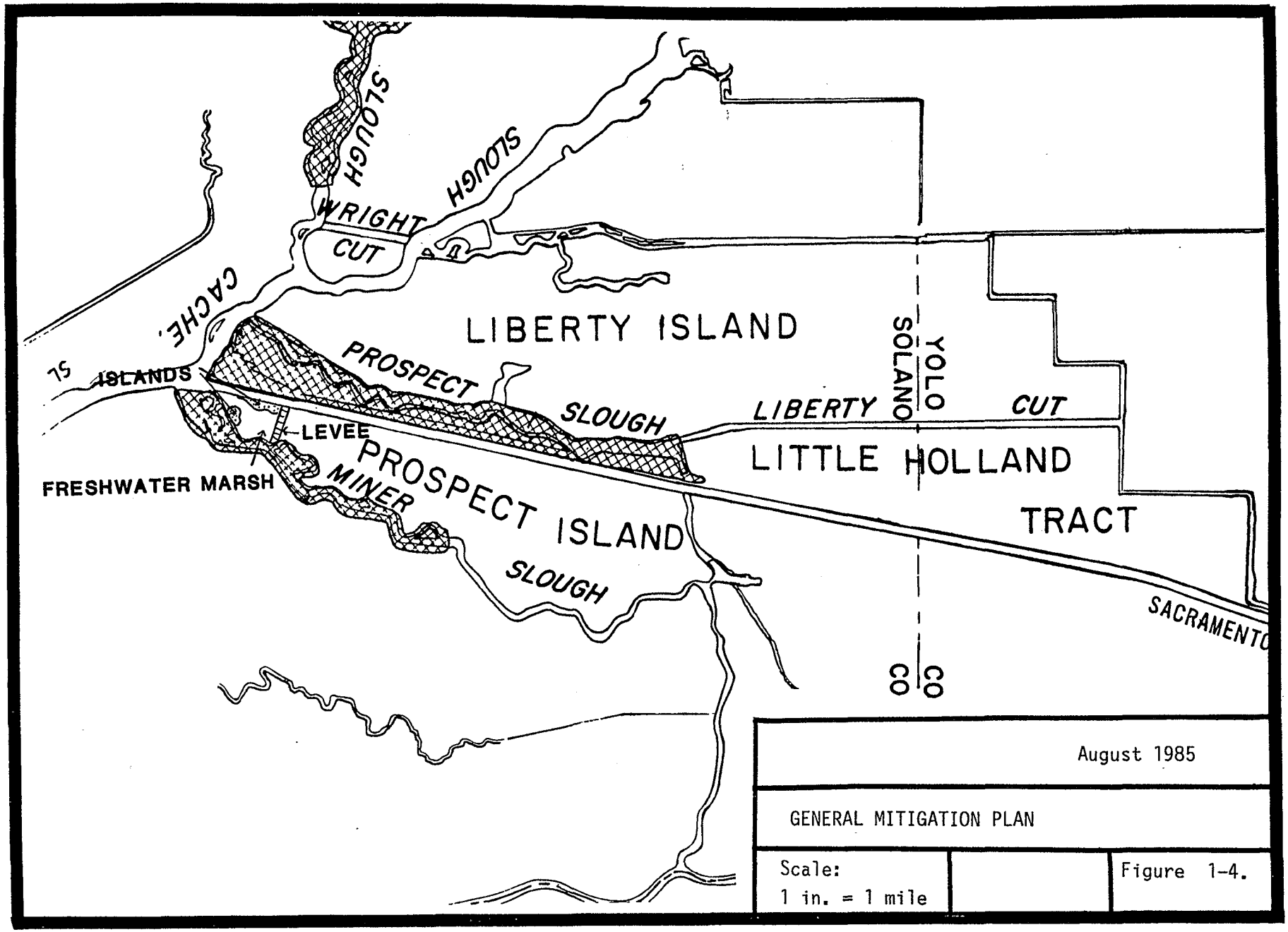
Individuals from the various universities and herbaria, as well as resource agency personnel, were consulted for their opinions and information regarding the occurrence of these species of concern. It was found that several of the species had little historic record or documented information; therefore, the personal interviews were of prime importance. The researchers contacted during the preparation of this report and their contributions are recorded in the Coordination section of this report.

2.3 FIELD STUDIES

Field surveys of selected portions of the study area were made on numerous occasions during the months from November 1984 through August 1985. The surveys were conducted as appropriate to the plant or animal species being investigated. The entire study area was generally surveyed by car and on foot in February 1985 and by boat in June 1985 to identify potentially important habitats, specifically, high quality wetland, riparian, and sand dune habitats. Ground surveys were made to check all of the known species locations and to identify other potentially important areas.

No trapping was done for the salt marsh harvest mouse, Suisun shrew, or California black rail. The study methods for fauna are described in the "Surveys in the Project Area" section of this report.

The plant surveys were conducted according to Nelson's method for rare plant surveys (Appendix C). Each of the DMD sites was assessed by habitat type and then specifically searched in areas where potential habitat for the plant species of concern was found. The plants were searched for during



August 1985		
GENERAL MITIGATION PLAN		
Scale: 1 in. = 1 mile		Figure 1-4.

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their peak flowering time (Figure 2-1) and repeat visits were made if species identification was impossible (i.e., not flowering). Any plants collected and positively identified as a species of concern were submitted to the Jepson Herbarium at the University of California at Berkeley.

3.0 RESULTS AND DISCUSSION

3.1 OVERVIEW OF SPECIES OF CONCERN

An overview of known occurrences of the species of concern surveyed in this report is presented on Plates 1-6. Each plate shows a reach of the study area, the critical habitats, known locations, and an indication of abundance of where it is known.

The Federal list lists one endangered mammal, one threatened insect, and two candidate faunal species - one small mammal and one bird. Other species considered rare or unusual by the State of California include a variety of mammals, reptiles, and insects (DFG, 1980; COE, 1979). One insect, investigated in the preparation of this report, is the Anthicid beetle (*Anthicus sacramento* and *A. antiochensis*). This report discusses the status of this insect since it was found in the study area during the preparation of previous reports on the project (COE, 1979; COE, 1985), but it is not listed by either the FWS or the State.

The federal list of rare and endangered plant species includes two endangered species: an unusual grass and a shrub with extremely specific habitat requirements. Five other species are under consideration for federal listing, but there is insufficient data about their status to support a ruling. The State of California, the Smithsonian Institute, and the California Native Plant Society each have lists of plant species of concern that were also considered in the preparation of this report, but no textual discussion of these is presented (CNPS, 1984; DFG, 1984).

All known occurrences are recorded for reference to range and distribution within the study area (Plates 1-6).

3.2 FAUNA

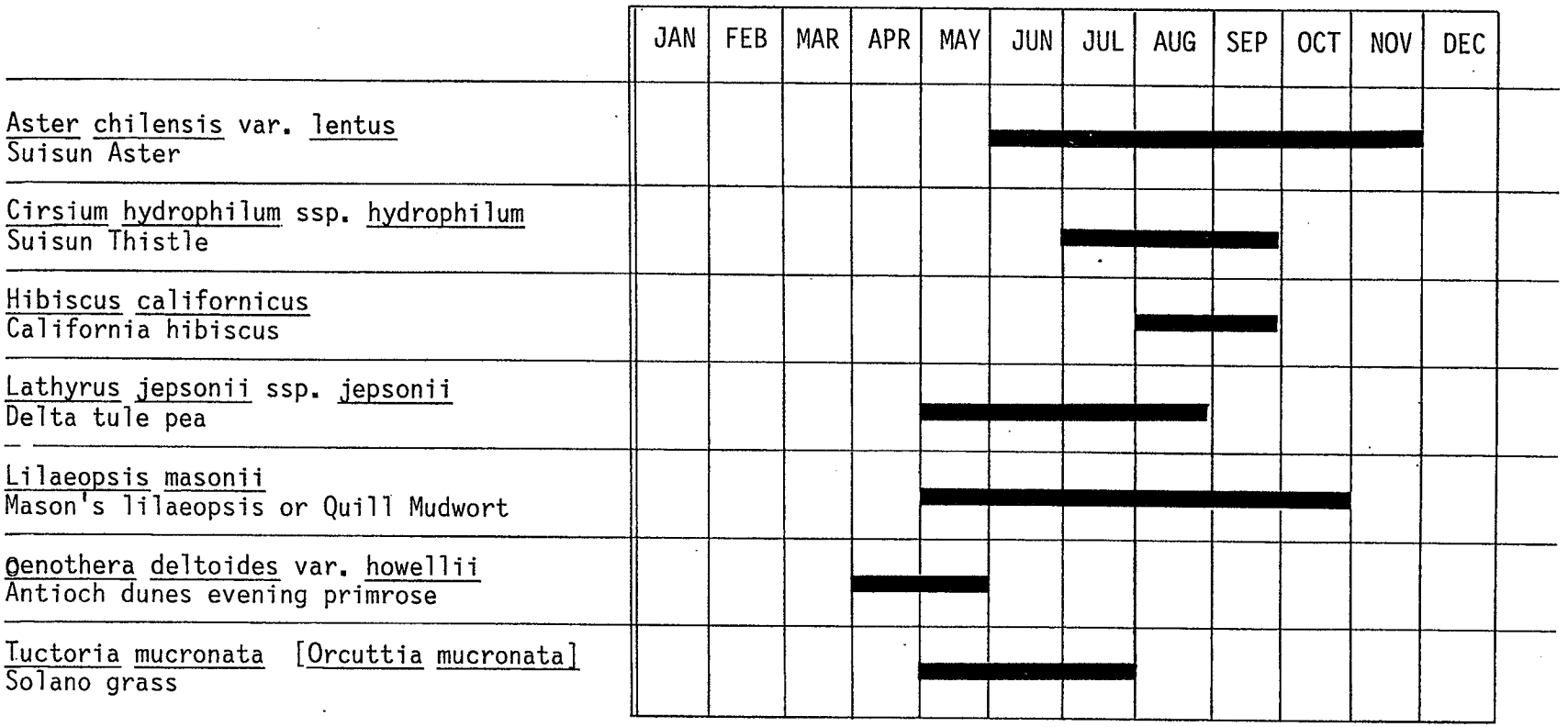
3.2.1 Salt Marsh Harvest Mouse *Reithrodontomys raviventris*

Legal Status. The salt marsh harvest mouse is listed as endangered by both the FWS (1980) and the California Department of Fish and Game (DFG) (1978).

Distribution.

Historical. Salt marsh harvest mouse (SMHM) evolved with the creation of the San Francisco Bay some 8,000-25,000 years ago (Shellhammer, et al., 1984). Fisler (1965) indicated that SMHM were probably found in most of the marshes throughout the San Francisco Bay. The wetlands and marshes of the original Sacramento-San Joaquin Delta were probably too fresh to support these mice. The Collinsville-Antioch area was probably the eastern limit of their distribution, as it is today (Shellhammer, et al, 1984).

Figure 2-1. Outline of flowering periods for the plant species of concern in the DWSC study area.



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Present. The SMHM is presently found in the saline and brackish emergent wetlands of San Francisco Bay and its tributaries. There are two subspecies. The northern subspecies, R. raviventris halicoetes is found on the Marin peninsula, through the Petaluma, Napa, and Suisun Bay marshes, and in northern Contra Costa County (Figure 3.2-1). The southern subspecies, R. raviventris raviventris is mostly restricted to a band extending from San Mateo County and Alameda County south along both sides of San Francisco Bay to Santa Clara County, but isolated populations occur in Marin and Contra Costa Counties. Pickleweed-dominated wetland is the preferred habitat (Shellhammer, 1977) where R. raviventris may be locally common. Grasslands adjacent to pickleweed marsh are used, but only when the new grass growth affords suitable cover in the spring and summer months (Fisler, 1965; Shellhammer, 1982; and DFG, 1985c).

Habitat Requirements. SMHM use pickleweed-dominated plant communities as their primary habitat. The value of pickleweed increases with depth, density, and the degree of intermixing with fat hen (Atriplex patula var. hastata) and alkali heath (Frankenia grandifolia) (Shellhammer, 1982). Pickleweed is the primary habitat, but non-submerged salt-tolerant vegetation (peripheral halophytes) for escape during highest tides is essential (Shellhammer, et al, 1982).

Some movement of individuals from pickleweed marsh to higher grassland occurs in the spring and summer, or otherwise as plant cover affords escape from predators. These movements are likely to occur daily and do not represent complete shifts in habitats. The movement of individuals between marshes does not seem to occur (Shellhammer, 1977).

The distribution and abundance of the SMHM are dependent on the availability of dense pickleweed salt marsh. Both the northern and southern subspecies co-occur with the closely-related western harvest mouse Reithrodontomys megalotis, at the upper edges of marshes and in marginal areas. Both the SMHM and the western harvest mouse may be found in pickleweed, although R. raviventris excludes or replaces R. megalotis in denser stands. The abundance of R. megalotis increases with predominance of annual or perennial grassland.

There are little data on feeding by SMHM, but they probably subsist on leaves and stems of plant species found in the salt marsh. There is much seasonal variation in stomach contents (Fisler, 1965). In winter, fresh green grasses seem to be preferred. The rest of the year, pickleweed and salt grass are the main food sources. The herbivorous diet of R. raviventris in comparison with R. megalotis is reflected in a significantly greater intestine length (Fisler, 1965). Free water is required, but both subspecies are capable of drinking pure sea water. R. r. halicoetes is capable of drinking pure sea water (Fisler, 1963; Haines, 1964), but R. r. raviventris selects water with salinities between fresh and sea water, leaning toward sea water (Fisler, 1963, 1965). The differences probably relate to the normal salinity levels in the salt water available to natural populations.

Salt marsh harvest mice do not burrow. Nests of grass and sedge built on the ground are associated with the north bay subspecies and are similar to those constructed by R. megalotis. The south bay subspecies seems to do little nest-building, but it may construct a loosely organized nest of dry grasses (Fisler, 1965; Shellhammer, 1982). The south bay form (R. r.

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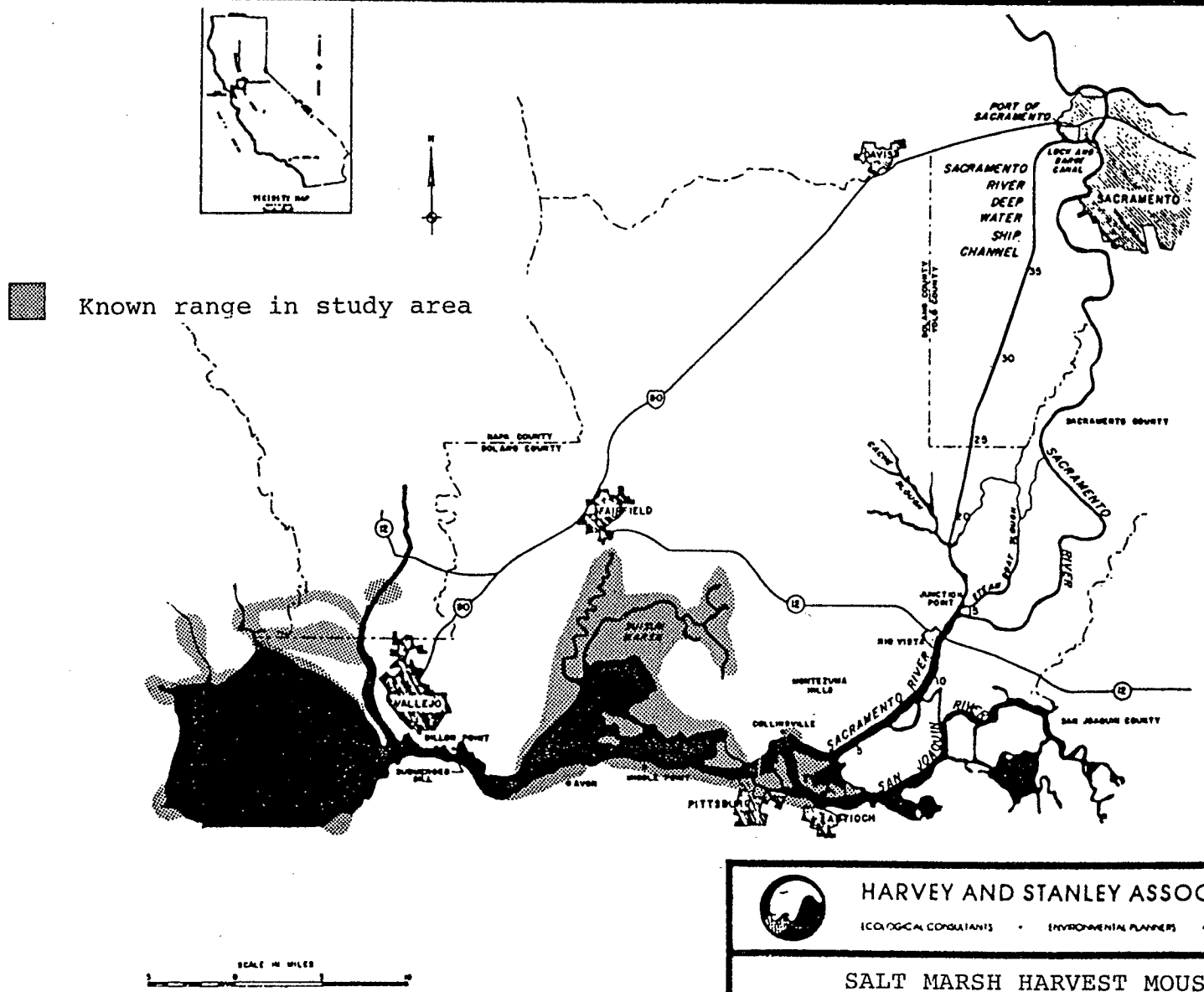

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SALT MARSH HARVEST MOUSE:
KNOWN LOCATIONS

File No 265-01	Date 8/16/85	Figure 3.2-1

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raviventris) breeds mostly from March to November. The north bay form (R. r. halicoetes) breeds from May to November (Fisler, 1965). Litter size averages around four young for both forms. R. r. raviventris may produce two litters each year, but the shorter breeding season for R. r. halicoetes suggests this form has only one litter per year (Fisler, 1965). There are no data regarding the age of weaning of the young, or the age of sexual maturity.

Salt marsh harvest mice are primarily nocturnal, but between 15 and 20 percent of daily activity recorded under laboratory conditions was between sunrise and sunset (Fisler, 1965). Most of this daylight activity occurred in the afternoon. The south bay subspecies (R. r. raviventris) can become torpid, particularly in the early morning hours. Neither the north bay subspecies (R. r. halicoetes) nor the closely related western harvest mouse (R. megalotis) share this characteristic (Fisler, 1965).

There are no data regarding home range or territory size for either subspecies. Predators include owls (Johnston, 1956), hawks, gulls, weasels, and probably other mammalian predators when mice use the grasslands. There are also several documented instances of salt marsh harvest mice being eaten by another endangered species, the California Clapper Rail (Rallus longirostris obsoletus).

Reasons for Decline in Populations. The draft recovery plan for the SMHM (Shellhammer, et al., 1985) listed five principal reasons for the decline of the SMHM. These reasons, which all relate to the commercial and residential development around San Francisco Bay, are as follows:

1) habitat loss;
2) fragmentation of the remaining marshes;
3) widespread loss of the high marsh zone as a result of backfilling;
4) land subsidence;
5) vegetational change.

Marsh loss is mainly attributed to filling, diking, subsidence, and changes in salinity (Shellhammer, 1982). R. raviventris has been especially affected by habitat loss. Vegetational changes over the last three decades, notably the increase of bulrush (Scirpus spp.) and salt grass (Distichlis spicata), and the decline in pickleweed, are attributed to changes in salinity of the marshes, brought about by increasing volumes of sewage water, as well as subsidence-related causes (Wondolleck, et al, 1976, Shellhammer, 1977).

Status of the Population in the Study Area. As has been indicated, the northern subspecies, Reithrodontomys raviventris halicoetes is found in the Suisun marshes, which are at the far western end of the project boundaries. To date, the eastern most populations of SMHM have been found near Collinsville on the north side of the San Joaquin River. Trapping studies were conducted in 1978 for the Pacific Gas and Electric Company (PG&E) near Collinsville (Envirodyne Engineers, 1978; Harvey and Stanley Associates, 1978).

The Collinsville area has been identified in the recovery plan as essential habitat. The area includes two diked-off marshes totaling approximately 132 hectares just northeast of Montezuma Island. The plan proposes to secure and manage the marshes under diked conditions. Conditions

at present are below optimum, and planting or seeding of saltmarsh plants and/or modification of the flooding regime may be required to improve the habitat for the mouse (Shellhammer, et al, 1985).

Surveys in the Project Area. Sites S-35 and S-21 are near the known eastern edge of the distribution of the salt marsh harvest mouse. These two sites were examined for appropriate habitat for the species. Site S-35 is primarily pasture, but there is tidal marsh on the southern edge of the site, along the Sacramento River. This marsh is a mixture of bulrush and some cattail, and does not include pickleweed, the prime habitat for the species. However, at the northern edge of the marsh is an area which ponds seasonally. This fringe area is a mixture of grasses, bare ground, and pickleweed. During surveys of the site in May and June 1985, the pickleweed was in small isolated patches, with little cover, and no large continuous pickleweed areas.

The pickleweed alone is probably not of sufficient cover or abundance to support the salt marsh harvest mouse. Capture of the R. r. halicoetes this year in brackish marsh situations at Antioch, (P. Sorenson, FWS, pers. comm.) has left the question somewhat open with respect to the mouse at site S-35. Other brackish or fresh-water marshes where the salt marsh harvest mouse was found, including Antioch, were contiguous with either tidal or diked pickleweed habitats (H. Shellhammer, pers. comm.). this is not the case at site S-35. Nevertheless, there seems to be significant use of non-prime habitats this year, which may be in part the result of high population levels of the mouse. Therefore, the recommendation was made to trap for the mouse at site S-35. Funding limitations prevented completion of trapping this year.

Site S-21 is also largely grassland. Levees protect most of the site from water from the Sacramento River. However, at the eastern end of the parcel, a marsh exists, fed by surface water runoff from the site, but also apparently from the occasional overtopping of the levee. June field investigations showed evidence of very recent overtopping of a low spot in the levee, as there was 1-2 feet of water in the marsh.

As with site S-35, the recommendation was made to trap in this marsh to determine if the SMHM was present. While the area does not contain prime or even moderate habitat, the precise geographical and habitat limits of R. r. haliocoetes are not clear in light of recent trapping results.

Project Impacts. Both sites S-21 and S-35 are proposed as DMD sites. In both cases, the marshes which are potential habitat are largely avoided by the proposed deposits. At site S-35, some of the seasonally ponded area which contains some pickleweed will be covered. This area and the marsh adjoining it might be habitat for the salt marsh harvest mouse, although it is marginal in nature at best. Without trapping the impacts are impossible to quantify. If this area is included in the final DMD plan, it should be trapped before depositing begins.

At site S-21, a proposal was made to avoid the marsh entirely. If this is done, and no alteration is made to the levee between the marsh and the Sacramento River due to this project, then there should be no impacts to any endangered species in the marsh. There would be no impacts to the marsh under the No-Action plan.

3.2.2 Delta Green Ground Beetle *Elaphrus viridus*

Legal Status. The delta green ground beetle (DGGB) is listed as threatened by the FWS and it has no status with the State of California.

Distribution.

Historic. The historic distribution of DGGB is unknown. It was described in 1878 by Dr. George Horn based on a single specimen. The locality was unknown until the species was rediscovered in 1974 at the Jepson Prairie Preserve. The species may have been widespread in the Central Valley before grazing agriculture converted grassland and wetland habitats.

Present. Today the species is known only from "hogwallow" vernal pools and pastures surrounding Olcutt Lake on the Jepson Prairie Preseve in Solano County (Figure 3.2-2).

Habitat Requirements. Specific details regarding the habitat requirements of the DGGB are unknown. It is found now in the vernal pool habitats of the Jepson Prairie, but this may not be its preferred habitat. Rather, this may represent the only undisturbed grassland areas of what was once a widespread habitat (FWS, 1985).

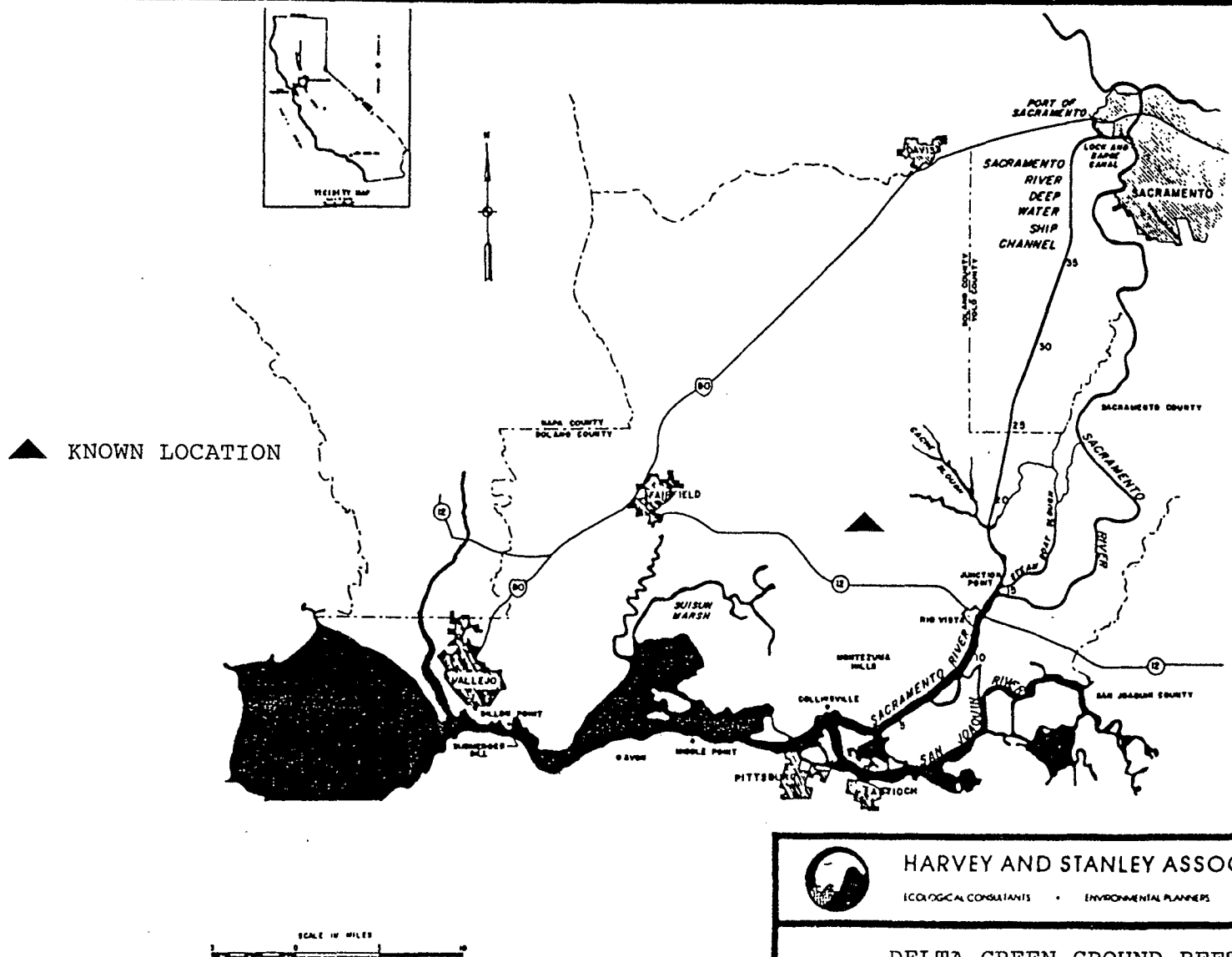
Since its rediscovery, the species has been collected from the margins of vernal pools, on bare ground, and along sheep trails. The adults are small (about one cm) and brilliantly but cryptically colored and are difficult to locate when hiding in low-growing vegetation (Arnold, 1983; FWS, 1985).

The DGGB is apparently active during the daytime and during the warmest part of the day. This is unusual for a carabid, as most other carabids are nocturnal, seeking cover during the day. Adults have been collected from early February to mid-May, and may be active earlier in the winter. This winter activity is unique among *Elaphrus* species, which are typically active in the late spring and summer (Goulet, 1982). Adult *Elaphrus viridus* enter obligate diapause in late spring, as dry weather begins in California. Other *Elaphrus* species diapause in late summer.

Elaphrus viridus is likely a generalized predator, feeding on soft-bodied prey. Terrestrial chironomid (Diptera) larvae may be a major food source for the species. Arnold (1983) speculated that these soft-bodied prey may be widespread in grasslands in the winter but restricted to the margins of vernal pools as summer dries the area.

Other *Elaphrus* species are found in bare or sparsely vegetated areas. The precise habitat requirements of the DGGB are poorly understood, for while a number of adults have been captured in dense vegetation, more sparsely vegetated areas may indeed be the preferred habitat. Detection of prey would be simpler in such areas, and in dense vegetation, cryptic coloration is not much of a benefit. These factors both suggest that more open areas may be the prime habitats (FWS, 1985).

Adults may be strong fliers, which would allow them to locate in the widely dispersed vernal pools and islands or grassland.



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DELTA GREEN GROUND BEETLE:
KNOWN LOCATIONS

File No 265-01	Date 8/16/85	Figure 3.2-2

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Reasons for Decline in Populations. The primary threat to survival of DGGB has been and continues to be the loss of habitat by agricultural conversion, river channelization, dam construction, drainage and pipeline construction, and other means (FWS, 1985).

Status of the Populations in the Study Area. The DGGB is apparently limited to a small population in the vicinity of vernal pools at the Jepson Prairie Preserve. However, as the species went nearly 100 years before its rediscovery at its current location, other similar habitat may also support populations of the beetle. Vernal pool habitat and associated grassland areas should be examined for possible populations.

Surveys in the Project Area. A May 1985 survey of Rio Vista site S-13 was conducted by Dr. Ronald Stecker and Ronald Duke. This survey did not reveal any evidence of *Elaphrus viridis* at the site. The area is mostly pasture with several vernal pools in the northwest corner, (Plates 4, 16, 17). The vernal pools were dry by the time that surveys were conducted, but there was still some water in the drainage ditch which connects the pools to a drainpipe at the northwest corner of the parcel.

One vernal pool is apparently used for watering sheep and cattle which graze the property. This pool is connected to the drainage ditch, but holds water later in the season because of a small man-made rise (less than one foot) at the outlet of the pool. Thus the site is modified (drainage) and disturbed (grazing). While we did not conduct winter or early spring surveys, we found no evidence that there are vernal pools of the "hogwallow" type on the property.

Project Impacts. No individuals are recorded from this site, nor were any observed in the spring of 1985. The site is drained and disturbed, and there do not appear to be any "hogwallow" type vernal pools. Although early spring surveys were not completed, there does not appear to be suitable habitat for the beetle at the site. There should be no impacts to the species by the Selected Plan, which would place dredge material on the parcel. No impacts would occur with the No Action Plan.

3.2.3 Suisun Shrew
Sorex ornatus sinuosus

Legal Status. FWS designates the Suisun shrew as a candidate category 2 species. This status indicates that the Suisun shrew may warrant listing, but additional biological information is needed before a ruling on a proposed status can be made (Appendix B).

Distribution.

Historic. The historic distribution of the Suisun shrew is unknown. Suitable habitat probably occurred along the Sacramento-San Joaquin Delta, the Napa River, and the Petaluma Creek drainages, in addition to the marshes of the San Pablo and Suisun Bays (Williams, 1983). Upland habitats north of the San Pablo-Suisun Bay region are likely too dry for shrews.

Present. Suisun shrews are found in the northern perimeters of San Pablo and Suisun Bays, from Grizzly Island westward to the mouth of Petaluma Creek (Rudd, 1955a)(Figure 3.2-3). Distribution may be more extensive, but recent status surveys (Williams, 1984) have not documented any further distribution.

Habitat Requirements. Suisun shrews are found in tidal salt marshes characterized by pickleweed (Salicornia pacifica), cordgrass (Spartina foliosa), and gumplant (Grindelia humilus). They are also found in brackish marshes dominated by California bullrush (Scirpus californicus) and cattail (Typha latifolia) (Rudd, 1955; Williams, 1983). The structure of the community, not the species composition, appears to be the determining factor in shrew occurrence.

Shrews feed on insects and other invertebrates under driftwood litter and under the dense cover of low-lying vegetation (DFG, 1985b). Driftwood and other litter above the mean high tide line may be essential for nesting and foraging sites (Williams, 1983).

Sorex ornatus is generally active all year long. Most surface activity is nocturnal. Pearson (1959) reported two peaks of activity, one at dusk and another later at night.

Little specific work has been done on the breeding characterisitics of S. o. sinuosus. Rudd (1955a) has described breeding characteristics of S. vagrans. S. vagrans exhibits most pregnancies in March and April, though they may occur from February through October. The litter size is about six, and females may have more than one litter in a year. Most individuals do not live to breed a second year. The information on S. vagrans may not apply to S. o. sinuousus.

Reasons for Decline in Populations. Sorex ornatus sinuousus occurs only in San Pablo and Suisun Bays. It is both less dense and more restricted in distribution than the endangered salt marsh harvest mouse (SMHM). It prefers the dense, low-lying cover of Salicornia. As it is restricted to the same habitats as the SMHM, it may therefore be subject to the same threats.

Management of portions of the Suisun marshes as brackish marsh for waterfowl may pose an additional threat, as with the SMHM. Furthermore, the Suisun shrew is insectivorous and so may require different management techniques than the herbivorous SMHM.

Status of the Populations in the Study Area. The range of the Suisun shrew extends westward at least into the Suisun Bay marshes. Records of animals include specimens from Grizzly Island and its periphery, Suisun City. Trapping conducted by Harvey and Stanley Associates (1978) for PG&E at Collinsville found only a single shrew. Other than these scattered records, little data exist.

Work by Rudd (1955a,b) and Williams (1979), indicates that S. o. sinuosus reaches its eastern most distribution in the vicinity of Grizzly Island. East of this area, S. o. sinuosus apparently hybridizes with S. o. californicus in a zone with spatially intermediate populations. Thus the most likely resident of the study areas in S-35 and S-21 is S. o. californicus, although the precise range has not been established.

Surveys in the Project Area. The sites were surveyed for appropriate habitat for the Suisun Shrew. What little is known about the habitat requirements of the shrews indicates that they require tidal marshes, either salt or brackish marsh. Both sites S-21 and S-35 contain marshes which are not subject to regular tidal inundation, at least in the area which may

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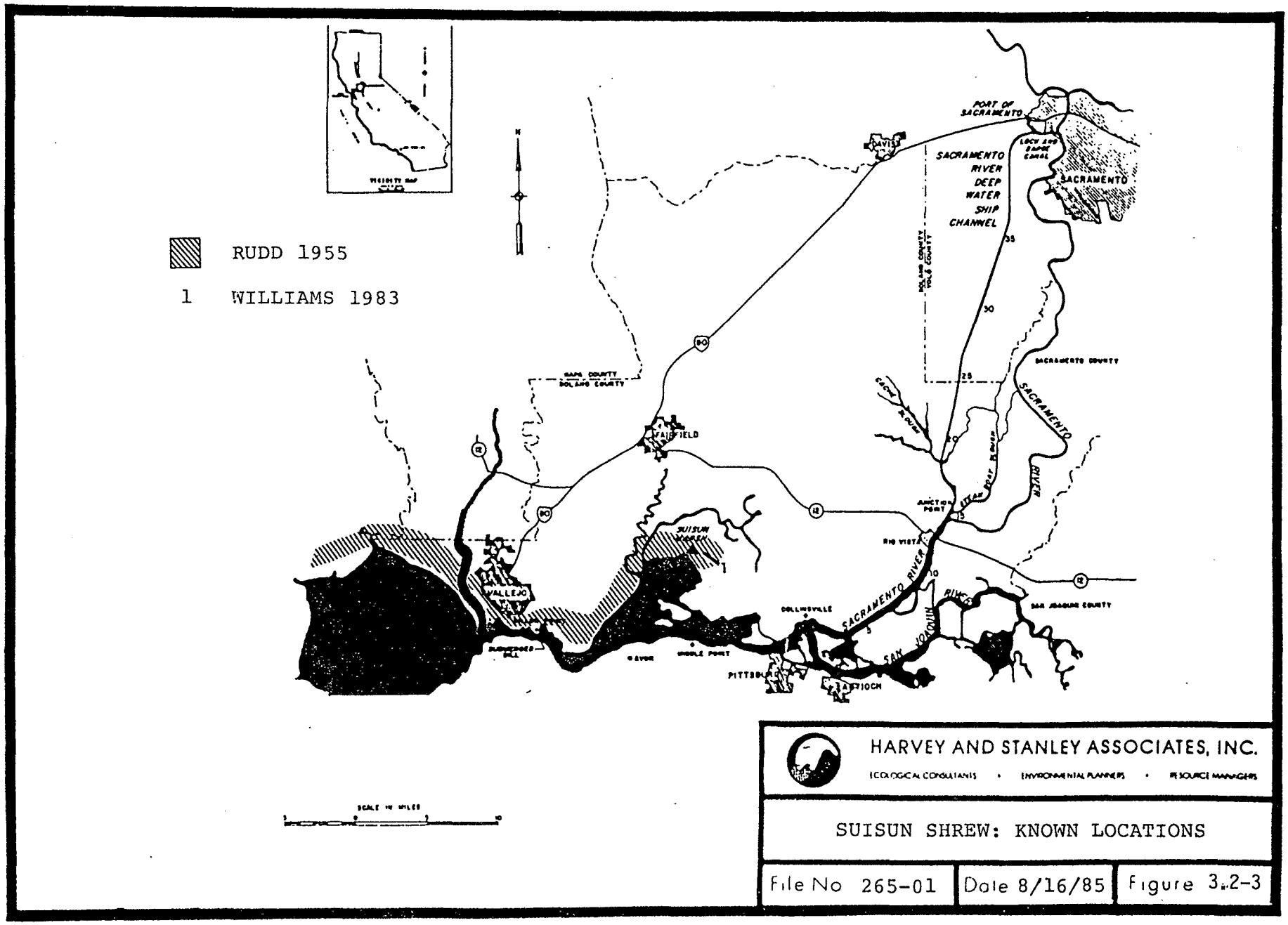

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receive DMD. The habitat was therefore deemed not appropriate and no additional surveys for the Suisun Shrew were recommended.

Project Impacts. Based on the analysis of available habitat, no impacts are predicted from the No Action, or the Selected Plans.

3.2.4 California Black Rail *Laterallus jamaicensis coturniculus*

Legal Status. The California Black Rail (CBR) is a candidate species category 2 according to the FWS, indicating a need for more biological information about the bird. The State of California (DFG, 1978) assigns it a "rare" status which indicates that "although (the species is) not presently threatened with extinction, (they) are in such small numbers throughout their range that they may become endangered if their environments worsen".

Distribution.

Historic. The California Black Rail (CBR) was known to occur from Tomales Bay, Marin County, south along the coast into northern Baja California and in the inland marshes in the Sacramento-San Joaquin Delta (EDAW and WESCO, 1981).

Present. The CBR is a rare, year-long resident of salt, brackish, and freshwater marshes in the San Francisco Bay area, Sacramento-San Joaquin Delta (Figure 3.2-4), coastal southern California at Morro Bay, the Salton Sea and lower Colorado River area. It was formerly a local yearlong resident in coastal lowland marshes from Santa Barbara County to San Diego, where it still winters rarely. The CBR is secretive and elusive, and has never been considered abundant (Wilbur, 1974; EDAW and WESCO, 1981) but few quantitative studies have been conducted. The DFG initiated studies of the species in 1974, in order to determine the breeding status of the species. Breeding CBR were located in Solano, Napa, and San Joaquin Counties (Jurek, 1975 and 1976), and in 1977 Manolis surveyed the San Francisco Bay and Sacramento - San Joaquin Delta for the species.

Habitat Requirements. CBR occur most commonly in tidal salt marshes dominated by pickleweed or brackish marshes supporting bulrushes in association with pickleweed. In exclusively freshwater marshes where CBR occur (e.g. along the Colorado River), bulrushes, cattails, and saltgrass are usually present. CBR were thought to be usually found in the immediate vicinity of tidal sloughs (Manolis, 1977), but recent work by Evens and Page (1983) at the Corte Madera Ecological Preserve showed no preference for such sloughs. Rather, the species was found almost exclusively in tall, dense pickleweed which was relatively open at ground level, at least during the breeding season. Pickleweed salt marshes or pickleweed upper marsh zones of brackish marshes were also found to be preferred habitat by Manolis (1977).

CBR are found in the high marsh zones near the upper limit of tidal flooding and not in low marsh areas with considerable annual and/or daily fluctuations in water levels (DFG, 1985). Along the Colorado River, CBR prefer dense bulrush stands, shallow water, and gently sloping shorelines (Repking and Ohmart, 1977).

During winter high tides, CBR take refuge in dense, tall vegetation immediately adjacent to the salt marsh and above the reach of the tides. At these times, they are especially subject to predation (Evens and Page, 1983). Thus CBR may depend on the zone where the upper marsh vegetation intergrades with peripheral halophytes or upland vegetation for cover.

CBR glean and peck for a variety of arthropods (e.g., isopods and insects) from the surface of mud and vegetation (DFG, 1985a).

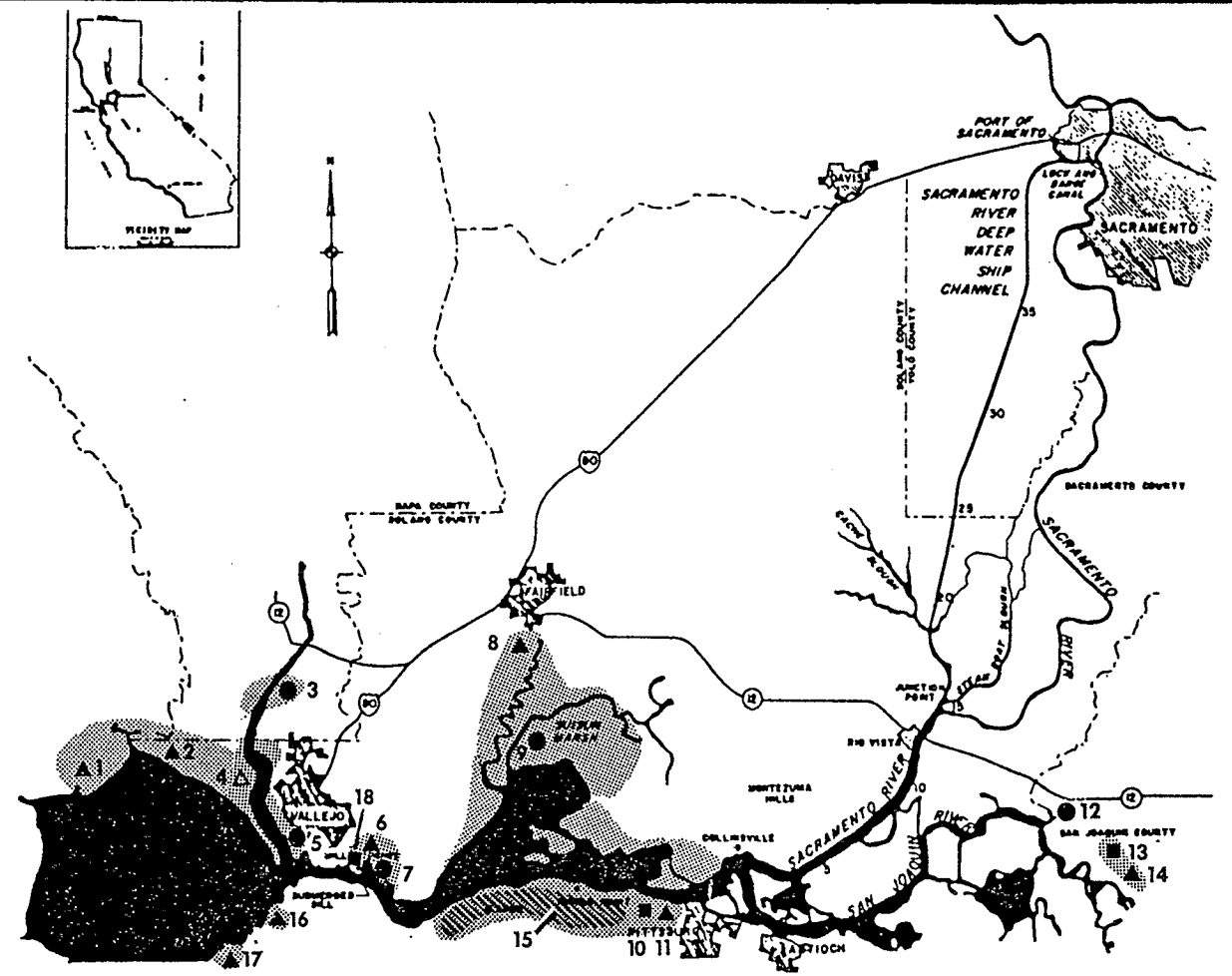
CBR nests are concealed in dense marsh vegetation, such as pickleweed, near the upper limits of tidal flooding (Stephens, 1909) and consist of a loosely-made, deep cup which may be at ground level or elevated several inches high. Nests with eggs have been discovered from 12 March to 4 June (Bent, 1926; Wilbur, 1974). Clutch sizes of birds in California ranged from 3 to 8 and averaged six eggs per clutch (Wilbur, 1974). CBR are single-brooded (Dawson, 1924). They may abandon their nests if disturbed before completing their clutch (Huey, 1916; Heaton, 1937; DFG, 1985).

CBR apparently winter in locations where they do not breed (Manolis, 1978; Garrett and Dunn, 1981; Evens and Page, 1983). Evens and Page (1983) found eleven wintering birds in a marsh which they believe supports no more than two breeding pair. There may also be some post-breeding wandering, as individuals have been recorded during late summer and fall away from marshes (Wilbur, 1974; Ripley, 1977). There does not seem to be an established seasonal migration, however (DFG, 1985).

There are little data regarding density of CBR populations. Evans and LeValley (1981) estimated a population of 150 in an area of unreported size at Port Chicago, Contra Costa County. Jones and Stokes (1982) reported 25 birds in a marsh at the Concord Naval Weapons Center. Repking and Ohmart (1977) reported densities of 1.14 to 1.58 rails per hectare (0.40 to 0.64 per acre) during the spring and 0.73 rails per hectare (0.30 per acre) during the winter on the lower Colorado River.

Reasons for Decline in Populations. There is no strong evidence for a decline in distribution and numbers statewide; however, significant loss of saltwater and freshwater wetland habitat has probably reduced population (Wilbur, 1974). Extreme high tides in saltwater marshes and water level fluctuations in freshwater marshes have disrupted nesting attempts. Loss of high marsh vegetation around San Francisco Bay has evidently eliminated the species as a breeder in the south bay (Manolis, 1977).

Status of the Species in the Study Area. Suitable habitat for the CBR occurs in many sloughs and rivers of the Delta. Recent work by Manolis (1977) and Evens and Page (1983) suggests a strong preference for tidal pickleweed habitats. Recent surveys (Evans and LeValley, 1981; Jones and Stokes, 1982) within the vicinity of the Suisun Marsh indicate that the principal area of concern with respect to the CBR may be at the west end of the project area, particularly in the Collinsville area. However, there have been few surveys of the Delta, and CBR are consistently found in the upper sections of White Slough near Terminous, CA. in Sacramento County. This indicates that the CBR may be more widespread than previously discovered through surveys.



Known range in study area

SCALE IN MILES

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CALIFORNIA BLACK RAIL: KNOWN LOCATIONS

File No 265-01	Date 8/16/85	Figure 3.2-4

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Surveys of the Project Area. The dredge disposal sites were surveyed in May and June for appropriate habitat. As with the Suisun shrew, what little is known about the habitat requirements of the Black Rail indicates that they require tidal marshes, either salt or brackish marsh. Both sites S-21 and S-35 contain marshes which are not subject to regular tidal inundation, at least in the area which may receive spoils. The habitat was therefore deemed unsuitable and no additional surveys for the CBR were recommended.

Project Impacts. Based on the analysis described above, no impacts are predicted from the No Action or the Selected Plans.

3.2.5 Other Species of Concern in Study Area

3.2.5.1 Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus*

Legal Status. The Valley Elderberry Longhorn Beetle (VELB) was listed as threatened by FWS in 1980, FR 45:52803 - 52807. The State of California considers it rare (DFG, 1985).

Distribution.

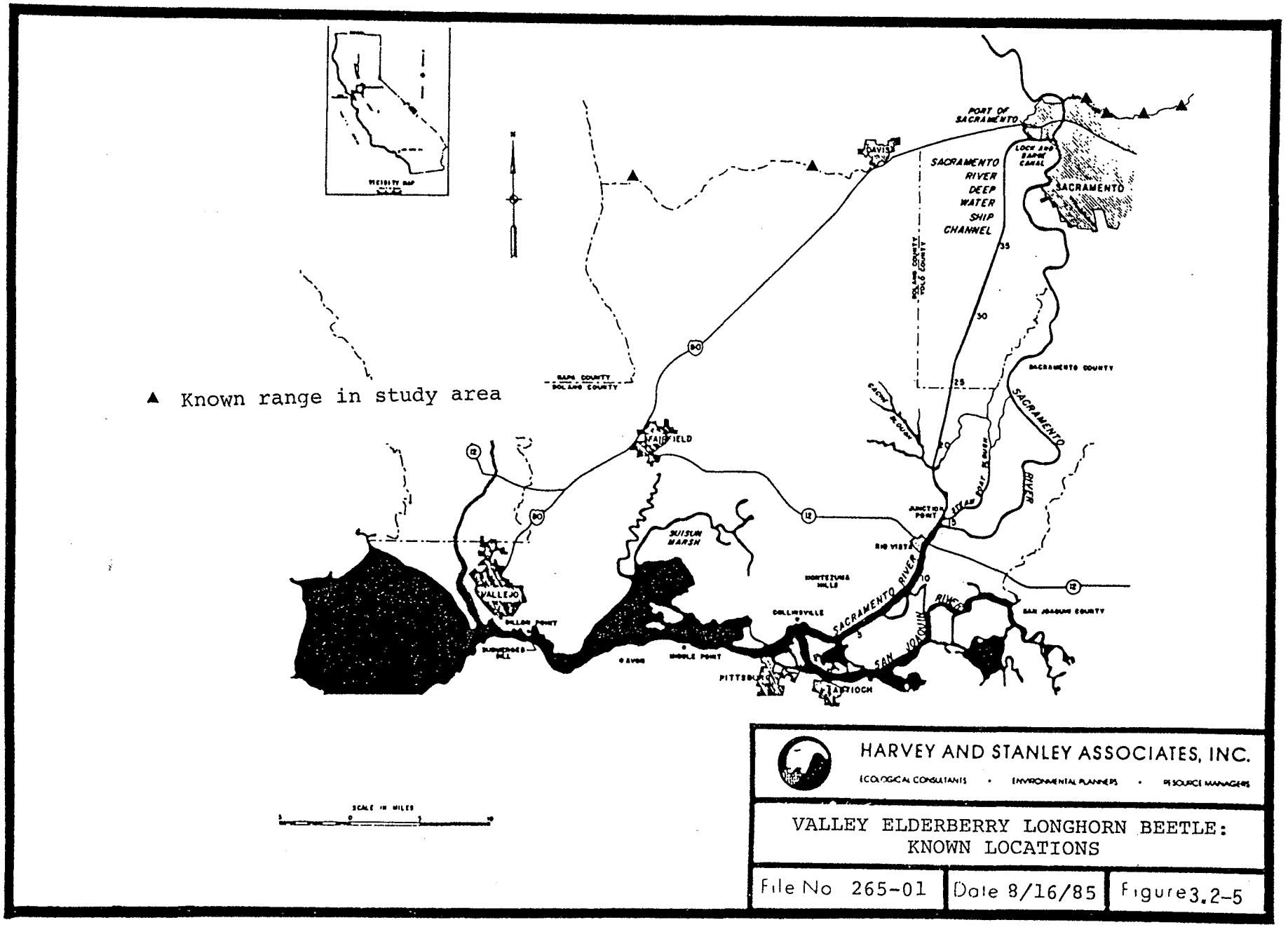
Historic. The entire historical range of this beetle is unknown because of mass destruction of riparian forests of the Central Valley. It was described from material collected in 1921 from Sacramento, California.

Present. This subspecies is known from present riparian regions of the Central Valley of California, namely, the American River in Sacramento County and Putah Creek in Solano and Yolo Counties. Museum records show it has also been collected in the McConnell State Recreation Area in Merced County (FWS, 1984) (Figure 3.2-5).

Habitat Requirements. The beetle is host-specific, maturing in and feeding as adults on elderberry (*Sambucus* spp.). The VELB apparently prefers to inhabit trees with a trunk girth of 15 to 65 cm (Eya, 1976).

Reasons for Decline in Population. Early placer mining for gold and later development of agriculture in this part of California are thought to be the major reasons for the loss of host plants, hence decline in population of this beetle. Katibah et al. (1981) estimated that only 41,310 ha of riparian forest remained as of that date in the Central Valley, and later conservatively estimated that riparian forest formerly covered 373,410 ha, an amount nine times greater than present host habitat (Katibah, 1983).

Status of Population in Project Area. Elderberry plants are located in the project area (S-14) on the southern tip of Grand Island, a triangle 1 x 1 x 3/4 miles (Figure 3.2-6). No emergence holes or adult beetles were noted during an exacting survey of most, if not all of the elderberry within this site. Areas I and II (Figure 3.2-6; Plates 7, 8, 9, 10) had only very scattered elderberry, which were all outside of the dike road, most being hundreds of feet apart. A dense pocket of the elderberry plants grow on several hectares in the extreme northern corner of Area III (Pl. 15). All of these elderberry are surrounded by a dense growth of thistle and blackberry, accessible only with difficulty from a southwest approach. No signs of emergence or adults were found.



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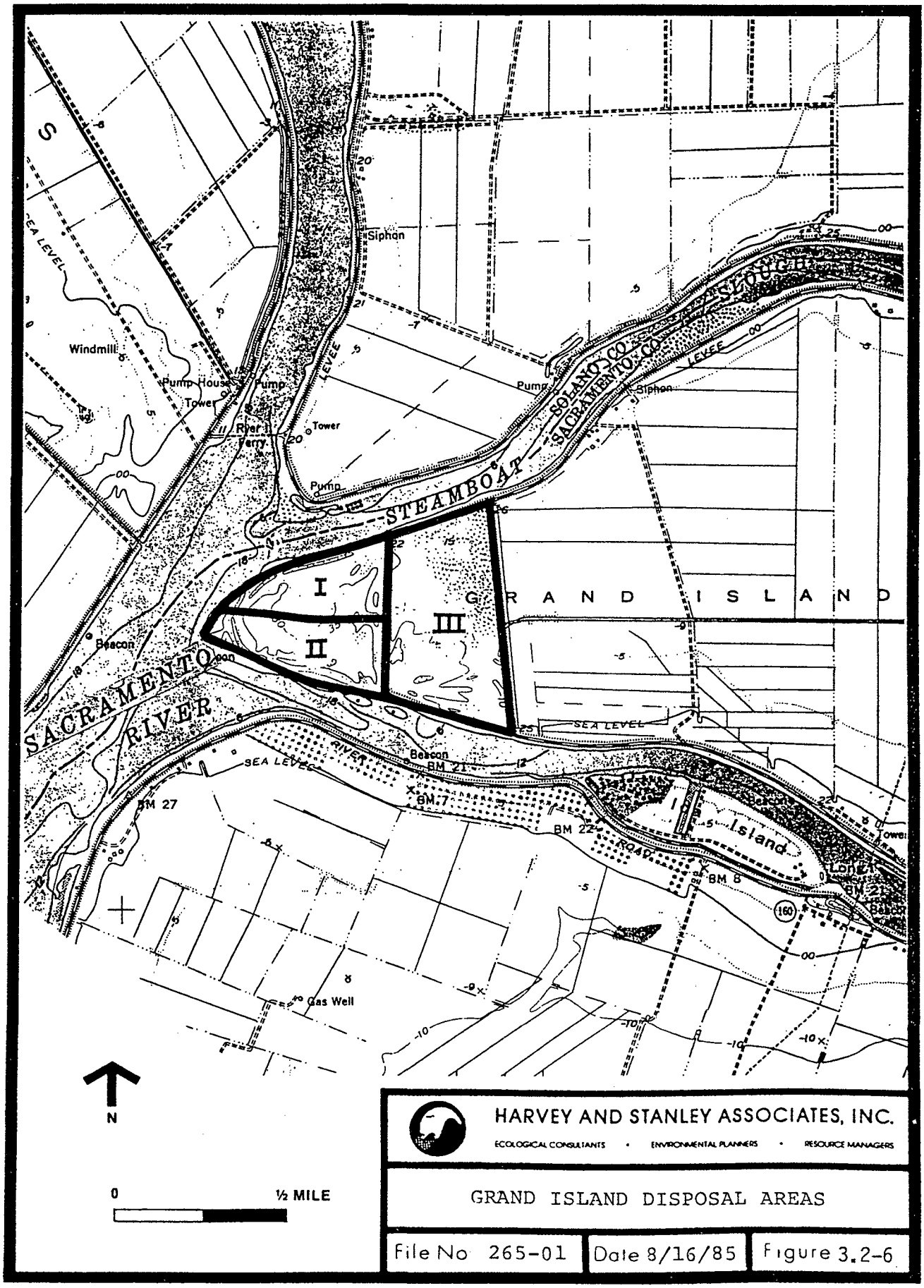
SEA LEVEL
Windmill
Pump House
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Tower
River
Ferry
Siphon
LEVEE
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Pump
STEAMBOAT
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SOLANO CO.
SACRAMENTO CO.
Siphon
Pump
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GRAND ISLAND
Beacon
SACRAMENTO
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GRAND ISLAND DISPOSAL AREAS
File No 265-01
Date 8/16/85
Figure 3.2-6

Project Impacts. VELB has a two year life cycle within the stem or limbs of its host. Any emergence holes would indicate possible site record for this beetle. A two year life cycle allows convenient monitoring of new populations. No signs were observed in living or dead elderberry. No negative effects on this beetle from the No Action or the Selected Plans are anticipated. The host plant does not grow at sites S-13 or S-16.

3.2.5.2 Sacramento Anthicid Beetle *Anthicus sacramento*

Legal Status. The Sacramento anthicid beetle (SAB) has no status with FWS. It is considered unusual by entomologists and the State of California is interested in it as an endemic, rare insect species (K. Hagen, 1984).

Distribution

Historic. The historical range of SAB is not known. These beetles, commonly called "antlike flower beetles", may be endemic to the Antioch Dunes of Contra Costa County, California. Stabilization of these dunes in the mid-twentieth century may have eliminated any such populations (Eng, 1979).

Present. Only two possible population sites are known for the SAB. Both are small sand dune areas in the Sacramento-San Joaquin Delta area. One is located at the southern tip of Grand Island, the other at nearby Sandy Beach or Rio Vista County Park Recreation Area, just downstream from Rio Vista, California (Figure 3.2-7 and Plate 4).

Habitat Requirements. The SAB, a small beetle (2-5mm in length) is known only from the loose sand slip faces of sand dunes at both sites (Eng, 1979). Such dunes were among willows (*Salix* spp.) and bamboo (*Arundo donax*) that have grown out of dredge spoils of the past. Leaf litter of these plants may be a source of food for the immature beetles. Adults are presumably scavengers on debris, including dead insects, as are other members of this family of beetles.

Reasons for Decline in Population. Heavy equipment activity and/or almost complete removal of sand at each dune site has taken its toll on suitable habitat, which would include dynamic dune communities.

The major reason for possible decline of the SAB is the removal of past spoil deposits for commercial sand purposes. Grand Island has been affected by extensive excavation, where sand has been scraped away to the island "floor" (Plate 7). All vegetation has been removed along the edge of the spoil area thus eliminating the major habitat for the SAB (Plate 8). The habitat at the boundary of sand and new vegetation would slowly change through natural succession, but the sand mining activites dramatically alter this habitat within a short time period.

Status of Population in Study Area. Field surveys during June 1985 failed to locate any of SAB at either of two sand substrate study sites, S-14 and S-16.

Grand Island Site (S-14): This area is located at the southern end of Grand Island, the downstream tip that projects into the Sacramento River

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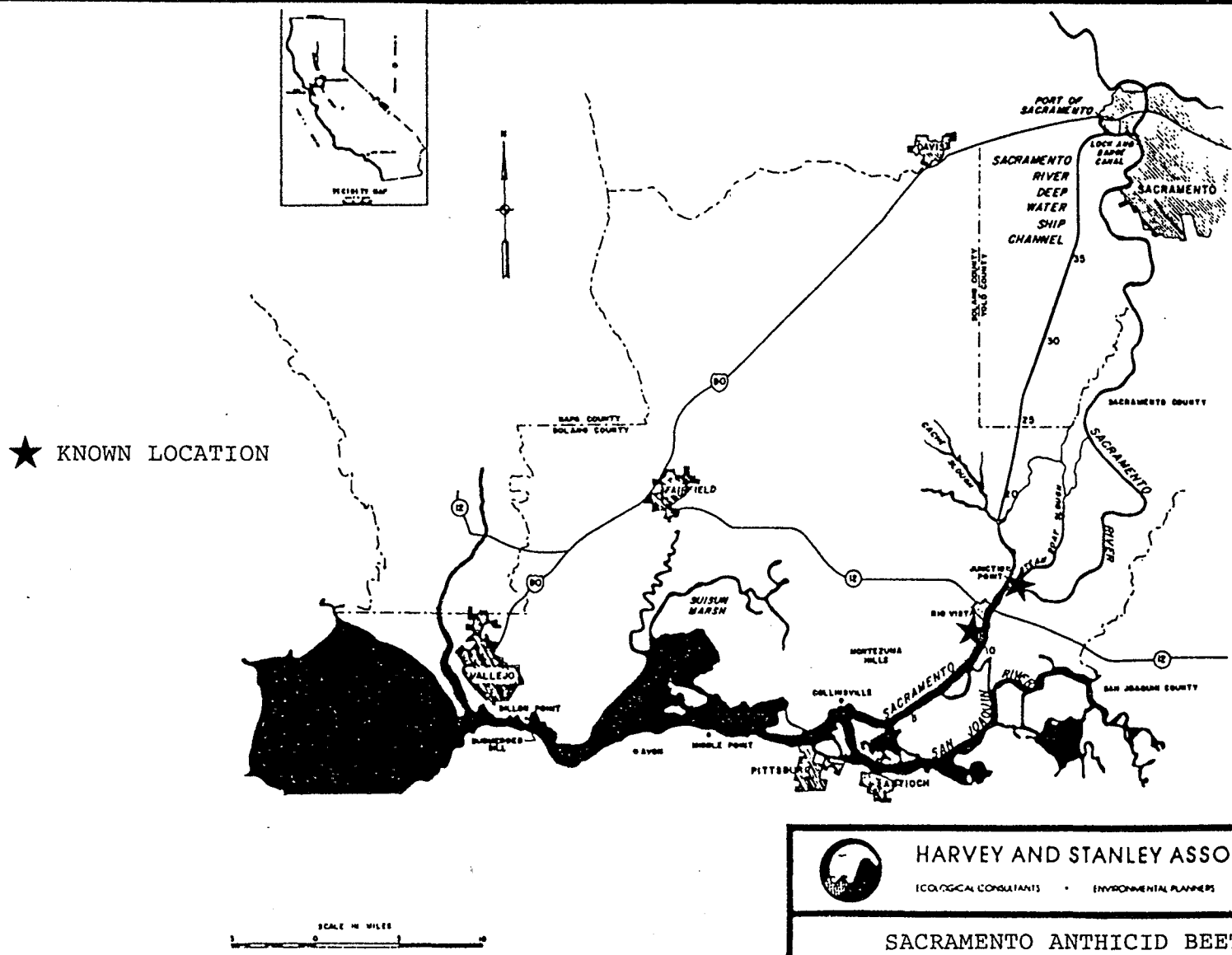

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SACRAMENTO ANTHICID BEETLE:
KNOWN LOCATIONS

File No 265-01	Date 8/16/85	Figure 3:2-7

C-090867

approximately two miles north of Rio Vista (Figure 1-2). The site is bound on two sides (1 mile each) by fresh waterways and two dirt roads divide the triangle into thirds (i.e., areas labeled I, II, and III in Figure 3.2-6). Parts of each of the three areas have been habitat for the SAB prior to stabilization and recolonization of the sand substrate in recent years.

A dense cover of Fremont's cottonwood (Populus fremontii), willows (Salix spp.), blackberry, some elderberry, thistle, and other herbaceous species comprise the rest of the cover. The vegetation tends to limit the amount of exposed sand in areas II and III. Area I has been scraped bare to the floor of the island (Plate 8). Minimal sand slip face habitat adjacent to low-growing vegetation is to be found due to sand harvesting efforts (Plate 9). The SAB population numbers will likely be very small until new sand is deposited in this holding area (Area I). This is the only area with potential for SAB because of the advanced maturity of areas II and III (Plate 10).

Sandy Beach Recreation Area Site S-16: The Sandy Beach site has similar characteristics and constraints to SAB as the Grand Island site (S-14). Site S-16 extends about 1·3/4 miles along the west shoreline of the Sacramento River, its northern limits being 1/2 mile south (downstream) from Rio Vista. It is primarily deposition of dredge spoils extending 1/4 mile inland from the river to the base of the Montezuma Hills which overlay the Rio Vista Gas Field. As viewed from across the river at Brannan Island State Recreation Area, Sandy Beach receives heavy wind disturbance to the sand dune habitat (Plate 11). Vegetation is almost nonexistent at the Sandy Beach Recreation Area (Plates 12, 13 and 14). Several willow trees along the mid-hillside boundary exhibit slip facing of sand. No specimens of the SAB were found during field surveys of the area. A more likely location for this beetle was noted within the narrow margin of willows and sand between the dike and the river, but outside the study area. However, no SAB were found when this area was surveyed.

Project Impacts. Both of these sites are former dredge material disposal locations which have provided and will likely again provide habitat for the SAB if the sand dredge spoils are allowed to drift and evolve naturally. There appears to be a period during the stabilization by vegetation that is optimum for this beetle (K. Hagen, 1985). Ecological change and the human activity of sand removal will alter this. Deposition of dredged material at these two sites is consistent with past use of the sites and may in fact create new habitat for the SAB. Natural succession should be allowed to take place along the perimeters of the spoil areas or portions of these border habitats. No impacts are anticipated from the No Action or the Selected Plans.

3.3 FLORA

3.1 Solano Grass or Crampton's tuctoria
Tuctoria mucronata (Crampton) J. Reeder
(syn: Orcuttia mucronata Crampton)

Legal Status and Description. Solano grass, Tuctoria mucronata, was listed by FWS as endangered in 43 Federal Register 44812, 28 September 1978. It is designated endangered and protected by the State of California (Section 1900, Chapter 10 of the Fish and Game Code) (DFG, 1979) and it is classified

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Habitat Requirements. Solano grass occurs in vernal pool habitat surrounded by annual grassland. The dry lake bed of Olcutt Lake, a mosaic of soil surfaces, contains shallow spots scoured by waves during winter months. These spots dry into uniformly white and sandy textured surfaces (Griggs, 1980). Shallow ponded areas (less than 1 or 2 cm deep) which persist for many weeks after the drying of the higher surface in the spring provide suitable habitat for the *Tuctoria mucronata* seeds to germinate. As the water evaporates, the sediment partially congeals and eventually dries into a thin crusty film, later cracking into angular-sided sheets noticeably darker in color than the high spots. Most often Solano grass inhabits these deeper parts of the lake and starts to break the surface after the last water has evaporated. This type of vernal pool habitat is found in scattered localities around the Central Valley of California and supports a rich, largely endemic, and often endangered flora. Olcutt Lake, the known habitat of Solano grass, is perhaps 250 acres; it appears white alkaline (Griggs, CNPS unpublished file data), and the plant is found in association with coyote thistle (*Eryngium aristulatum*). The flowering season is May to July depending on seasonal precipitation and the plant produces several decumbent shoots (about 6 inches tall) in a small tuft.

Reasons for Decline in Population. Since the plant was discovered well after agricultural development was in effect in the Central Valley, it can only be speculated that the populations have declined from their original size (FWS, 1985).

Status of Population in Study and Project Areas. As far as is known, Solano grass does not grow in the study area. Site S-13, the dredged material disposal area that has some vernal pool habitat within it, was thoroughly searched for the presence of the plant three times during the 1985 spring season. No evidence of the plant was found. Other DMD sites do not contain suitable habitat; therefore, it is highly unlikely that the plant exists within the study area.

Project Impacts. Solano grass does not occur within the project area; therefore, the plant will not be affected by the No Action Plan or the Selected Plan.

3.3.2 Antioch Dunes Evening Primrose *Oenothera deltoides* Torr. and Frem. ssp. *howellii* (Munz) Klein.

Legal Status and Description. The Antioch Dunes Evening Primrose (*Oenothera deltoides* ssp. *howellii*) (OEDE) was listed as an endangered species in the Federal Register 43:17916 by the FWS on April 26, 1978. The critical habitat of this sand dune plant was determined and published in the Federal Register 43: 39042-39044 on August 31, 1978 (FWS,1980). OEDE is designated endangered and protected by the State of California (Section 1900, Chapter 10 of the Fish and Game Code) (DFG, 1979) and it is classified by the Smithsonian Institute as endangered. The California Native Plant Society (CNPS) lists it as endemic to California, endangered throughout its range, and limited to a few highly restricted populations (CNPS, 1984).

The OEDE has had an interesting taxonomic history. It was first collected by Alice Eastwood and J. T. Howell at Antioch and determined to be a species distinct from the *Oenothera trichocalyx* var. *cognata* which had

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previously been collected and described by Jepson (1925) from Corral Hollow in Alameda County. Munz distinguished the plant as a subspecies of the Oenothera deltoides and he gave it the subspecific epithet in honor of J. T. Howell, O. deltoides ssp. howellii. Later biosystematic and breeding investigations by Klein have borne out that this name is the most appropriate at this time for the plant (FWS, 1980).

OEDE is a short-lived perennial herb which reaches a height of up to 3 feet (Figure 3.3-2). It forms low, densely-branched bushes and produces large (3-inch diameter) white flowers in April and May (Munz, 1959). Large numbers of light, wind-borne seeds are produced and pollination is mainly by hawkmoths. OEDE requires freshly distributed sand for the survival of its progeny. Seedlings will not flourish where preceding plants grew to maturity (Roof, 1969).

Distribution.

Historic. The historic range of OEDE is unknown. There is no record as to the plant's existence outside of the Antioch dune area, although it is possible that it may have at one time inhabited the sandy areas throughout eastern Contra Costa County (FWS, 1980).

Present. The present range of the plant is confined to a single natural population at the Antioch Dunes and several introduced populations throughout Contra Costa, Alameda, and Sacramento Counties. The plant has been successfully naturalized at Brannan Island State Park and on Brown's Island; however, a transplant effort at Point Reyes National Seashore in Marin County failed (FWS, 1980).

Habitat Requirements. OEDE prefers to grow in nearly pure sand and it thrives in both loose sand and stabilized dunes. Because of this preference, the plant is designated a psammophyte or "sand-lover". Germination of psammophytes depends on occurrence and proper sequence of three factors: seed burial, appropriate moisture, and optimum temperature for the appropriate amount of time. The species is not found in areas where numerous exotic plant species have established themselves within the dune areas and it seems to prefer places where fresh sand is laid down regularly by the wind. For this reason the FWS concurs that the plant is easily maintained on slopes of natural moving sand dune systems such as that at Brannan Island State Park.

Reasons for the Decline in the Population. Since evening-primroses are self-incompatible (Klein, 1970), habitat reduction due to development may reduce the reproductive capacity of the population by adversely affecting the pollinators of OEDE (i.e., bees, hawkmoths). The current total population is estimated at less than 1,000 plants (FWS, 1980) because very little suitable sand dune substrate exists. Much of the wind-blown sand dune habitat of the Sacramento-San Joaquin Delta has been eliminated over the past century due to waterfront and upland development. This reduction in habitat is probably the key reason for the population decline.

Status of Population in Project and Study Areas. The on-site field surveys revealed that OEDE does not occur in any of the study area designated DMD sites or along the ship channel. Both Grand Island (S-14, Figure 1-2) and the Rio Vista site S-16 (Figure 1-2), contain loose sand habitat although no plants occur on either site. The plant has been successfully naturalized on Brannan Island which is within the study area and it could most likely grow well on the other sand areas within the project area.

Project Impacts. There will be no adverse effects on OEDE species or populations due to the No Action Plan or the Selected Plan.

3.3.3 Suisun Marsh Aster
Aster chilensis Nees var. *lentus* (Greene) Jeps.

Legal Status and Description. *Aster chilensis* var. *lentus* (ASCHL) is not officially listed by the FWS; it is a candidate category 2 status where insufficient distribution data are on file to support a a federal listing. There is no State of California listing and the CNPS regards it as confined to one extended population or several populations, endangered throughout its range, and endemic to California.

This plant is a robust, slightly succulent perennial with erect stems 1-2 m tall that are widely branching in the upper portion. The stems and leaves are glabrous (without hairs) or nearly so. The leaves are linear-lanceolate, 9-12 cm long. The upper flowering branches have conspicuous, nearly straight bracts. The flowering heads are few and large (rays 16-25 mm long) with 20-40 violet to purplish or whitish ray flowers around a central cluster of yellow disk flowers. The flowering time is June through November.

Distribution

Historic. The type collection came from the western part of the Suisun Marsh. One collection (1043) is from Hill Slough, Solano County, a branch of the Suisun Slough. The historic range of ASCHL was most likely from northern San Francisco Bay through the Suisun Marshes and into the Sacramento-San Joaquin Delta. It has been reported from the Napa marshes and east to the Antioch shorelines (DFG, 1985).

Present. Recent sightings of ASCHL are mostly in the marshes around San Pablo Bay, the Suisun Marsh and the west Sacramento-San Joaquin Delta. The range may extend upstream as far as Toland's Landing just south of Rio Vista in Solano County and along the San Joaquin River on Hog Island although none were found in the 1985 survey. Other sitings have been recorded in Contra Costa County on Brown's Island, in Sacramento County on Chain Island, and in Solano County in Barker Slough (DFG, 1985). The abundance of ASCHL is not known; it occurs at about twelve sites and the numbers of plants in each location were not recorded (DFG, 1985).

Habitat Requirements. ASCHL grows among tules (*Scirpus* spp.) in tidal streams, coastal salt marsh, and brackish marshes. It is most often found in densely vegetated areas in stabilized substrate.

Reasons for the Decline in the Population. ASCHL may be dependent upon a narrow water regime. It is not widely distributed and it appears to be restricted to brackish waters. The narrow adaptation to brackish water in addition to the historic destruction of tidally influenced freshwater habitats may be the reason for the decline in ASCHL numbers (COE, 1982).

Status of the Population in the Project and Study Area. Field surveys and herbaria records revealed several locations of ASCHL (Plates 5 and 6). None of the plants were found in area that would be affected by construction or maintenance of the project. The plants were not found within the DMDs and they were well removed from the channel and not within the construction corridor.

Project Impacts. No adverse impacts are expected to the ASCHL species or population as a result of the No Action plan or the Selected Plan.

3.3.4 Suisun Thistle
Cirsium hydrophilum (Greene) Jeps. var. *hydrophilum*

Legal Status and Description. *Cirsium hydrophilum* var. *hydrophilum* (CIHY) was once listed as endangered by the FWS (1976); however, currently it has no official status with the FWS. It is a candidate category 1 species for which enough data are presently on file to support a federal listing, but no status has been officially proposed. The State of California has no official listing, but the CNPS regards it as present in such small numbers that it is rarely reported, endangered throughout its range, and endemic to California.

CIHY is a perennial herb with slender, erect stems 1-1.5 m tall and well-branched above. The leaves are spiny and deeply lobed with ear-like basal lobes on the lower stems becoming reduced on upper stems to narrow strips with strongly spine-toothed margins. Small (2-2.5 cm long), cylinder-like to semi-bell-like in outline, pale lavender-rose flower heads fall in groups of two to five on each stalk. The flower head bracts have distinct, green, glutinous ridges on the back. The plant flowers from July to September but the major flowering period is early July (T.C. Fuller, 1985). No other *Cirsium* spp. occurs in the immediate area of the CIHY and other species in the surrounding area do not have a glutinous ridge on the backs of the flower-head bracts.

Distribution.

Historic. The type species is uncertain for this plant since it has a rather complicated nomenclatural history (DFG, 1977). The plant has been collected only from the Suisun Marsh since 1888, when it was originally named *Cnicus breweri* Gray var. *vaseyi* Gray. It is likely that it occurred in other locations of similar habitat but that it was never correctly identified as Suisun thistle.

Present. According to the records within the local herbaria, CIHY has been found approximately six times since 1959, all within the Suisun Marsh (Barbe, 1985). It is possible that the range is wider than recorded, but that the searches for this weedy species have been incomplete (York, 1985). City of Fairfield has one recorded occurrence of CIHY near the South Pacific railroad tracks and Peytonia Slough south of Suisun City (Jones and Stokes, 1975).

Habitat Requirements. This species occurs at the edges of salt water and brackish marshes that are periodically inundated during high tides. Soil disturbance and high light are important to proper reproduction and growth of this species. It thrives, as many *Cirsium* spp. do, in areas that receive periodic disturbance.

Reasons for the Decline in the Population. The abundance of this species was never high according to the historical record; however, its abundance may have been greater than is actually recorded. Factors adversely affecting marsh habitat may also affect CIHY; such factors are loss of, or disturbance to, the marsh habitat and changes in water quality. The plant is known to occur only in the Suisun Marsh and this area has been protected from

disturbance such as fire or soil disruption since it was designated as a wildlife preserve. The population of CIHY may actually increase if disturbances such as fire and dredging are permitted in the marsh area where the species exists (Fuller, 1985).

Status of the Population in the Project and Study Area. CIHY is not found within the study area. It only occurs west of the study area in the upper tributaries of Suisun Slough, although, it has not been recorded from there since 1976 (D. Barbe, 1985). The plant was not found in the known location near Peytonia Slough in the on-site search this year by Olmsted and Dains.

Project Impacts. There will be no adverse impacts on the CIHY as a result of the No Action or the Selected Plans.

3.3.5 California Hibiscus
Hibiscus californicus Kellog

Legal Status and Description. *Hibiscus californicus* (HICA) has no official status with the FWS. It is a candidate category 2 species under review. The State of California has no listing for the plant and the Smithsonian Institute lists it as endangered with no protection. The CNPS regards it as confined to several populations, endangered throughout its range, and endemic to California.

HICA is a large perennial herb which produces several stout stems and forms a relatively robust bush (up to ten feet tall). It has large white flowers (up to five inches in diameter) with dark purple centers (Figure 3.3-5). The plant matures about August to September and the showy flowers are conspicuous from a distance.

Distribution.

Historic. The species occurred throughout the fresher water areas of the Sacramento-San Joaquin Delta. It was once distributed along the Sacramento River from approximately the Chico/Red Bluff region in the north downstream to the upper San Joaquin Delta (DFG, 1985).

Present. HICA has a fairly wide distribution and it may have a relatively large total population. Several researchers were working in summer 1985 to establish the geographical range and abundance of this species (Papp, 1985). Known locations of the plant are distributed between the tule marshes and the woody riparian vegetation on the shorelines of the Sacramento and Delta Islands. HICA grows in freshwater marsh areas, on moist riverbanks, and on low peat islands of the Sacramento-San Joaquin Delta and lower Sacramento and San Joaquin Rivers. Although it occurs in areas of the Delta which are influenced by tides, it appears to be restricted to freshwater habitats. It grows abundantly locally among tules (*Scirpus* spp.) and cattails (*Typha* spp.) on low, inundated islands of the Delta and among undeveloped riverbanks and islands within the Sacramento River and the sloughs west of the river channel and east of DWSC (e.g., Snodgrass Slough to the west of the channel). It is also known in stabilized backwaters and creekbeds in the Butte Sink area near Colusa.

Fig. 261. *Hibiscus californicus: a,* mature open capsule, × ⅘; *b,* seed, the tubercles prominent, × 8; *c,* habit, upper part of plant, × ⅔; *d,* stellate hairs on leaf, × 4.

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CALIFORNIA HIBISCUS	
SOURCE: Mason, 1959.	FIGURE 3.3-5

C-090874

Habitat Requirements. HICA seems to prefer undisturbed moist banks and island edge habitats at slightly higher elevations but closely associated with tules (Scirpus spp.) It is often found in densely vegetated, undisturbed riparian habitats with willows (Salix spp.), blackberry (Rubus spp.), tules, rushes (Juncus spp.), and sedges (Cyperus spp.)(COE, 1980). From known occurrences of the plant, it appears that the plant requires fresh water saturated soil and does not occur in brackish or salt water habitats.

Reason for Decline in the Population. This species has been eliminated from many sites within much of its range because of the alteration of habitat by public works improvements, specifically flood control and erosion control projects, and weed eradication efforts. Historic levee construction and ongoing maintenance along the Sacramento and San Joaquin Rivers and in the Delta have eliminated much of the preferred habitat of this species while agricultural development and marsh reclamation have altered or eliminated many of the backwater and high marsh communities in which it occasionally grows. Water quality changes may also have threatened or altered the populations in parts of the lower Sacramento-San Joaquin Delta.

Status of the Population in the Project and Study Area. Several individual HICA plants were located within the study area (Pls. 4&5); however, none occur within the project DMD sites or channel widening area.

Project Impacts. HICA grows in several places within the study area, but no populations were found in any of the DMD sites nor along the man-made channel. The No Action Plan and the Selected Plan will not affect the existing HICA populations within the study area. Construction of the mitigation site on Prospect Island will not adversely affect the HICA.

3.3.6 Delta Tule Pea
Lathyrus Jepsonii Greene ssp. Jepsonii C.L.Hitch.

Legal Status and Distribution. Lathyrus Jepsonii ssp. Jepsonii (LAJE) was once officially listed as endangered in the Federal Register (1976); however, it is not currently listed nor proposed by the FWS for official status. As such, it is a candidate category 2 species, indicating that additional information is required to biologically support a proposed rule. The State of California has no listing for LAJE and the Smithsonian Institute lists it as endangered, but not protected. CNPS (1985) regards it as confined to several populations; not declining in numbers, but endangered in a portion of its range; and endemic to California.

LAJE is a vine-like perennial herb which typically grows at the water's edge, producing several stems from underground rootstocks up to 6 feet long. The stems are semi-erect or prostrate sometimes growing in tangled masses and they have broadly winged margins along the internode stem sections giving a flattened appearance. The leaves are compound with 10-14 lancelike to semi-elliptical leaflets, a terminal tendril, and small stipules. The inflorescence is a raceme with 10-20 pale pink to crimson (to rose-purple) flowers, each 2 cm long (Figure 3.3-6). The fruit is a pea pod 5-9 cm long. LAJE flowers between May and June, and the flowers remain sometimes until August. All the plant parts are glabrous (hairless) in subspecies Jepsonii which distinguish it from the other Lathyrus subspecies, Californicus. Most of the other Lathyrus species have bare (non-winged) round stem internodes.

Fig. 253. *Lathyrus Jepsonii: a*, fruit, × 4/5; *b*, habit, × 2/5; *c*, seed, × 4; *d*, flower, × 2; *e*, stem (cross section), × 2; *f*, diadelphous stamens, and the style hairy on one side near tip, × 2.

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DELTA TULE PEA	
SOURCE: Mason, 1959.	FIGURE 3.3-6

C-090876

Distribution.

Historic. The type locality for LAJE is in Solano County, near Teal Southern Pacific railroad station west of Grizzly Island. It has been found from the Napa River east through the Suisun marshes to Stockton and north to Brannan Island in Sacramento County. Numerous sightings have been made in past years on Mare Island, Suisun marsh, Antioch North, Rio Vista, Bouldin Island, and Honker Bay (DFG, 1985). Some sources list the possible locations as far upstream as Walnut Grove along the Sacramento River and within Steamboat Slough at the tip of Grand Island. Most of the plants have been found in tangled masses along the shorelines at elevations between sea level and 5 feet (DFG, 1979).

Present. The most recent records of LAJE show its distribution primarily along the riparian fringes of the islands in the lower Sacramento-San Joaquin Delta and the Suisun marshes. From the records of sightings within the last decade, the range appears to be from the mouth of the Napa River through the Suisun marsh and across the channel to Winter's Island, then upstream to Rio Vista at the edge of Steamboat Slough. Numerous plants were found along Dutch Slough (Harvey and Stanley, 1984) and one large population was found on the south side of Simmon's Island in the Suisun marsh (DiVittorio, 1985). The plant is usually associated with tules (*Scirpus* spp.), and occasionally with soft bird's beak (*Cordylanthus mollis*) or riparian vegetation such as horsetail (*Equisetum* ssp.), wild grape (*Vitus californicus*), and white alder (*Alnus rhombifolia*).

Habitat Requirements. LAJE grows in tidally influenced wetlands (mean sea level to +5 feet elevation) including tule marshes, muddy riverbanks, brackish and freshwater sloughs, and apparently occasionally along older riprapped bank habitats. It grows sometimes on drier ground in well-established riparian habitat, or as single individual plants typically climbing up tall emergent vegetation such as tules (*Scirpus acutus*, *S. californicus*) and cattails (*Typha latifolia*, *T. angustifolia*) (Jepson, 1925; Munz, 1959).

Reasons for Decline in Population. The reasons are unknown; however, the most likely threat to the LAJE populations is the changes in water quality (i.e., salinity increases). Habitat loss may have an adverse affect on the individual species, but there is considerable low marsh and riparian habitat left in the Delta to support the LAJE populations.

Status of the Population in the Project and Study Area. LAJE grows in association with tules and cattails at the far western portion of the study area (Pls. 4-6). It was also located at Grand Island within the higher portions of the riparian area on the Sacramento Channel (Plate 4). Herbarium records show that small populations of LAJE were found in the past along Brannan Island near Tomato Slough, and on Ryer Island near Steamboat Slough (Plates 4 and 5). These plants were not relocated during the 1985 surveys; however, it is possible they will return during another growing season. The Ryer Island site should be checked again prior to project construction.

Project Impacts. There will be no impacts to the LAJE from the No Action Plan. Construction and maintenance dredging in the channel with the Selected Plan could potentially affect the LAJE populations at the tip of Ryer Island and downstream of Grand Island if these populations still exist.

The impact to these population (if they exist) would be minimal for only portions of the shoreline will be affected by the construction and maintenance dredging (i.e., conveyance pipe access to disposal sites).

3.3.7 Mason's Lilaeopsis or Mudflat quill-plant *Lilaeopsis Masonii* Mathias & Const.

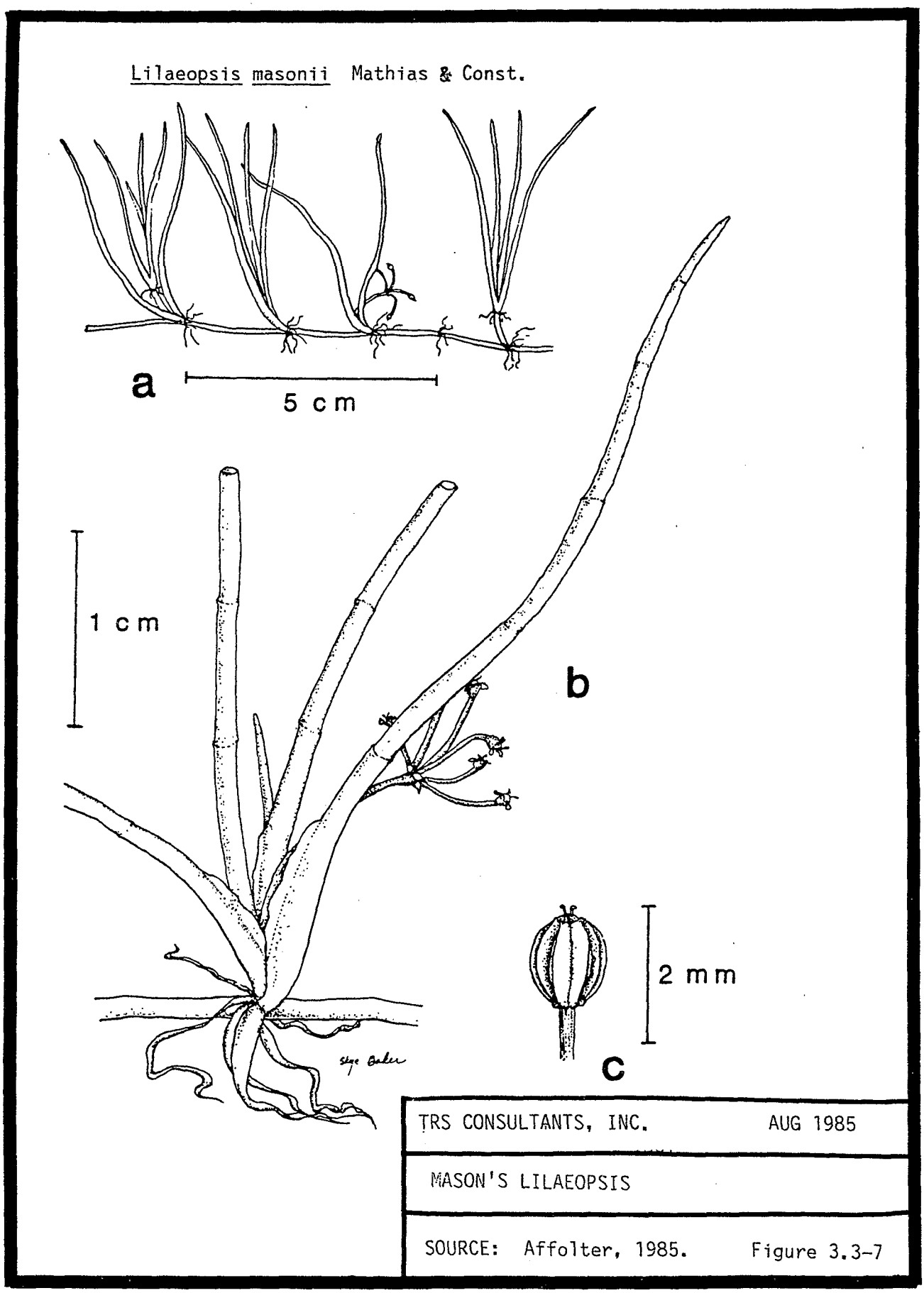
Legal Status and Description. The federal status of *Lilaeopsis masonii* (LIMA) is currently under review; it has been designated a candidate category 2 by the FWS meaning that distribution data are insufficient to support federal listing. The State of California calls it rare and has proposed it for listing in the future (DFG, 1979). The California Native Plant Society (CNPS) lists it as confined to several populations, endangered in a portion of its range, and endemic to California. The Smithsonian Institution presumed LIMA extinct prior to 1974, but since then, it was rediscovered in 1977 and it has been found in numerous locations.

LIMA is a low, hairless, perennial plant that spreads by rhizomes and forms low bright green sod mats on wave cut benches along freshwater channel banks. The leaves are quill-shaped, cylindrical, 1.5-7 cm long, less than 1 mm in diameter, with few and obscure transverse septae (the septae are totally obscure in field observation). Peduncles are long and weak, and mostly shorter than the leaves. The inflorescence is an umbel on a weak stalk with 3-8 tiny white flowers (Figure 3.3-7). The pedicels or flower stalks are weak and ascending to variously bent. The fruits are small (1.5-1.8 mm long, 1.25-1.5 mm broad) with low and corky-thickened ribs. LIMA flowers from May to August and it can usually be found in both flower and fruit from June to November (DFG, 1985). It is frequently found in association with marsh pennywort (*Hydrocotyl verticillata*), bulrush (*Scirpus koilolepis*), arrow grass (*Triglochin striata*), and Suisun aster (*Aster chilensis* var. *lentus*) (Harvey and Stanley, 1977; DFG, 1979; DFG, 1985). *Limosella subulata*, a plant that superficially resembles LIMA, is found closely associated with and sometimes growing in the same populations as LIMA. The leaves are so similar on these two species that it is impossible to accurately distinguish them in the field unless the two plants are in flower. *Limosella* subulata is in the Scrophulariaceae family and therefore, it has a simple flower and no umbel infloresence. This plant also grows in isolated populations without LIMA, but in similar mud/clay bank habitat.

Distribution

Historic. Past records are few for LIMA. The plant was mentioned in 1957, but it was not taxonomically distinct from *Lilaeopsis occidentalis*, a larger species found primarily in the San Francisco Bay area (Mason, 1957). The isotype specimen was collected and described from a site at the end of the Antioch bridge in 1977 (Mathias and Constance). Shoreline disturbance at the Antioch site and other places along the Sacramento-San Joaquin Delta was the reason the species was presumed to be extirpated. However, the plant has since then been found in several locations distributed from the Sacramento-San Joaquin Delta and on river margins of Sherman and Montezuma Islands (DFG, 1985).

Present. The known extent of LIMA today is from the mouth of the Napa River, through Suisun Bay, and up the Sacramento River to Prospect



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MASON'S LILAEOPSIS	
SOURCE: Affolter, 1985.	Figure 3.3-7

Island. Recent collections have been made of LIMA from areas in the lower Sacramento-San Joaquin Delta including the Antioch Dunes shoreline. On the east side of the Sacramento River channel, it has been found at Chain and Montezuma Islands and east of Collinsville along the slough mudflats. On the east side of the river, LIMA is found on Grand, Brannan, Jersey, and Sherman Islands and as far upstream as Walnut Grove (DFG, 1985). The range of this species also extends up the Sacramento River Deep Water Ship Channel to Cache Slough and Prospect Island. Although the highest concentration of populations is found in the lower Delta islands, the plant may be extending its range into the upstream areas.

Habitat Requirements. LIMA grows on low, wave-cut banks and on downed logs and wooden structures within the channel primarily in brackish waters. It generally grows in soils high in clay and at elevations which are regularly inundated by waves and tidal fluctuations, on stable shoreline mudflats, and on semi-stabilized substrate. It is not known from the salt marshes in the San Francisco Bay, but seems to prefer brackish to fresh water habitat. One small population (less than 75 individual plants) was found in sand on the east side of Montezuma Island (the sand looked as if it had been deposited after the plant was well rooted in the strata beneath).

Reason for Decline in Population. The most apparent reason for the decline of the LIMA population is the alteration or loss of habitat due to destruction of naturally stabilized shorelines by dredging and levee construction or maintenance. Changes in water salinity are suspected to adversely affect the reproduction and survival of the species; however, the extent of this effect is unknown.

Status of Population in Project and Study Area. A few to several LIMA plants are found on nearly every natural mud shoreline within the study area; therefore, it is difficult to show location of every plant. Only populations of 50 plants or more are mapped on Plates 1-6. The species appears to be more common than previously determined; however, the habitat is specifically clay/mud semi-stabilized substrate. The Collinsville shoreline has the most abundant populations and there are some scattered populations along the shores of Grand Island, Sherman Island, along Horseshoe Bend, Cache Slough and Prospect Island. The sizes of some of the LIMA populations are difficult to determine because they are so closely associated with *Limosella subulata*, another diminutive plant with similar characteristics and habitat requirements.

Project Impacts. Continued maintenance dredging along the channel under the No Action Plan could possibly eliminate some LIMA plants on the sides of the existing channel below Cache Slough. The dredging equipment such as the conveyance pipelines could drag over and potentially disturb a LIMA population on mud shorelines within the project area particularly downstream of Cache Slough. The wave action on the ship channel banks also affects LIMA populations to a certain extent.

The construction dredging of the Selected Plan may affect the existing populations of LIMA near Grand Island and the Collinsville shoreline if care is not taken to avoid clay benches with the dredge pipelines and other machinery (Plates 4-6). Widening the man-made channel will remove any mudflats that may have developed, thus eliminating habitat for LIMA. The

maintenance DMD in the Selected Plan would have the same impact as the current level of DMD under the No Action Plan.

The mitigation plan may adversely affect the LIMA populations around Prospect Island (Plate 4) unless the excavation of the site is managed to prevent cutting into the mud shorelines. The excavation of the site for mitigation purposes should be carefully designed to avoid LIMA population impacts. Recolonization of LIMA on new wetland habitat has not been observed. The plant requires stabilized clay/mud substrate; therefore, it may be difficult for the plant to recolonize the new sandy dredge spoils in the mitigation area.

4.0 SUMMARY AND RECOMMENDATIONS

4.1 PROJECT IMPACTS

Although several of the species of concern occur within the study area, the proposed actions for dredging and dredge material disposal should not impose serious threat to any of the existing populations. Based on these findings, each of the project components were evaluated for the potential threat to the species of concern (Table 4-1). Recommendations for management of areas where a plant or animal may be adversely affected are summarized for each DMD site and the mitigation site on Prospect Island (Table 4-1).

4.2 SECONDARY IMPACTS

Short-term changes in water quality due to the development may have secondary effects on the vegetative habitat within the channel. The populations of the species of concern within the project area are so small (or in some cases, non-existent) that these secondary effects could probably not be measured with respect to these species. Further investigations into the tolerances of the individual species such as OEDE, ASCHL, LIMA, and HICA are required to provide evidence about the sensitivity of these plants to water quality changes. The secondary impacts of the proposed project will not significantly change the status of these species nor the populations within the study area.

4.3 MITIGATION CONSIDERATIONS

The mitigation site (Figure 1-4) could provide a suitable location for trial introduction of the plant species of concern that inhabit sandy upland or freshwater wetlands (i.e., HICA, LIMA, OEDE). The habitat requirements and transplanting procedures for some of these plants are uncertain. Transplanting procedures should be carefully worked out and the FWS, the CNPS, the DFG, and plant specialists should be consulted as to the species composition, spacing, amount, and timing of planting.

OEDE has been successfully introduced in several dune areas within the Delta and it has potential to be successful in S-16 and S-14 providing careful management procedures are followed. The Brannan Island population of OEDE has successfully established, but it is carefully managed by the State Parks and Recreation personnel (California State Parks and Recreation Department, 1984). HICA and LIMA would likely grow in wetland habitat such as the proposed mitigation site at Prospect Island; however, little is known of these species transplant potential. The success of the plantings would be uncertain unless the site was carefully managed for several years after site construction.

5.0 COORDINATION

Numerous specialists, agency personnel, institutions, and herbaria were contacted throughout the preparation of this report. All personal communications are listed in the coordination table and not in the references section (Section 6.0) of this report (Table 5-1).

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Table 4-1. Summary of project impacts and recommendations.

SPECIES	MAN-MADE CHANNEL DREDGING	NATURAL CHANNEL DREDGING	DMD's CONSTRUCTION	DMD's MAINTENANCE	RECOMMENDATIONS
SMHM	none	none	possible S-21, S-35	possible S-21, S-35	trapping recommended prior to spoiling on these areas
DGGB	none	none	none	none	
SUISUN SHREW	none	none	none	none	
CBR	none	none	none	none	
SOLANO GRASS	none	none	none	none	
OEDE	none	none	none	none	
ASCHL	none	none	none	none	
CIHY	none	none	none	none	
HICA	none	none	none	none	potential for transplanting to mitigation site S-12
LAJE	none	minor	possible	possible	avoid disturbance by through checking prior to laying conveyance pipe to DMD's
LIMA	none	minor	possible	possible	avoid disturbance to extent possible

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Table 5-1. Coordination

Contact	Affiliation	Contribution
Jim Affolter, Ph.D.	Curator, US Berkeley Herb.	*Lilaeopsis masonii* data
Douglas Barbe, Ph.D.	Curator, CA Food and Agric. Herb.	data on all plants
Jim Bartell	Plant Ecologist, FWS - End. Sp.	background material
Dennis Breedlove	Curator, CA Academy of Science	specimens of plants
Ken DiVittorio	Plant Ecol., Harvey and Stanley	*Lathyrus* locations
Tom C. Fuller	Past CA state botanist	*Cirsium* spp. data
Ken Hagen, Ph.D.	Entomologist, UC Berkeley	*Anthicus* spp. data
Robert Holland, Ph.D.	Botanist, The Nature Conservancy	*Tuctoria* and *Hibiscus* data
June McCaskill	Manager, UC Davis Herb.	plant specimens and data
Jim Nelson	Plant Ecologist, CNPS	study design
Robert Ornduff, Ph.D.	Botanist, UC Berkeley	vernal pool data
Jerald B. Owenby, Ph.D.	Curator, U Michigan Herb.	*Cirsium* taxonomy data
David Papp	Grad student, Sacramento St. U.	*Hibiscus* data
Jim Shevock	Director, CA Nat. Div. Data Base	data on all plants
Peter Sorenson	Wildlife Biol., FWS - End. Sp.	data on all mammals
Greg Wooley	Ranger, Jepson Prairie Pres.	*Tuctoria* data
Rick York	Botanist, CNPS	data on all plants

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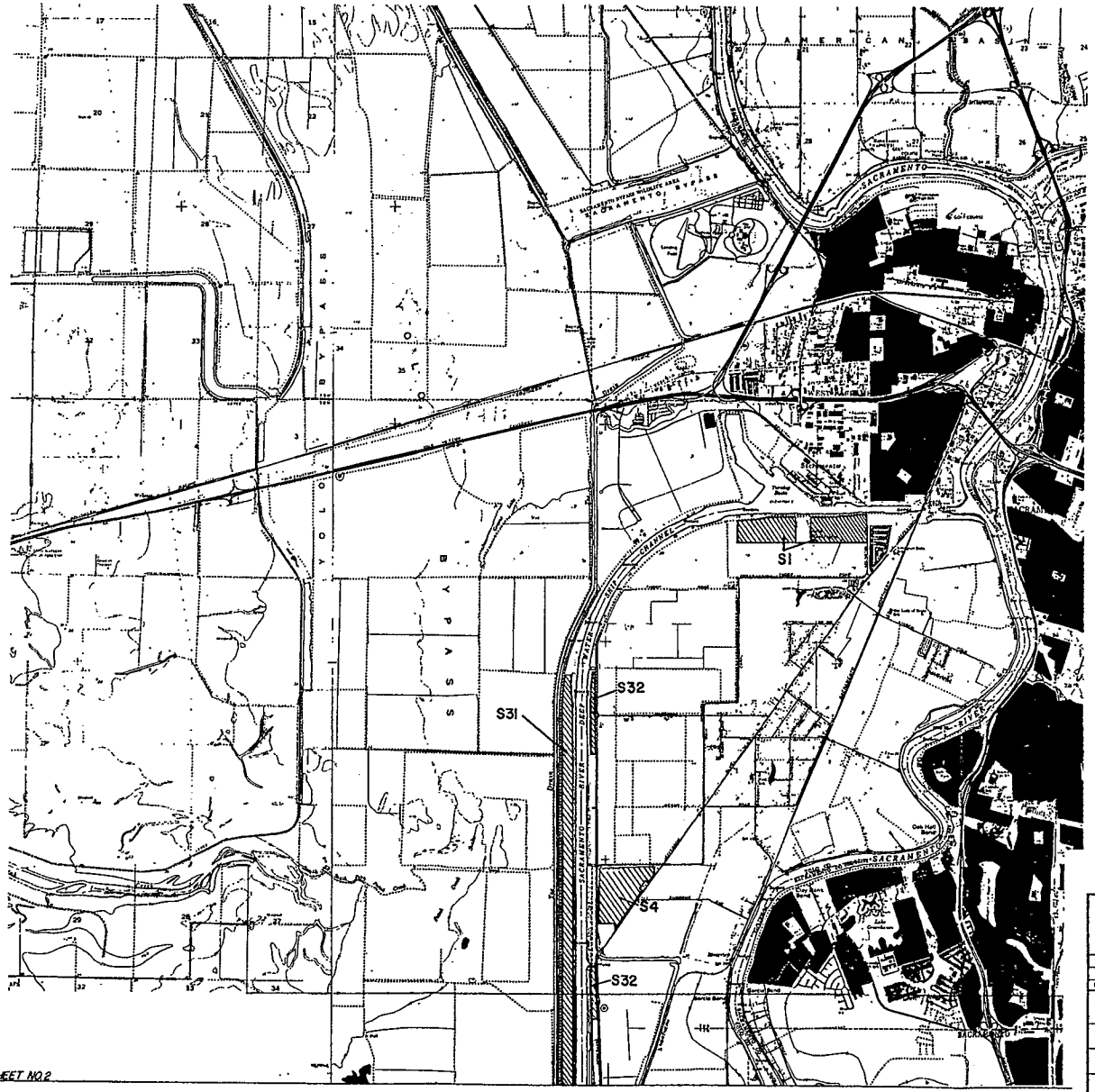


GRAPHIC SCALE

1" = 2000' 0 2000' 4000' 6000' 8000' 10000'

SPECIES OCCURENCES

REVISION	DATE	DESCRIPTION	BY	CK

PLATE 1

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: B. SULLIVAN
DRAWN: T. BRAUN
CHECKED: J. VERES

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

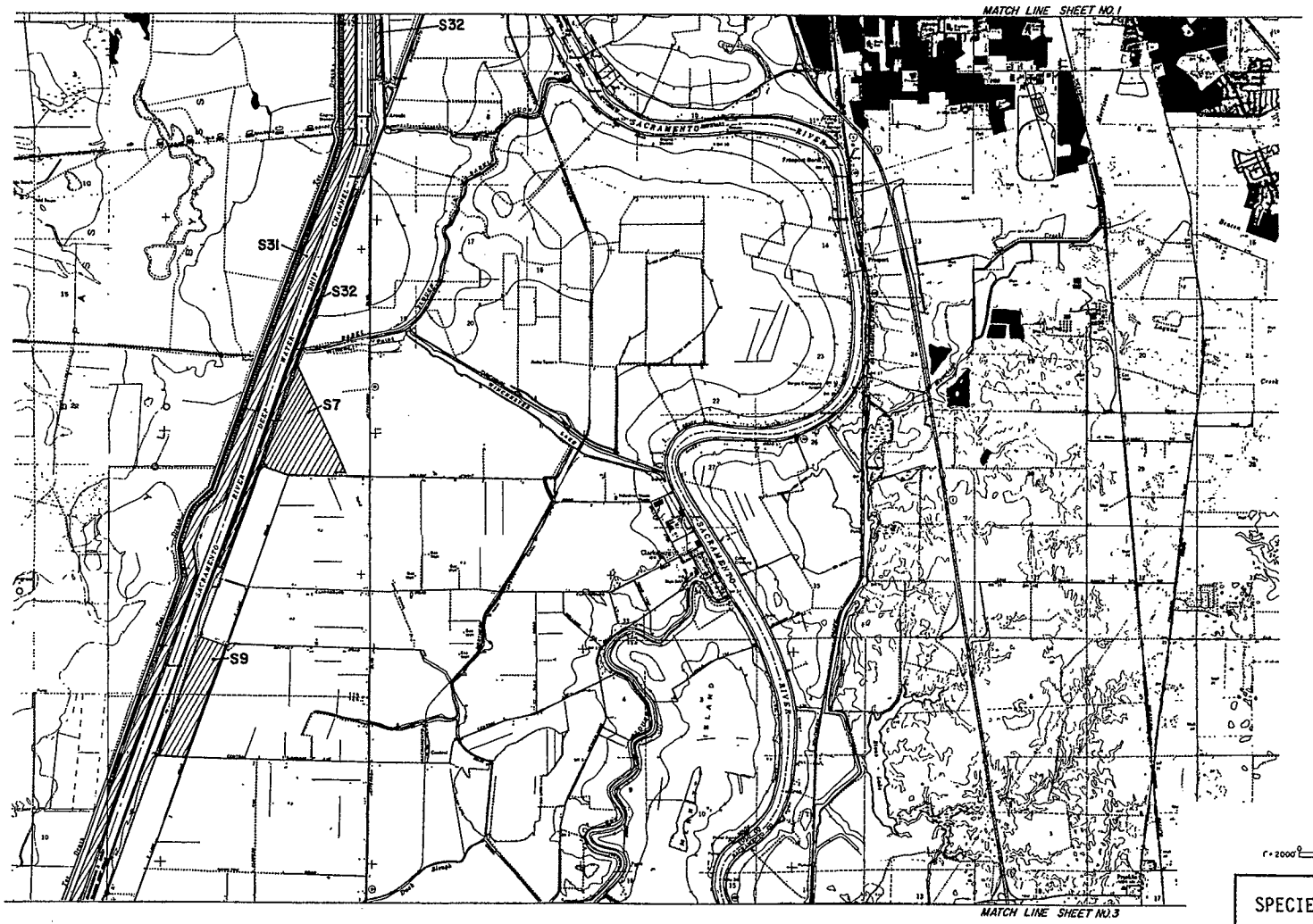
LOCATION OF DISPOSAL AREAS

SUBMITTED: DATE APPROVED:

SCALE: AS SHOWN
SHEET: 1
FILE No.: 52-6-368

C-090891

C-090891



GRAPHIC SCALE

1" = 2000' 0 2000' 4000' 6000' 8000' 10000'

SPECIES OCCURENCES

REVISION	DATE	DESCRIPTION	BY	CK
△				
△				

PLATE 2

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO CALIFORNIA

DESIGNED B SULLIVAN
DRAWN T BRAUN
CHECKED J VERES

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SUBMITTED DATE APPROVED

SCALE AS SHOWN SHEET 2 FILE No. 52-6-368

C-090892

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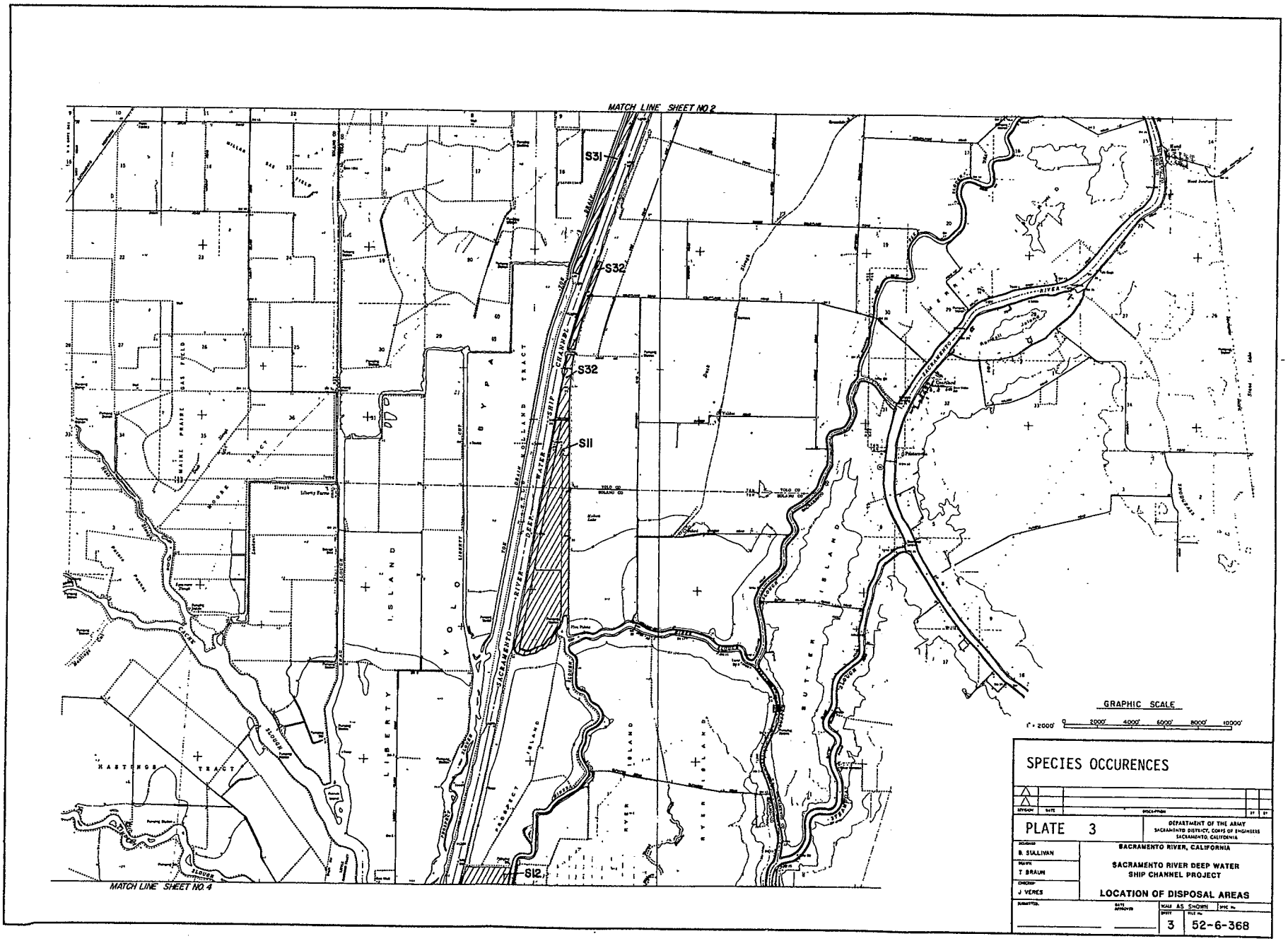

SPECIES OCCURENCES

PLATE 3	DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA		
DESIGNED B. SULLIVAN	SACRAMENTO RIVER, CALIFORNIA		
DRAWN T. BRAUN	SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT		
CHECKED J. VERES	LOCATION OF DISPOSAL AREAS		
SUBMITTED	DATE APPROVED	SCALE AS SHOWN	PHC No.
		SHEET 3	FILE No. 52-6-368

C-090893

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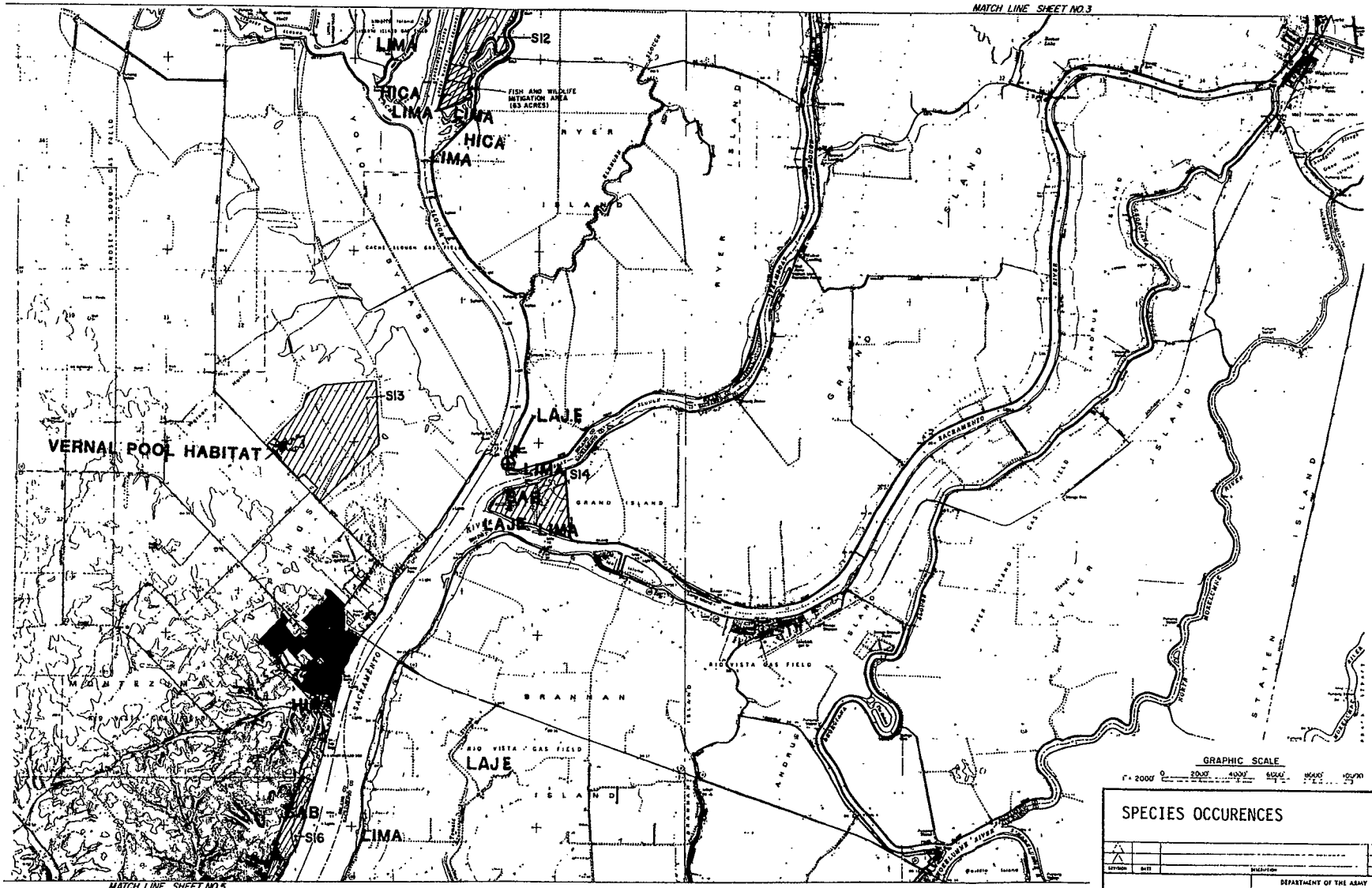

LIMA = Lilaeopsis Masonii
HICA = Hibiscus californicus
LAJE = Lathyrus jepsonii ssp. jepsonii
SAB = Anthicus sacramento
ASCHL = Aster chilensis var. lentus

SPECIES OCCURENCES

REVISION	DATE	DESCRIPTION	BY	CK

PLATE 4

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO CALIFORNIA

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

DESIGNED: G. SULLIVAN
DRAWN: T. BRAUN
CHECKED: J. VERES
SUBMITTED:
DATE:
SCALE: AS SHOWN
SHEET 4
FILE No. 52-6-368

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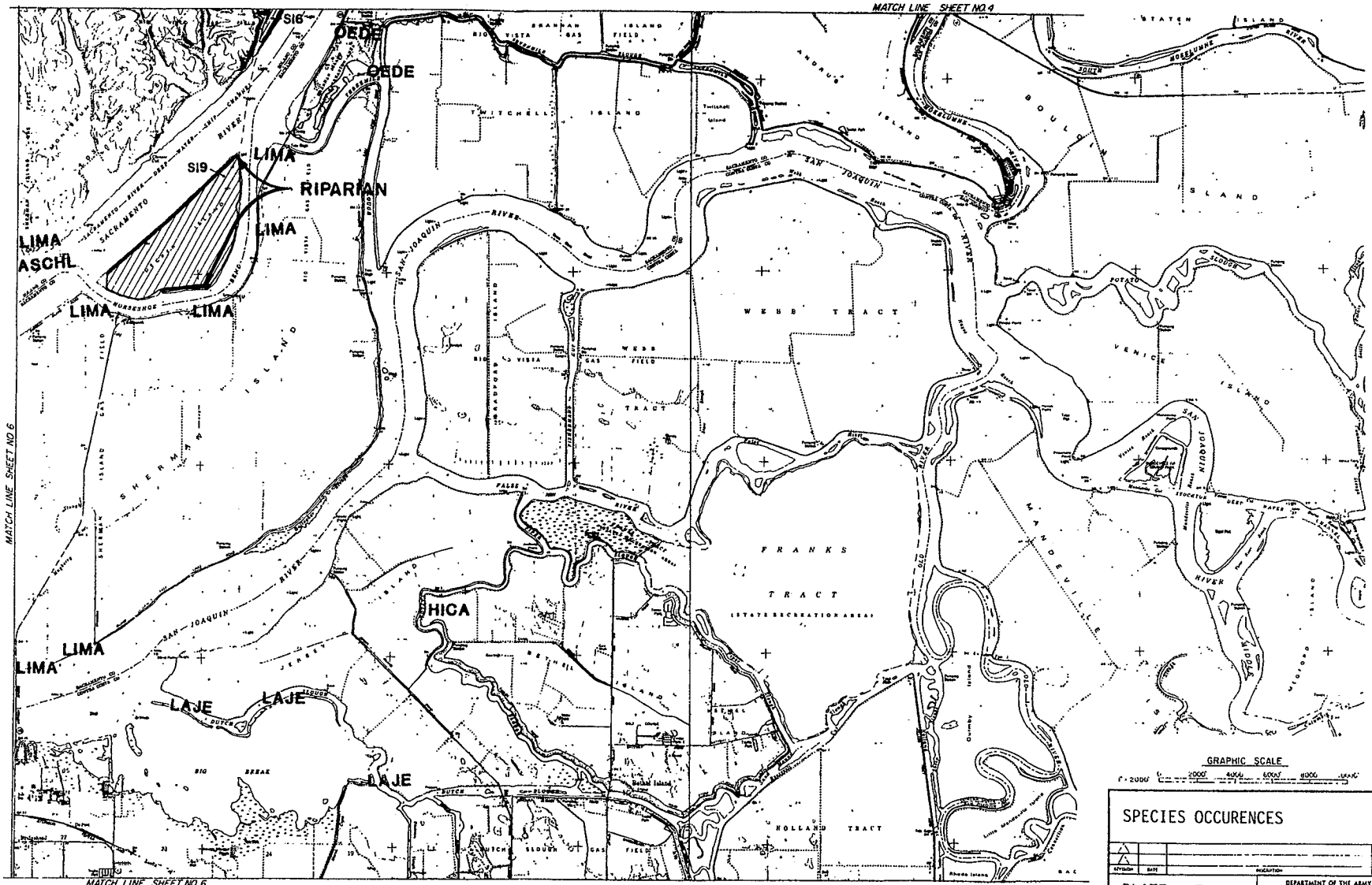

LIMA = Lilaeopsis Masonii
HICA = Hibiscus californicus
LAJE = Lathyrus jepsonii ssp. jepsonii
OEDE = Oenothera deltoides ssp. howellii
ASCHL = Aster chilensis var. lentus

SPECIES OCCURENCES

REVISION	DATE	DESCRIPTION	BY	CK

PLATE 5

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED: D SULLIVAN
DRAWN: T BRAUN
CHECKED: J VEHES
SUBMITTED:
DATE APPROVED:

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SCALE: AS SHOWN
SHEET: 5
FILE No. 52-6-368

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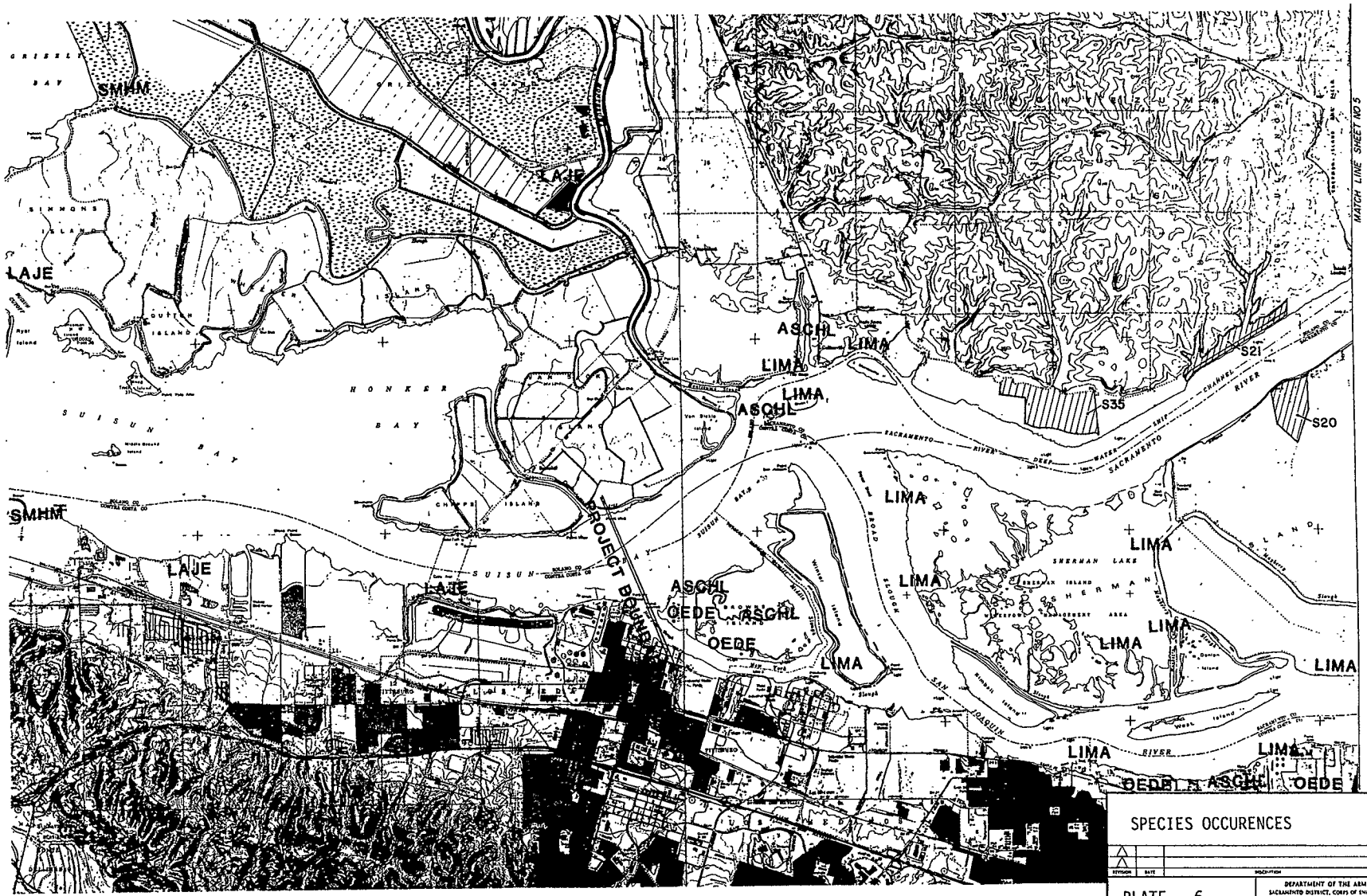

LIMA = Lilaeopsis Masonii
LAJE = Lathyrus jepsonii ssp. jepsonii
OEDE = Oenothera deltoides ssp. howellii
ASCHL = Aster chilensis var. lentus
SMHM = Salt Marsh Harvest Mouse

GRAPHIC SCALE
1" = 2000' 0 2000 4000 6000 8000 10000

SPECIES OCCURENCES

REVISION	DATE	DESCRIPTION	BY	CK

PLATE 6

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

DESIGNED B SULLIVAN
DRAWN T GRAUM
CHECKED J VERES
SUBMITTED
DATE APPROVED

SACRAMENTO RIVER, CALIFORNIA

SACRAMENTO RIVER DEEP WATER
SHIP CHANNEL PROJECT

LOCATION OF DISPOSAL AREAS

SCALE AS SHOWN
SHEET 6
FILE No 52-6-368

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PLATE 7. North end of Grand Island Area I which extends to the right ½ mile, a portion shown below.

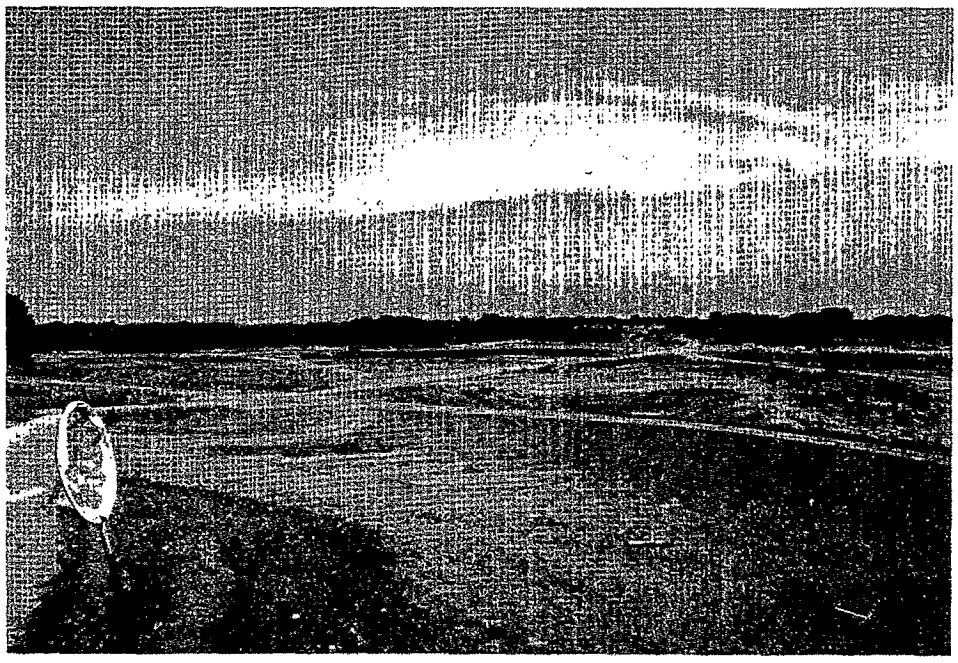

PLATE 8. View to north from midpoint of Area I. Note complete absence of vegetation. Area III begins at trees.

PLATE 9. The only remains of sand slip facing on Grand Island.

PLATE 10. Vegetation (willow & poplar) typical of stabilization areas II and III of Grand Island.

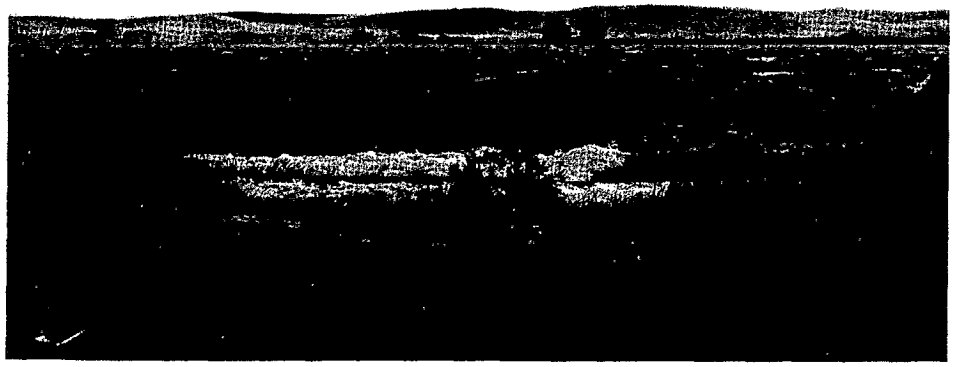

PLATE 11. Windswept Sandy Beach study area between Montezuma Hills and Sacramento River as viewed from Brannon Island Recreation Area.

PLATE 12. Sandy Beach study area from dike road, mostly void of vegetation.

PLATE 13. South end of Sandy Beach study area showing dried mud bed - river at right.

PLATE 14. One of two sand slip faces and major vegetation of above study site. Sacramento River shows from this midpoint view.

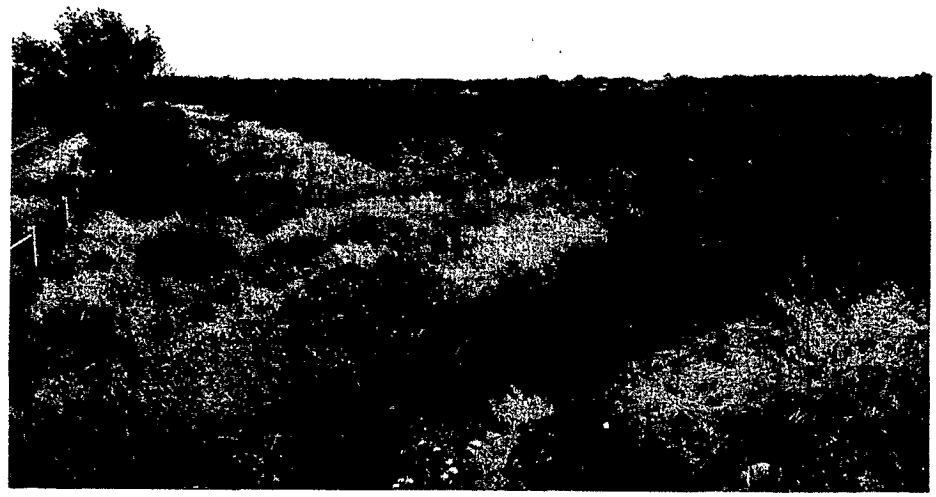

PLATE 15. Grand Island Area III as viewed from NW corner of study site. Elderberry thicket shows in center of dark vegetation.

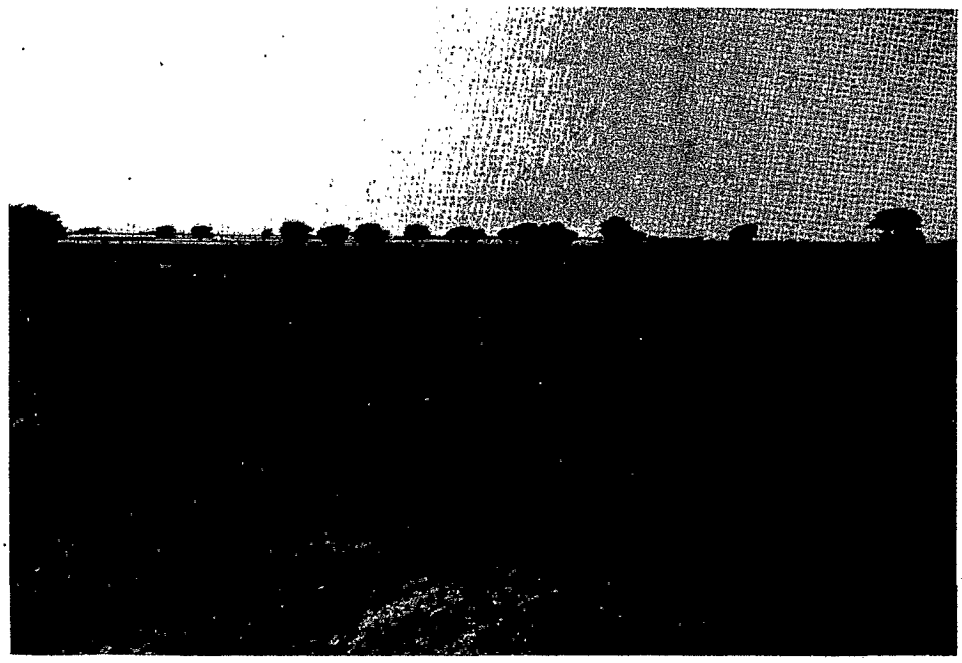

PLATE 16. Site 13 near Rio Vista Airport showing typical grass cover. Northview from midpoint of site.

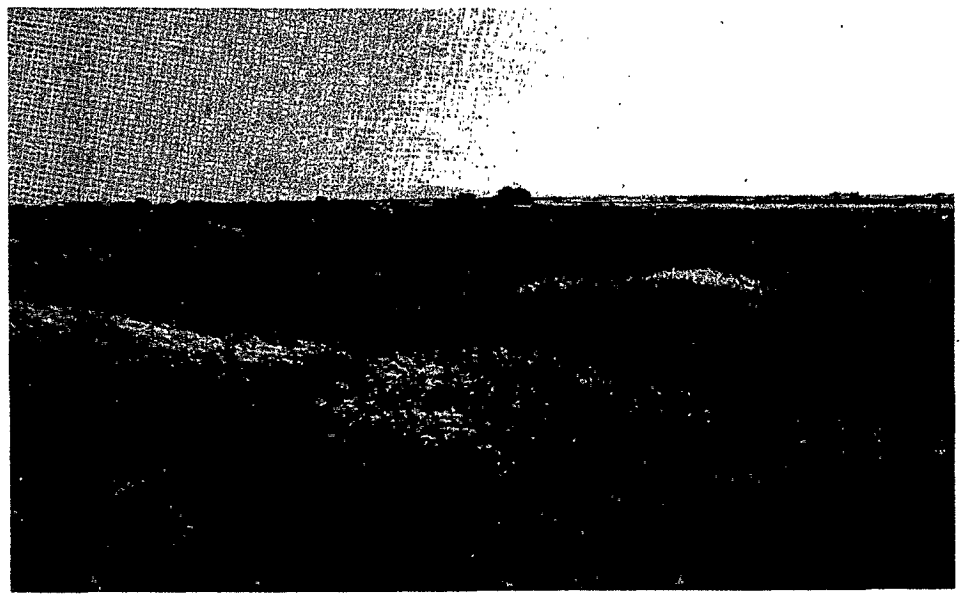

PLATE 17. Site 13, old sand removal area. Southeast view from near midpoint of site.

APPENDIX A

NOTE

October 28, 1984 and March 19, 1985 letters from the U.S. Fish and Wildlife Service, Endangered Species Office have been withdrawn from this Appendix as they appear in the FSEIS in Appendix D.

APPENDIX B

C-090905

THE FEDERAL PROGRAM

A BRIEF HISTORY

The federal Endangered Species Act of 1973 directed the Secretary of the Smithsonian Institution to review plants of the United States for recommendation to the Congress as either "endangered" or "threatened", according to definitions appearing in the act. An endangered species is "any species which is in danger of extinction throughout all or a significant portion of its range...". A threatened species is "any species which is likely to become an endangered species within the foreseable future throughout all or a significant portion of its range". This report, submitted to the Congress in January 1975, became widely known as "the Smithsonian list". For most areas of the country, the report provided the first compilation of rare plants and it stimulated many states to begin detailed studies. Recognition of plants on the Smithsonian list was advisory only and it did not confer any legal status. Although the act does not require it, the Smithsonian Institution continued its efforts to expand and revise its list of endangered and threatened plants of the nation. A revised report (Ayensu and DeFilipps, 1978), listed 275 California plants as endangered, 372 as threatened, and 33 as possibly or probably extinct.

The same federal act also assigned responsibility to the Secretary of the Interior for determining species to be listed as threatened or endangered under its provisions. Because the U.S. Fish and Wildlife Service was already responsible for endangered animals, it was now assigned responsiblity for plants as well. The first major action taken by the Service was to publish essentially the Smithsonian Institution's recommendations of January 1975 as a "notice of review" in the Federal Register of 1 July 1975.

To be listed at the federal level, a plant must be the subject of a proposed rulemaking, followed by a final rulemaking published in the Federal Register. On 16 June 1976, a proposed rulemaking for 1783 plants for endangered status was published. By the end of 1979, final rulemakings had appeared for 56 of these plants; 51 as endangered (15 of them from California) and seven as threatened. The remaining proposals were withdrawn on 10 November 1979, in accordance with the 1978 amendments to the Endangered Species Act.

THE FEDERAL CATEGORIES AND LISTING PROCESS

by J. A. BARTEL
Office for Endangered Species
U. S. Fish and Wildlife Service
Sacramento, California

It is necessary to understand the difference between listed, proposed, and candidate taxa under the provisions of the Endangered Species Act (ESA). The discrimination is critical, because the level of protection afforded these three groups of plants is not the same.

California has 658 federal candidate species as of 28 November 1983. Of these, 110 taxa are in Category 1, while the remaining 548 plants are in Category 2. The U. S. Fish and Wildlife Service defines Category 1 candidate species as "taxa for which the Service currently has on file substantial information on biological vulnerability (relating to autecology and distribution) and threat(s) to support the appropriateness of proposing to list the taxa as endangered or threatened species". The development and publication of proposed rules for these plants will take some years.

The data on threats and biological vulnerability for Category 2 plants are not completely known by the Service. The two categories thus delimit level of information, not degree of threat or biological vulnerability.

The non-candidates (plants previously considered candidates and included on past lists, but now excluded) total 284 taxa. These plants, which constitute Category 3, may have been excluded because they are known to be extinct [3A], taxonomically invalid or not meeting the Service's definition of a species [3B], or they are too widespread or they are not threatened at this time [3C].

The Service plans to revise the candidate list anually. Consequently, it should not be viewed as final. Although there has been and will continue to be substantial switching of taxa among the three categories, the probable trend over the next few years will be an overall reduction in candidate plants, especially those in Category 2. This trend is a function of the increasing data delimiting the vulnerabilty and threats facing these candidate taxa.

SOURCE: California Native Plant Society Rare and Endangered Plant Inventory. September 1984. (Third Edition)

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Candidate species are not protected under the Endangered Species Act (ESA). Although some federal agencies, such as the Forest Service, Bureau of Land Management, National Park Service, and the Fish and Wildlife Service, do grant some level of security or management consideration to federal candidate species, such policies are not mandatory under the ESA, nor should they be confused with its legal mandates.

Proposed species, those for which a rulemaking notice has been published in the Federal Register, enjoy limited protection under the ESA. Essentially, proposed taxa must be addressed by federal agencies in biological assessments—— a document required under Section 7(c) of the ESA for federal projects. Also, federal agencies must confer with the Service regarding any action or project "likely to jeopardize the continued existence" of a proposed species. This conference is an advisory process only. The Service would normally review project plans and determine the effects of a federal action on a proposed species. Recommendations for protective measures are not binding on a federal agency.

Federally listed plants, of which there are now 17 in California (See Appendix III), enjoy the full protection of the ESA. Listed taxa must be addressed in biological assessments. Moreover, all federal actions (funded, authorized, or carried out) that affect a listed species require a formal consultation, pursuant to Section 7 of the ESA. It may result in a requirement to modify actions and/or to compensate or mitigate for the effect of a proposed activity on a listed species, when such activity is likely to jeopardize the plant or animal. Although federal agencies can seek an exemption from the provisions of Section 7, typically the results of a formal consultation are mandatory if it finds that a listed species is in jeopardy.

Two provisions must be met if a particular species in a given circumstance is to receive the full protection of Section 7 of the ESA. The proposed activity must be contingent upon an action of one or more federal agencies. Examples of federal actions include funding, authorization, granting of permits, and activities on federal land. The proposed activity must also affect a listed species. There are few times when both conditions are met. It is generally the lack of a listed species which prevents the implementation of Section 7 of the ESA.

The process of listing a species, as defined in Section 4 of the ESA, is a long and difficult one. Our office annually identifies species that need the protection of the ESA. Generally we select taxa which, in our opinion, face the greatest threats and which would receive the greatest benefits from protection.

Taxa are also identified through the petition process. Any interested person or organization may ask the Service to list, delist, or reclassify any species. It is essential, however, that what is submitted to the Service must meet the requirement of a petition. It is a written request for petitionable action that clearly states the action recommended, e.g., listing or delisting. The petitioner must be clear that he or she is requesting specific action and that the document is clearly identified as a petition. Suggestions of candidates to consider, or other comments received in response to notices of review that solicit information on candidates will not be considered petitions, unless the comment states that it is a petition. This restriction is necessary so that the Service need not respond in the Federal Register to numerous inadvertent "petitions" submitted because the writer was unaware that he or she might be making a petition.

The Serivce has 90 days to determine whether the document qualifies as a petition. In addition, the Service must decide within this same time period whether the document is a first or second petition. If it is determined to be the latter, the document is treated as nothing more than a comment.

All of the plants presently referred to as federal candidates—— those now residing in Categories 1 and 2—— are considered petitioned taxa. Any petition relating to these taxa submitted to the Service would be a second petition and treated as a letter of comment. Consequently, the petition process for plants or for vertebrates should be limited to taxa not considered as federal candidate species.

If the document is a first petition, the Service has 90 days to determine whether substantial information is presented to justify the action requested. The Service must also determine whether listing may be warranted or whether a status review is needed. These results must be published in a notice in the Federal Register within 120 days from the date the petition was received. If it is determined that a listing may be warranted or that a status review is needed and conducted, then a finding is published in the Federal Register within a year of the first notice. The finding may be that the action is a) not warranted; b) warranted, in which case the species is proposed; or c) warranted, but precluded because the Service states that the taxon will not be proposed immediately due to staffing and time constraints.

A plant is considered a proposed species after it has been proposed for listing in the Federal Register as endangered or threatened. Within one year, the Secretary of the Interior must make a final determination regarding the proposed regulation. The Secretary will publish a final rule in the Federal Register determining the species to be endangered or threatened, publish a notice in the Federal Register extending the proposed regulation six months because of a disagreement on the sufficiency or accuracy of data, or publish a notice withdrawing the proposed regulation due to a lack of sufficient evidence. In any event, the Secretary can act only on biological vulnerability and threat data. Economic or socio-political information cannot be used to withdraw a proposed species, nor to prevent its becoming listed under the ESA. Economic information will be considered in the process of determining critical habitat.

As you can see from this brief summary, the federal endangered species program is a very complicated subject. Questions may be directed to Monty Knudsen or me at 2800 Cottage Way, Room E-1823, Sacramento, CA 95825 or call (916) 484-4935.

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APPENDIX C

RARE PLANT SURVEYS: TECHNIQUES FOR IMPACT ASSESSMENT

by James R. Nelson

Passage of environmental quality legislation in the early 1970s and later passage of endangered species legislation, produced a need for reliable information on the distribution of rare plants, particularly at locations near proposed development projects. While many rare plant surveys have been conducted over the past decade, approaches to these surveys have varied considerably. For some agencies a written certification from an acknowledged botanist stating his opinion about the presence—or absence—of rare plants has been considered to be sufficient proof of the occurrence of rare plants. This certification may have been without any field examination, or may have used field examination techniques that were inappropriate for locating the rare species in question.

Most state agencies in California do require surveys when rare species are known to occur in the immediate vicinity of a project. Yet such searches often will not

SOURCE: Fremontia, Bulletin of the California Native Plant Society, 1984.

locate *all* of the rare plants on a particular parcel, because the searches are targeted toward a specific group of species based on historic collection records. Depending on what species are actually searched for, surveys may take place at a time of year when other rare plants on the site are not recognizable. In fact, quantitative vegetation analysis techniques are often inappropriate for rare plant searches because of their inherent bias toward the dominant species on a site rather than rare ones.

In this paper I will outline some approaches and methods designed to assure more uniform systematic, and reliable rare plant surveys. If these procedures are followed, the result will be more thorough surveys, which in turn will provide better information for the decision-making process. And this in turn may provide better protection for rare plants.

Goals of Rare Plant Surveys

Rare plant surveys are the process by which the spatial distribution of rare plants and natural communities are characterized by attempting to locate all populations of a single rare plant species, to locate all rare plant species in one location, or, to locate all rare plants of one habitat type. Additionally, an investigator may also be asked to identify plant communities that require protection because of values to wildlife, water quality, or other natural features, or to identify other vegetational characteristics that may influence a proposed project (e.g., fire potential, erosion control, timber values, etc.). These purposes can easily be accomodated during a rare plant survey; however, it is important to have a clear purpose for a rare plant survey prior to establishing an appropriate study design.

A rare plant survey is needed for any project where the existing information is insufficient to show that no rare plants occur in areas that could be affected by the project. When the proposed project has the potential to adversely affect plants, there needs to be enough factual information on hand to indicate that no rare plants are present (or at least that those plants that are present will not be affected).

Sometimes there are clues that indicate the need for a rare plant survey such as records of previous sitings, or the presence of habitat that is suspected or known to support rare plants. But the lack of such clues is not sufficient reason to assume that rare plants *do not* occur. The fact that rare plants have not been reported from a site may merely be an indication of the lack of previous field work in the area. Often, only a field survey can determine the presence of rare plants on a site.

In order to be complete, surveys must be conducted periodically through at least one flowering period (based on the blooming period of local species), and must completely cover the proposed project area. Complete documentation of methods, procedures, and results is critical for reviewers to determine the adequacy of the study effort.

What qualifications are needed?

When a survey is to be conducted to determine the occurrence of rare plants, it is common practice to contract with a consultant. Deciding whether a person has the qualifications to conduct a botanical survey can be difficult. At a minimum, a qualified consultant should have experience as a botanical field investigator (including experience in field sampling design and field methods), taxonomic experience, and a knowledge of plant ecology. The consultant selected should also be familiar with state and federal laws which pertain to rare plant protection and environmental quality, a demonstrated ability to prepare detailed technical reports with standard citations, and have enthusiasm for and the physical capability to conduct strenuous field work.

Planning a Rare Plant Survey

Once the need for a study has been established and a competent botanist selected, the planning begins. The investigator must have a clear understanding of the activities of the proposed project, the type of disturbance, the location of facilities, and the potential for effects after construction. The project proponent should provide the following items to the field investigator to aid in planning and reporting the survey: a clear project proposal, a base map of project site, engineering drawings showing the location of all facilities, aerial photographs of the project area, and information on the post-construction operation of the facility.

Next, information should be collected on rare and endangered plants known to occur in the region. Species known within twenty-five miles of the site, or reported in similar habitat (even though not known to occur locally) should be considered to have a likelihood of occurring on the study site. Information collected on these species prior to conducting the field survey should include: 1) a taxonomic description and illustration or photograph; 2) information on habitat and associated species; 3) blooming periods and habitat constraints; 4) endangerment assessment; and 5) data on the known locations. Sources of information include floras and other published literature (taxonomic monographs, ecological studies), environmental impact reports and previously completed rare plant survey reports, informal reports such as status reports prepared by agency personnel, local checklists, her-

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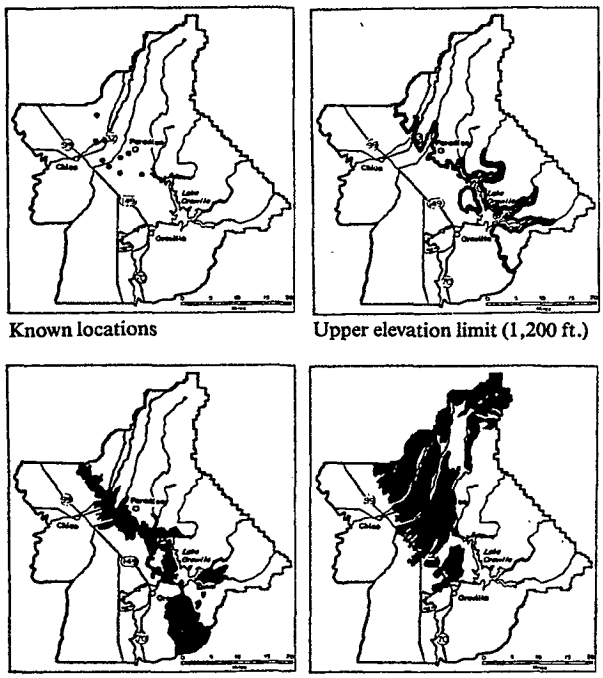
Factors used to predict the occurrence of *Polygonum bidwelliae.*



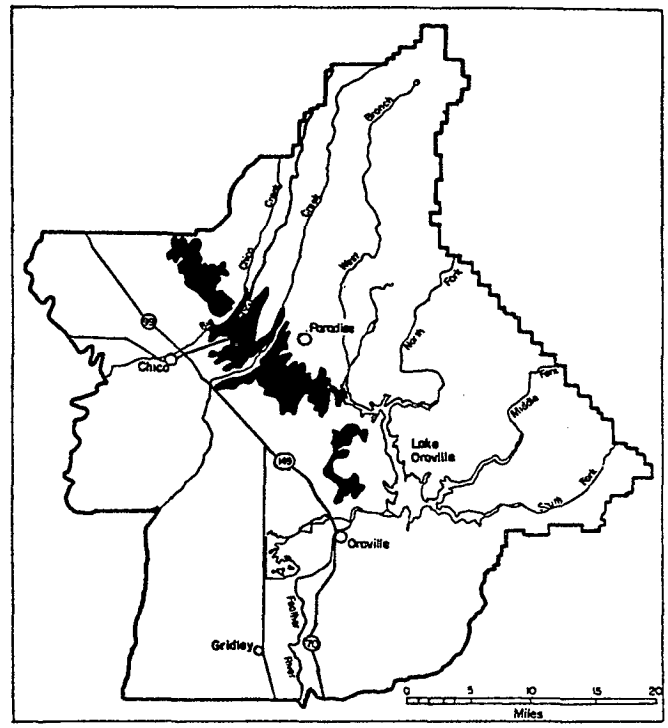
Known locations

Upper elevation limit (1,200 ft.)

Associated plant community (Foothill woodland)

Geologic association (pyroclastic)

Predicted occurrence of *Polyganum bidwelliae.*



barium labels and rare plant field reports, knowledgeable persons, and for some regions, computer data bases. The use of existing information is not a substitute for field searches as information in the literature is almost always incomplete and may be confounded by inaccuracies, lack of space to publish pertinent data, and in some cases data overload. Herbarium labels and rare plant field data forms may be subject to problems with nomenclature, identification, and imprecise locality information. While these limitations should be kept in mind, it remains critical to examine any pertinent data sources before conducting field searches for rare plants.

Determining the Study Area Site

The selection of a study area site must reflect the goals of the survey and the characteristics of the study area. For the purpose of impact identification, the study area should include: 1) areas that will be disturbed during construction; 2) a substantial buffer area; and 3) areas that will be disturbed by project operation.

The study area should not be so small as to be a constraint to the flexibility of the developer. Because rare plant surveys are often conducted early in the project planning process, changes in initial plans must be expected. Thus is is important to select a study area which is large enough to allow unforeseen changes in development plans. It is good practice to examine the areas to be affected *and* a significant buffer zone.

Some projects have the potential to affect vegetation beyond the construction zone, and it is necessary to survey larger areas. For example, the construction of a campground may actually disturb very little ground. Yet a rare plant population located near the campground or hiking trails may be affected by users of the campground. Some industrial facilities may have distinct construction boundaries yet produce pollutants that affect surrounding vegetation. Both the construction and operation of a project should be considered.

In addition, the field investigator must be prepared to expand the survey area if rare plants are found as small populations may grow many miles from the nearest known population, a "tip" of a range-extension "iceberg". When a rare plant population is found, the investigator should assess its significance in local and regional scales, as well as with respect to the overall distribution.

Predicting Rare Plant Occurrence

Every planner, consultant, and developer would undoubtedly love to be able to predict the occurrence of rare plants accurately without field work (and the necessary scheduling around the blooming periods).

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But no methodology exists to *predict* the occurrence of all rare plants accurately. Field examination remains the only reliable method to determine the presence of rare species. However, for some species, correlation of geographic and habitat features can suggest the location of potentially suitable habitat and this can be extremely useful for locating new populations of a single rare species. Predicting the occurrence of a plant involves correlating the geographic overlap of critical habitat features that appear to limit the distribution of the plant. An experienced field investigator does this through a subjective and intuitive evaluation of the appearance of a particular site. A planner would overlay maps of different habitat features to see where all habitat features overlap.

There are serious restrictions to the use of predictive approaches (whether intuitive or based on map overlays) for impact analysis, where *all* rare plants should be identified. The problems include 1) the inaccuracy of prediction for some species and 2) the "surprise" occurrence of unexpected, unrecorded, and uncooperatively disjunct species. Thus, while the investigation of species that are known to be in a region can be assisted by predicting habitat distributions, there remains no suitable substitute for field investigations.

Timing Field Work

Rare plant surveys need to be conducted at the right time of the year to ensure that plants in the field are both "evident" and identifiable. Many plants are more or less "invisible" except during periods when flowers cause them to stand out from surrounding plants. For most parts of California it would be impossible to locate all plants in one area during a single visit. Though most California plants can be found and identified during the period between March and June, because of differing flowering periods, it is important to plan botanical surveys in advance and allow for several visits during the entire flowering period. It is helpful to construct a calendar of flowering periods to help establish to proper time to conduct field work.

There are situations when even the best plant survey would not reveal a rare plant that exists on a site. The relative abundance of any species can vary annually. Some species (particularly those in desert situations) have the ability to withstand stresses, such as drought, by storing seed for extended periods. Thus, in unfavorable seasons, some rare species may not be apparent at all. An investigator may need to search more than one season to locate living populations. Because of these uncertainties, it is fair to say that a rare plant survey cannot deny a species' existence; it can only confirm it.

The purpose of a field survey is to: 1) describe the habitat (natural communities) of the study site; 2) search for rare plant populations; and 3) document rare plant populations found within the study area.

The description of the habitat should include a map of major habitat types and a written description. The map should accurately show the boundaries of different habitat types. Aerial photography is the best reference for maps of vegetation. Aerial photos are available for public use at many government agencies and universities. Transfer of information from aerial photos can be accomplished without expensive and complex equipment. The use of air photos is essential to identify plant community boundaries accurately, but cannot be considered adequate for identifying many plant communities without ground verification.

A written description of the natural communities should be based on field observations. Nomenclature should be based on major references on the subject. To standardize community nomenclature, the classification system used by the California Natural Diversity Data Base is recommended.

The purpose of the field search is to compile the most complete information available on the occurrence of rare plants. This requires that: 1) every species encountered be identified (to the point that its rarity can be confirmed); and 2) the entire study area be covered (although the intensity of coverage may vary based on study goals and site characteristics).

It is prudent to expect that rare plants will make up only a very small percent of the total cover. Floristic studies require the investigator to identify every species found. By contrast, targeted searches focus on species whose presence is expected based on previous records. When surveys are targeted to a few species, the investigator is not encouraged to locate and identify rare plants that are not expected or not previously recorded in the area.

The investigator must select an approach which provides the greatest confidence of completely examining the study area with the least overlap, thus keeping time and costs to a minimum. Many investigators use a random meander in which the investigator searches areas that appear good based on professional judgment and intuition. The problem with this method is that it is very difficult to keep track of what has and what has not been covered; some areas are covered twice (or more times) while others may never be covered. A systematic method that divides the study area into manageable units is more likely to cover an area completely with the least possible duplication. If the study area is larger than can be easily divided, the use of transects is especially helpful; for rare plant searches, transects serve only as a guide.

The intensity of the search will determine the amount of time required to cover the study area and needs to reflect the circumstances of the study site.

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Some times in an attempt to reduce costs of a rare plant survey, the intensity of the search is diluted. The intensity of a search should be determined by the size of the plants, and the density of the vegetation, as these control the effort required to locate a single species. Plant communities known to support rare plants require greater survey intensity than other community types.

Documenting Rare Plant Populations

Once a rare plant population is located, its characteristics need to be documented. This should include the identity of the species, the number of plants, the precise location, the area covered by the population, and the habitat characteristics of the population. Additional information may include blooming times, and ecological observations including any evidence of predation, excessive competition, or pollination activities. These data are important for evaluating the importance and sensitivity of a population and may be useful in a larger sense toward a better understanding of the species.

Plant collections should follow accepted methods and the specimen should be deposited in a recognized public herbarium for future reference. In addition, if there is any question about the identity of the specimen, the appropriate taxonomic expert should be contacted for confirmation. Correspondence on the identity of a specimen should be attached to written reports.

Many populations are too small to allow any collecting. In such cases careful notes and photography must suffice. Notes should be taken on the taxonomic features used to identify the plant (how many flowers were examined, what were the measurements of the parts, etc.). Photos should be taken of the plant, its habitat, and close-ups of morphological features that determined the identity of the plant.

Of most importance for impact assessment is the precise location of the rare plant population (i.e., habitat that is occupied by the species). Boundaries of populations should be accurately delimited using measurements from fixed land marks, aerial photographs, or by a professional surveyor. Surveyed population boundaries are particularly important where there is a possibility of creating an easement or dedicating the land for mitigation purposes.

The ecological requirements of the plant should be kept in mind while mapping the boundaries of the population. Often, plant populations are limited for environmental reasons (e.g., soils, exposure, moisture). An attempt should be made to discover the reason for population boundaries whenever possible. If the population is dependent upon other land features (e.g., springs, drainage patterns) that do not occur within the population itself, these should be noted also. Where buffer zones are included in the mapping, they should be clearly marked as such, and the investigator should explain their necessity.

Rare Plant Survey Report

One of the major deficiencies of many rare plant surveys is the quality of reporting. Many reports are written in such a fashion that there is no way to determine how the results were obtained. In general, the survey report must discuss exactly what was done, why it was done, and any uncertainties involved. Without this information, it is impossible to determine if the field work has been detailed enough to eliminate the possibility that additional rare plants might occur within the study area.

A rare plant survey report should include:

1. **A description of the project.** This should include maps of major facilities that will cause ground disturbance, and a discussion of construction and operational aspects of the project.
2. **A detailed description of the study methods.** Early in the report, the methods employed in collecting background information and conducting the field work should be discussed. This should include an overview of the research design and the rationale for selecting particular methods.
   a. **Background information.** Report what kinds of information were considered necessary and the methods used to obtain them. Identify what sources of information were actually used.
   b. **Field work.** Report the methods that were employed in the field to search for rare plants in sufficient detail to permit the reader to understand the method used and appreciate the reasons for using them. Were different methods used at different phases of the search? When populations were discovered, what methods were used to define boundaries (consider the accuracy of these), the identification of the plants, and the characteristics of the population? What areas were examined with negative results?
3. **A discussion of the survey results.** Describe the dates surveys were conducted, what was found (include detailed maps, and description), and the characteristics of the population and its habitat. Standardized data forms should be attached if used as part of the study. A list of all species identified should be attached.
4. **References used in preparing the survey report.** References cited, persons contacted, herbaria visited, the location of voucher specimens should be included, and the name of the investigator.

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DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

January 22, 1986

Environmental Resources Branch

Mr. Gail Kobetich, Project Leader
Endangered Species Office
U.S. Fish and Wildlife Service
2800 Cottage Way
Sacramento, California 95825

Dear Mr. Kobetich:

Enclosed is a biological assessment of listed and candidate species in the Sacramento River Deep Water Ship Channel project area. I have concluded from the enclosed information that the endangered salt marsh harvest mouse will not be impacted by the project. Also, potential project impacts to the candidate species, delta tule pea and Mason's lilaeopsis will be avoided or minimized. No other endangered, threatened, or candidate species will be affected by the project.

Accordingly, formal consultation pursuant to Section 7 of the Endangered Species Act is not necessary.

Sincerely,

Walter Yep
Chief, Planning Division

Enclosures

Copy Furnished:

Mr. James J. McKevitt, Field Supervisor, Division of Ecological Services, Fish and Wildlife Service, 2800 Cottage Way, Room E-1803, Sacramento, California 95825 without enclosure

Sacramento River Deep Water Ship Channel, California Project

Biological Assessment

January 1986

1. Introduction. - This biological assessment is required by Section 7(c) of the Endangered Species Act (16 USC 1533). A biological data report and addendum has been prepared analyzing impacts to one endangered species (salt marsh harvest mouse), and seven candidate species (Suisun shrew, California black rail, Suisun aster, Suisun thistle, California hibiscus, delta tule pea, and Mason's lilaeopsis). Two other species, the threatened valley elderberry longhorn beetle and the rare Sacramento anthicid beetle were also investigated, although they were not listed by the Endangered Species Office (ESO).

2. Biological Data. - TRS Consultants, Inc. and Harvey and Stanley Associates conducted field surveys of the study area from November 1984 through August 1985, as well as a literature search for the Corps. They used this data to prepare the Biological Data Report (BDR) dated September 1985. This report is enclosed and is hereby incorporated by reference. The September 1985 BDR was based on project descriptions included in the draft General Design Memorandum and Supplemental Environmental Impact Statement dated August 1985. A March 19, 1985, list of Federal endangered and threatened species was the basis for the BDR.

An addendum to the BDR was written to reflect project revisions and a re-analysis of the impacts to endangered and threatened species and candidate species addressed in the BDR. This reevaluation was mostly based on the results of a joint Corps/ESO field trip to the project site on December 13, 1985 and subsequent meetings. An updated list, dated December 20, 1986, from the ESO reflects this re-analysis.

Project Impacts to Endangered Species

Project boundaries were realigned for DMD sites 21 and 35 to avoid permanent impacts to existing wetlands, much of, but not all of which contain known and potential salt marsh harvest mouse habitat. These wetlands will not be used for DMD disposal. Contract plans and specifications will require that the wetland on DMD site 21 be entirely avoided.

Temporary impacts will occur to the wetland adjacent to S-35, in areas where discharge and outlet pipes will be placed for access to the disposal site during the construction period. Contract plans and specifications will require that these pipes be located on areas containing unsuitable salt marsh harvest mouse habitat, if possible. Access to this DMD site will be located on the least environmentally sensitive areas. Prior to

construction, field visits and evaluations will be made to identify the best locations of the pipes to cross the wetland. A Corps biologist in consultation with ESO will participate in these visits and evaluations. The contract plans and specifications will identify acceptable locations for pipe placement. A construction inspector and Corps biologist will conduct field investigations during construction to insure compliance with these requirements. Upon completion of the project, the contractor will be required to restore the access locations to preproject conditions. A Corps biologist will conduct a post construction evaluation assessing the contractor's compliance with these environmental requirements, along with a follow-up visit one year after completion of the construction to evaluate natural recovery of the site. If site recovery is not adequate, the biologist will develop a revegetation plan to be implemented by the Corps.

Project Impacts to Candidate Species

The BDR reported possible minor impacts to the delta tule pea due to construction and maintenance dredging in the natural channel as a result of the use of pipelines and other machinery at DMD sites at Rio Vista, Sherman Island and downstream of Grand Island. The report also predicted possible minor impacts to Mason's lilaeopsis due to construction activities in the natural channel below Cache Slough, if care is not taken to avoid clay benches with dredging pipelines and other machinery. Areas of specific concern are shorelines near Collinsville, Grand Island, Sherman Island, and the mitigation site at Prospect Island.

Construction and access will be designed to avoid or minimize impacts to candidate species. Exact locations of candidate species will be determined by a Corps biologist, in consultation with the ESO, and will be noted in contract plans and specifications. Discharge pipes and outlet pipes will be required to be located in the least environmentally sensitive areas to avoid or minimize impacts to candidate species. A construction inspector and Corps biologist will conduct field investigations during construction to insure compliance with these requirements. Upon completion of the project, the contractor will be required to restore the access locations to preproject conditions. A Corps biologist will conduct a post construction evaluation assessing the contractor's compliance with environmental requirements, along with a follow-up visit one year after completion of the construction to evaluate natural recovery of the site. If site recovery is not adequate, the biologist will develop a revegetation plan to be implemented by the Corps.

3. Assessment. - I have concluded that the salt marsh harvest mouse, an endangered species, will not be impacted by the Sacramento River Deep Water Ship Channel, California project. Also, the project will avoid or minimize impacts to two candidate species, the delta tule pea and Mason's lilaeopsis. No other endangered, threatened, or candidate species will be impacted by the project. Accordingly, formal consultation pursuant to Section 7 of the Endangered Species Act is not necessary.

2 Encl
1. Sacramento River Deep Water Ship Channel Project Endangered Species Biological Data Report dated September 1985 and Addendum dated January 1986
2. Draft Sacramento River Deep Water Ship Channel General Design Memorandum and Supplemental Environmental Impact Statement dated August 1985.

WAYNE J. SCHOLL
Colonel, CE
Commanding

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825

24 January 1986

Mr. Walter Yep
Chief, Planning Division
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

Subject: Endangered Species Informal Consultation on the Sacramento Deepwater Ship Channel (Case No. 1-1-86-I-141)

Dear Mr. Yep:

This responds to your letter of 22 January 1986 transmitting for our review the Biological Assessment, Addendum to the Biological Data Report, draft General Design Memorandum No. 1, and Supplemental Environmental Impact Statement for the subject project.

We have reviewed these documents and concur with your conclusion that the endangered salt marsh harvest mouse will not be affected. We also agree that impacts to candidate species would either not occur or would be minimized to the maximum extent possible. We therefore concur that formal consultation will not be necessary on this project.

We appreciate the cooperation of your staff in modifying this project to avoid impacts to endangered and candidate species. Close coordination between our respective staffs allowed possible conflicts to be resolved through informal consulation, thus avoiding any delay associated with formal consultation.

Sincerely,

David L. Harlow

for Gail C. Kobetich
Project Leader

cc: Field Supervisor, Ecological Services, Sacramento, CA (ES-S)
Chief, Endangered Species, Portland, OR (AFA-SE; Attn: Ralph Swanson)

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL,
CALIFORNIA

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

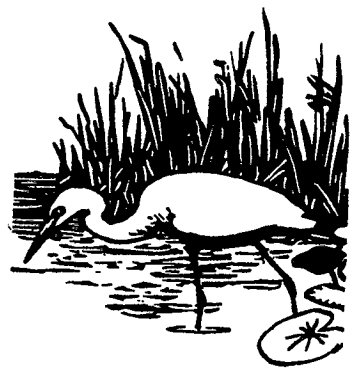
APPENDIX E

FISH AND WILDLIFE COORDINATION ACT REPORT

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL



REGION ONE

A SUPPLEMENTAL DETAILED REPORT ON FISH AND WILDLIFE RESOURCES

C—090920

C-090920

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
2800 Cottage Way, Rm. E-1803
Sacramento, California 95825

January 30, 1986

District Engineer
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Subject: CE - Sacramento River Deep Water Ship Channel Project

Dear Sir:

This supplements our detailed Fish and Wildlife Coordination Act report of March 20, 1980 regarding the effects of deepening and widening the Sacramento River Deep Water Ship Channel, Sacramento, Yolo, Solano and Contra Costa Counties, California, on fish and wildlife resources. It includes (1) an assessment of those impacts associated with changes in the location of disposal sites and the increase in acreage of disposal sites from 3,500 (formerly evaluated) to 4,464 acres, and (2) a refinement of project impacts and mitigation measures, provided in our March 20, 1980 report, using the Fish and Wildlife Service's Habitat Evaluation Procedures (HEP).

It has been prepared under the authority, and in accordance with the provisions, of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.). It is for inclusion in your General Design Memorandum for the Sacramento River Deep Water Ship Channel project.

The findings of this report are based on project changes provided by the Corps of Engineers prior to February 1986, available data, field investigations, and surveys conducted according to the methods set forth in the Fish and Wildlife Service's Habitat Evaluation Procedures (HEP).

The HEP provides a means to calculate an index of existing and future conditions. Characteristics of the community are appraised with respect to their value in providing the necessary habitat requirements for selected species. The habitat carrying capacity is displayed as Habitat Unit Values, an index of quality and quantity of the habitat being evaluated (Appendix I). The basic objective of these procedures is to quantify, in nonmonetary terms, the impacts of the plan and to provide a basis for determining the preservation, compensation and enhancement measures which are needed to maintain the integrity of the ecosystem.

Our recommendations are based on the U.S. Fish and Wildlife Service's Mitigation Policy (Federal Register, Volume 46:15, January 23, 1981) which provides internal guidance for establishing appropriate compensation for projects under our purview. Under this policy, resources are divided into four categorie to assure that recommended compensation is consistent with the fish and wildlife values involved. These resource categories cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be relatively low value to fish and

wildlife. In accordance with the policy, we have designated the tidal marsh and riparian habitat in the project area as Resource Category 2, and the agricultural and grassland areas as Resource Category 3.

The riparian and wetland habitats are of high value and becoming scarce locally and nationally, thus they have been included in Resource Category 2. As such, our mitigation goal is no net loss of in-kind habitat value. Both wetland and riparian habitats are extremely valuable habitat types in California; they also are scarce and extremely vulnerable to development. These habitat types support a greater number and a more diverse assemblage of wildlife species than other types in California. Therefore, any further loss of these habitat types should be discouraged. Habitat within the agriculture and grassland areas are in Resource Category 3. This habitat is of high to medium value for evaluation species and is relatively abundant locally and nationally. Therefore, the mitigation goal is no net loss of habitat value while minimizing loss of in-kind habitat value.

The recommendations presented in this report have the concurrence of the California Department of Fish and Game as indicated by the attached copy of Director Jack C. Parnell's letter of January 28, 1986. The report was also reviewed by the National Marine Fisheries Service.

DESCRIPTION OF THE PROJECT

The selected plan is as described in our March 1980 report except for changes in location of some sites and the increase in acreage of disposal sites from 3,500 acres to 4,464 acres. It still includes deepening and widening portions of the 46.5-mile long Sacramento River Deep Water Ship Channel between New York Slough to the Port of Sacramento. From New York Slough to Junction Point (Mile 15), the channel will be widened from 300 to 350 feet. No deepening will be needed from New York Slough to Collinsville. The channel will be deepened from 30 to 35 feet mean lower low water (MLLW) between Junction Point to the entrance of the man-made channel (Mile 18.6). From here, the channel will be widened from 200 to 250 feet and deepened from 30 to 35 feet MLLW. Material dredged from the channel will be placed on sites shown on Plate 1 and listed in Table 1. Several of the sites are existing disposal sites used during channel maintenance dredging operations conducted every 2 to 3 years. The capacity of the disposal sites is 34 million cubic yards, but only 21.5 million cubic yards are expected to be deposited within the 4,464 acres during the 7-year construction period. Construction of dikes or bulkheads to retain dredged material will be the responsibility of the local sponsor. All disposal sites will be partitioned to eliminate rapid return of effluent to the river to meet State and Federal water quality standards.

WITHOUT THE PROJECT

Fish and Wildlife

Fish and wildlife resources are as described in our March 1980 report. The proposed disposal sites consist primarily of 4,464 acres of agricultural lands and grasslands. It includes 935 acres of land (Sites S14, S16 and S19) presently used for disposal during channel maintenance operations conducted

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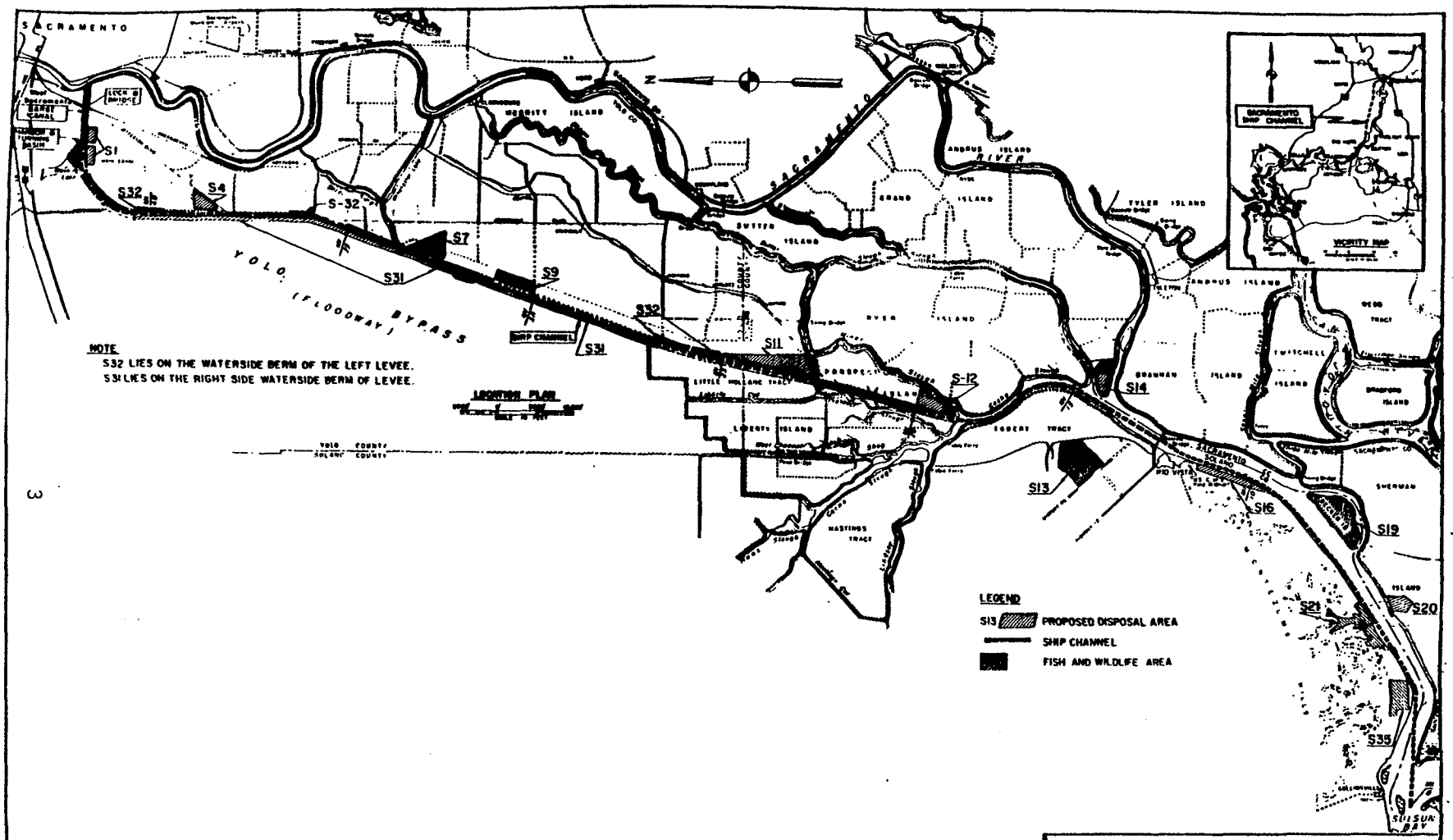

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

GENERAL MAP
CORPS OF ENGINEERS

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
Sacramento, Solano, Yolo Counties, Calif.

January 1986 Sacramento, Calif.

PLATE I

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Table 1. SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
PROPOSED DREDGED DISPOSAL AREAS

Disposal Site	Acres	Capacity* (cubic yards)	Authority**
S 1	158	1,300,000	PS
S 4	137	1,100,000	Private
S 7	228	1,800,000	Private
S 9	173	1,400,000	Private
S 11	640	5,200,000	Private
S 12	241	1,400,000	PS
S 13	570	4,700,000	DWR
S 14	196	1,600,000	COE,RB
S 16	149	1,200,000	COE
S 19	590	4,800,000	RB,PS,COE
S 20	98	800,000	PS
S 21	160	1,300,000	RB
S 31	663	4,300,000	PS
S 32	265	1,500,000	PS
S 35	196	1,600,000	RB,COE
	4,464	34,000,000	

* 5' disposal depth, except S 12, S 31 and S 32
3.7' disposal depth on S 12
4' disposal depth on S 31
3.8' disposal depth on S 32

** PS - Port of Sacramento
DWR - Department of Water Resources
COE - Corps of Engineers
RB - State Reclamation Board

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every 2 to 3 years. Therefore, no change of wildlife values is expected. The present uses of these lands are expected to continue in the future. Some development may occur on lands near the Port of Sacramento facilities; however, it is expected to be minimal.

Endangered and Threatened Species

In response to a request from the Corps, a list of endangered and threatened species for the project area was provided by the Sacramento Endangered Species Office in a letter dated December 20, 1985.

Listed Species

Saltmarsh harvest mouse	*Reithrodontomys raviventris* (Endangered)

Candidate Species

Suisun shrew	*Sorex ornatus sinuosus*
California black rail	*Laterallus jamaicensis coturniculus*
Suisun aster	*Aster chilensis* var. *lentus*
Suisun thistle	*Cirsium hydrophilum* var. *hydrophilum*
California hibiscus	*Hibiscus californicus*
Delta-tule-pea	*Lathyrus jepsonii* subsp. *jepsonii*
Mason's lilaeopsis	*Lilaeopsis masonii*

WITH THE PROJECT

Fish and Wildlife

The with-project analysis described in our March 1980 report is still applicable for fish resources. However, impacts on wildlife resources will change. Widening of the man-made portion of the channel will result in the loss of 52 acres of wildlife habitat consisting of 9 acres of tidal mudflat, 18 acres of tidal marsh, and 25 acres of riparian vegetation. As stated in our previous report, there will be some regrowth of riparian and marsh vegetation following construction; however, these areas will not return to pre-project levels. It is estimated that there will be a recovery of 26 acres of marsh and riparian vegetation.

The size of the disposal sites has increased from 3,500 acres to 4,464 acres. About 21.5 million cubic yards of dredged material will be placed on 4,464 acres of mainly agricultural and grassland areas. The loss of terrestrial wildlife values within these habitats will be severe but only temporary. We believe that there will be a two-year loss of wildlife values on 4,464 acres, including those sites currently being used for deposition of dredged material during channel maintenance. We also believe that wildlife values on agricultural and grassland areas will return to pre-project levels after the initial two-year loss. Maintenance dredging disposal sites will continue to be periodically cleared of vegetation and disposed upon as under without-project conditions. Therefore, no additional loss of wildlife habitat values are expected to occur. In fact, as proposed, alternating use of these sites under with-project conditions would provide some additional wildlife values. Impacts are quantified in the HEP analysis appended to this supplemental report.

We believe the project will induce some development on lands on and adjacent to the Port of Sacramento. However, as stated earlier, developments could also occur without the project. Therefore, without a firm basis to determine the impact on land-use change, an analysis was not conducted on this aspect of the project.

Endangered Species

The January 24, 1986 response (attached) to the Corps from the Sacramento Endangered Species Office concurred with the Corps' conclusion that the endangered saltmarsh harvest mouse will not be affected by construction activities. Also, impacts to candidate species would either not occur or would be minimized to the maximum extent possible.

DISCUSSION

In our March 1980 report, we recommended management of a 45-acre area at the southern end of Prospect Island to offset marsh and riparian habitat losses along the man-made channel. In addition, we recommended that the loss of upland habitat at the disposal sites be offset by the development of 156 acres of upland habitat in small tracts on the disposal areas. Upland habitat, comprised mainly of grassland and agricultural land, is relatively common and loss of wildlife value for evaluation species will be temporary. We believe that additional wetland and riparian habitats should be developed in lieu of upland habitat. Consequently, a method to determine trade-off or relative values for the evaluation species was used to determine the additional wetland and riparian habitats needed for compensation (Appendix I).

Based on the HEP analysis, about 63 acres will be needed to compensate the loss of 129 relative average annual habitat units (AAHU's) due to project construction. As such, we recommend that an additional 18 acres of agricultural land within the adjacent disposal site (S-12) be included as part of the proposed compensation plan. The plan is to convert 63 acres of agricultural land into a series of elongated mudflats, marsh, and shrub and tree covered islands surrounded by open-water sloughs and levees. Mean elevation of the mitigation site is +2.0 feet or about mean sea level (NVGD). Work would involve construction of a levee on the north side, excavation of the site to elevations needed to obtain the habitat types and acreages listed below.

	Habitat types	Elevations	Acres
1.	Open water, subtidal	-3' below MLLW	8
2.	Tidal mudflats	MLLW to MSL	20
3.	Tidal marsh	MSL to MHHW	20
4.	Riparian	MHHW to +3'	15
		Total	63

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Material dredged from the man-made channel during construction of the project could be used to construct the north cross levee. Levee construction should be done early in order to provide a basin on the mitigation site for island development. Slope construction for the establishment of tidal mudflats and emergent aquatic vegetation should be about 15 to 1. The transition from wetland to upland habitat should be on a slope of 4 to 1 with a level area at the top of the islands.

Aquatic vegetation is expected to establish naturally from nearby seed sources. As such, planting will not be necessary. Although riparian vegetation such as willow and alder trees will establish naturally, planting should be done in order to assure diversity and density within the area. When construction of the area is completed, and trees and shrubs are planted, the levee should be breached on the southern end of Prospect Island to allow tidal flow into the area. Further design studies will be required to determine the width of the area to be breached.

Major costs would result from earthwork needed to construct the compensation area to the desired configuration. Estimated cost to develop the area is $1,000,000 and should be a project cost. Maintenance costs are expected to be minimal and should be included in the operation and maintenance program for the project. Once developed, the site should be monitoried by the Corps and Fish and Wildlife Service to evaluate the success of the wetland development.

There is an opportunity to enhance marsh habitat in connection with project construction as authorized under Section 150 of the Water Resources Development Act of 1976 (Public Law 94-587). Given certain conditions specified in the statute, including costs not to exceed $400,000, wetland development with the use of dredged material can be allocated to the Federal government.

Potential areas were identified in our March 1980 report. Since that time, however, a different area has been tentatively selected for marsh development. The area is located immediately west of Sherman Island at the confluence of the Sacramento and San Joaquin Rivers. The total area encompasses an estimated 3,000 acres which is about equally divided with emergent aquatic vegetation and subtidal habitat. Water depths throughout most of the area are relatively shallow and vary from 2 to 6 feet deep.

The basic plan is to construct several islands by selective placement of fill in the open-water environment with material dredged from the Sacramento River Deep Water Ship Channel. Design criteria should be similar to that of nearby Donlon Island. The number, size and location for construction of the islands has not been determined, but will depend on additional development costs not exceeding $400,000. Details should be coordinated with the Fish and Wildlife Service, the California Department of Fish and Game, National Marine Fisheries Service, and the Environmental Protection Agency.

There is, of course, concern with the disposal of dredged material in an open-water environment relative to impacts on aquatic resources. A variety of resident and anadromous fishes utilize the area for various life cycle phases. Juvenile chinook salmon pass through the area between

early April and late June on their way to the ocean. These small fish feed on benthic organisms. The area is also utilized by striped bass. Sampling for benthic organisms and presence of young salmon should be done this spring prior to and commensurate with the out-migration of young chinook salmon. This study should be coordinated with the Service, Department of Fish and Game and National Marine Fisheries Service. Following completion of the study, the Service will assess the impacts of placing dredged material on aquatic resources. However, until this evaluation has been completed, we tentatively recommend that the Corps proceed with the enhancement plan.

RECOMMENDATIONS

We recommend:

1. That the report of the District Engineer, Corps of Engineers, include the conservation and development of fish and wildlife resources among the purposes for which the project is to be authorized.

2. That to compensate for the loss of wildlife habitat values due to construction of the project, the Corps of Engineers convert 63 acres at the southern end of Prospect Island to tidal wetlands as described in the Discussion Section. Capital costs to develop the area are estimated to be $1,000,000 and should be a project cost. The Fish and Wildlife Service and California Department of Fish and Game be consulted during advanced planning for technical assistance on the development of the 63-acre area. Once developed, the site should be monitored by the Corps and Service to evaluate the success of the wetland developement.

3. That to enhance wetlands, the Corps use material dredged from the Sacramento River Deep Water Ship Channel to construct islands within the open-water area immediately west of Sherman Island. Details for this development should be coordinated with the Service, California Department of Fish and Game and the National Marine Fisheries Service. Cost of this enhancement measure should be a Federal cost.

Please advise us of your proposed action regarding these recommendations.

Sincerely,

James J. McKevitt
Field Supervisor

C—090928

C-090928

STATE OF CALIFORNIA—RESOURCES AGENCY

GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814
(916) 445-3535

January 27, 1986

James J. McKevitt
Field Supervisor
Division of Ecological Services
2800 Cottage Way, Room E-1803
Sacramento, CA 95825

Dear Mr. McKevitt:

The Department of Fish and Game has reviewed and concurs with your July, 1985 Draft Fish and Wildlife Coordination Act Report on the Corps' Sacramento Deep Water Ship Channel Project in Yolo, Sacramento, and Solano counties.

If the Department can be of further assistance, please contact Paul T. Jensen, Regional Manager, Region 2, 1701 Nimbus Road, Suite A, Rancho Cordova, CA 95670, telephone (916) 355-0922.

Sincerely,

Jack C. Parnell
Director

SACRAMENTO ENDANGERED SPECIES OFFICE
2800 Cottage Way, Room E-1823
Sacramento, California 95825

24 January 1986

Mr. Walter Yep
Chief, Planning Division
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, California 95814

Subject: Endangered Species Informal Consultation on the Sacramento Deepwater Ship Channel (Case No. 1-1-86-I-141)

Dear Mr. Yep:

This responds to your letter of 22 January 1986 transmitting for our review the Biological Assessment, Addendum to the Biological Data Report, draft General Design Memorandum No. 1, and Supplemental Environmental Impact Statement for the subject project.

We have reviewed these documents and concur with your conclusion that the endangered salt marsh harvest mouse will not be affected. We also agree that impacts to candidate species would either not occur or would be minimized to the maximum extent possible. We therefore concur that formal consultation will not be necessary on this project.

We appreciate the cooperation of your staff in modifying this project to avoid impacts to endangered and candidate species. Close coordination between our respective staffs allowed possible conflicts to be resolved through informal consulation, thus avoiding any delay associated with formal consultation.

Sincerely,

David L. Harlow

Gail C. Kobetich
Project Leader

cc: Field Supervisor, Ecological Services, Sacramento, CA (ES-S)
Chief, Endangered Species, Portland, OR (AFA-SE; Attn: Ralph Swanson)

2

APPENDIX 1

HABITAT EVALUATION PROCEDURES

(1980 HEP)

SACRAMENTO DEEP WATER SHIP CHANNEL

U.S. ARMY CORPS OF ENGINEERS, SACRAMENTO DISTRICT

CONDUCTED BY THE U.S. FISH AND WILDLIFE SERVICE

IN COOPERATION WITH

CALIFORNIA DEPARTMENT OF FISH AND GAME

U.S. ARMY CORPS OF ENGINEERS

NATIONAL MARINE FISHERIES SERVICE

PORT OF SACRAMENTO

June 1985

INTRODUCTION

The selected plan for the Sacramento River Deep Water Ship Channel is essentially that described in the July 1980 feasibility report and EIS prepared by the Corps of Engineers, Sacramento District (Plate 1, Table 1).

METHODOLOGY

The 1980 Habitat Evaluation Procedures (HEP) were used in the field evaluation conducted on April 22 and 23, 1985. Participants in the field analysis were Bob Mapes, California Department of Fish and Game; Wally Wiest, U.S. Fish and Wildlife Service; Carol Calza, Corps of Engineers; George Redpath, consultant to the Port of Sacramento; and Paget Leh, National Marine Fisheries Service. Two observers also assisted in the evaluation: Nancy Olmsted, consultant to the Corps on the project and Ron Duke, a private consultant.

Seven vegetative types were evaluated. These included:

(1) Agriculture (2,239 acres; Sites S1, S4, S7, S9, S11, S12, and S31) - This type consists mainly of field and row crops such as corn and safflower;

(2) Grassland (2,029 acres; Sites S13, S16, S19, S20, S21, S32, and S35) - The areas are presently grazed by cattle. One site, S16 south of Rio Vista was being cleared of woody vegetation when the HEP team conducted the field evaluation. This is one of the existing disposal sites used during maintenance dredging;

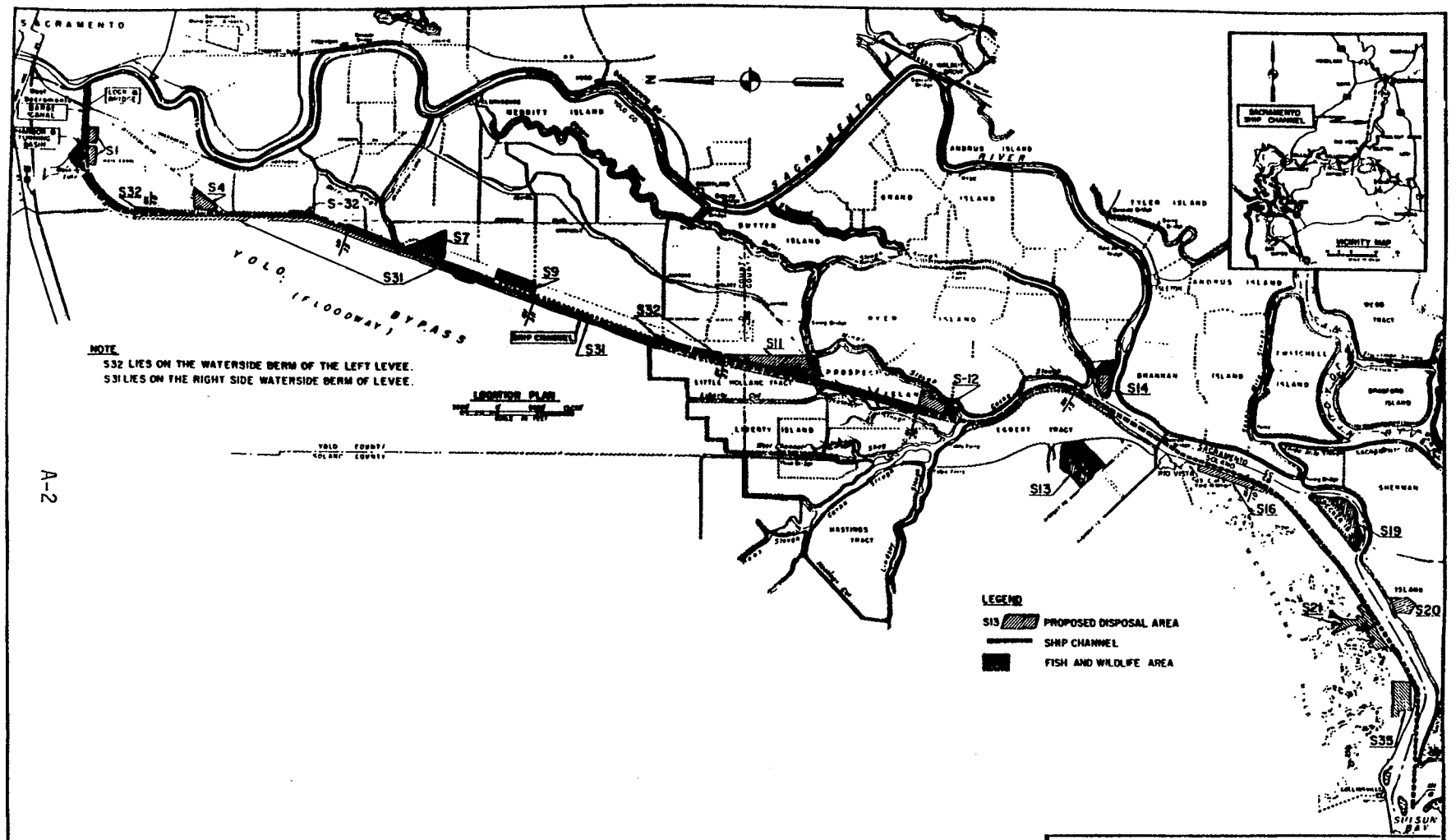
(3) Disturbed woodland (196 acres; S14, Grand Island) - This site, although currently used as a maintenance dredging spoil site, has some good stands of cottonwood and willows. We were informed by the Corps that the wooded sections would be periodically cleared for disposal of dredged material without or with the project;

(4) Seasonal wetlands - This type occurs within Site 35 and consists of sparse growths of pickleweed and brass buttons within low-lying areas in the southeast portion of the site that pond water during the winter. These areas were evaluated by the HEP team. However, due to the relatively small and undetermined acreage within the grassland site, this type was not included in the HEP analysis;

(5) Tidal mudflats - An estimated 9 acres occur along the man-made channel;

(6) Tidal marsh (18 acres) - Vegetation is primarily cattail, bulrushes and sedges;

(7) Riparian (25 acres) - Vegetation consists mainly of willow trees, brush and some blackberries.



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

GENERAL MAP
CORPS OF ENGINEERS

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
Sacramento, Solano, Yolo Counties, Calif.

January 1986 Sacramento, Calif.

PLATE I

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Table 1. SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
PROPOSED DREDGED DISPOSAL AREAS

Disposal Site	Acres	Capacity* (cubic yards)	Authority**
S 1	158	1,300,000	PS
S 4	137	1,100,000	Private
S 7	228	1,800,000	Private
S 9	173	1,400,000	Private
S 11	640	5,200,000	Private
S 12	241	1,400,000	PS
S 13	570	4,700,000	DWR
S 14	196	1,600,000	COE,RB
S 16	149	1,200,000	COE
S 19	590	4,800,000	RB,PS,COE
S 20	98	800,000	PS
S 21	160	1,300,000	RB
S 31	663	4,300,000	PS
S 32	265	1,500,000	PS
S 35	196	1,600,000	RB,COE
	4,464	34,000,000	

* 5' disposal depth, except S 12, S 31 and S 32
3.7' disposal depth on S 12
4' disposal depth on S 31
3.8' disposal depth on S 32

** PS - Port of Sacramento
DWR - Department of Water Resources
COE - Corps of Engineers
RB - State Reclamation Board

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EVALUATION SPECIES

The evaluation species used for the field evaluation are listed in Table 2 and were based primarily on feeding guilds. Approved habitat suitability index (HSI) models were not available for this evaluation.

California Fish and Wildlife Habitat Relationships System, Species Notes (CDFG) were used as a reference in which a combination word model with variables was developed for use by the HEP team (Appendix 1-1 to HEP).

Ratings for evaluation species within each habitat type were averaged to produce a habitat suitability index (HSI) for each evaluation species. The HSI, a number between 0 and 1.0, is a measure of the capacity of the study area to meet the life requisites of the species evaluated. The HSI, when multiplied by the acreage of each habitat type utilized by the evaluation species, yields the total number of habitat units (HU), a measure of the quality and quantity of habitat available to each evaluation species.

ASSUMPTIONS

For the 15 species selected, the HEP team evaluated baseline habitat conditions and also future without project and with project conditions. Using HSI values produced in the baseline habitat evaluation, the team predicted with-project future HSI values. For this evaluation, assumptions were adopted by the HEP team for predicting future without project and future with project conditions. They are as follows:

Scenario (Future Without the Project)

1. The existing disposal sites (S14, S16 and S19), now being used for disposal of material during maintenance dredging at about 3 year intervals (Mile 0-15), will continue to be used in the future. Maintenance dredging of the man-made channel and placement of dredged materials within S31 and S32 will continue at intervals of about 7-8 years.

2. Periodic clearing of woodland habitat within S14 (Grand Island) will occur similar to S16 (Rio vista) for the purpose of placing dredge materials (about every 3 years).

3. Present use of lands for agriculture and grassland production in the future.

4. Tidal wetlands north of the turning basin and at Lake Washington will not be degraded or filled in the future.

5. Water-quality conditions in the project channel will not change significantly in the future.

6. The man-made portion of the channel will not be riprapped in the future.

Table 2. STUDY AREA EVALUATION SPECIES AND COVER TYPES

Evaluation Species	Agriculture 2,239 acres	Grassland 2,029 acres	Wood/Grass. 196 acres	Tidal flat 9 acres	Tidal marsh 18 acres	Riparian 25 acres
Rufous-sided towhee			Reproductive Cover			Reproductive Cover
Great Egret	Feeding			Feeding		
Western sandpiper				Feeding		
Long-billed marsh wren					Reproductive Cover	
Bushtit			Reproductive Cover			Reproductive Cover
Greater yellowlegs				Feeding		
Red-winged blackbird	Feeding				Reproductive Cover	
Black-shouldered kite	Feeding	Feeding	Reproductive Cover			
Meadowlark	Feeding	Reproductive Cover				
Ring-necked pheasant	Reproductive Cover	Feeding				
Muskrat					Reproductive Cover	
Striped skunk			Reproductive Cover			Feeding
California vole		Reproductive Cover				
Belted kingfisher						Reproductive Cover
Black phoebe						Feeding

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7. There will be no significant change in the amount of marsh/riparian habitat along the project channel.

Scenario (Future With the Project)

1. Dredged material will be placed within the entire 4,464 acres of designated disposal sites during project construction.

2. The land-use data provided by the Corps indicated that 670 acres (Sites S1, S2, S3, S21 and S35) may be developed for industrial purposes in the future. Some of this may occur without the project and some may be project-induced. Without any firm basis to make this determination, we did not include this in our analysis.

3. There will be a 2-year loss of HU values for evaluation species on 2,239 acres of agriculture land and 2,029 acres of grassland during the 7-year construction period. Return to baseline or existing acreage will occur at target year 9. The HU values for evaluation species will remain the same during the period of analysis on acreage in full production.

4. Woodland habitat within S14 (Grand Island) will remain in a disturbed condition. This will be due to periodic clearing a portion of the site for deposition during maintenance dredging. Losses will occur during placement of dredged material in the entire area during project construction.

5. About 9 acres of tidal mudflats will be lost due to widening of the man-made channel. There is little sedimentation in the man-made portion of the channel. Erosion of the berm will continue, but at a lower rate than under present conditions. As such, we assumed that there will be little, if any, recovery of mudflats following project construction.

6. Channel widening will result in a loss of 18 acres of tidal marsh and 25 acres of riparian vegetation along both sides of the man-made channel during project construction. Marsh and riparian vegetation occur at the edge of the bank on the channel berm. Recovery of marsh and riparian habitat is estimated to be 60 percent of the original acreage or about 10.8 acres of marsh and 15 acres of riparian. We estimate a recovery of habitat values for evaluation species in the tidal marsh to pre-project levels 7 years following project construction and 10 for riparian habitat.

7. Dredged material will be contained within all disposal sites and that there will be no degradation of adjacent wetlands or terrestrial habitat.

8. There will be more benthic habitat created by channel widening. However, deeper draft ships will tend to keep the channel bottom in a turbid condition. There will be no significant change in the quality of subtidal habitat in the man-made channel.

RESULTS

Data analysis was performed using version II of the HEP accounting software for micros. Results of the field evaluation of baseline conditions indicate that there are 9,350 Habitat Units in the project area (Table 3). Species with the highest number of Habitat Units are species associated with grasslands and agriculture lands. Habitat Suitability Index (HSI) values for baseline conditions varied from 0.2 to 0.7.

Changes in the average annual habitat units (AAHU's) under future without project is the same as baseline conditions. All habitat types evaluated were assumed to be managed for agricultural purposes, and grasslands at the existing disposal sites will continue to be used for the same purpose without and with the project.

Changes in the average annual habitat units under future with project conditions indicate that there will be a total of 9,109 Habitat Units or a reduction of about 240 HU's (Table 4). Most of the losses will occur to evaluation species within the agricultural areas and grasslands. Also, these losses will be for two years only out of the 55-year analysis period.

The proposed compensation plan evaluated by the HEP team is to create tidal wetlands and riparian habitat to offset project-caused losses.

These habitat types are not only very valuable but scarce in California and the project area. As such, it seemed more equitable to develop trade-off values. These are defined by a Relative Value Index (RVI) value for each evaluation species. Under this concept, a gain of HU's for one species is used to offset the loss of HU's for another species at a differential rate depending on the species involved. Table 5 presents the criteria and relative weights used to derive RVI's for the evaluation species. The derivation of RVI's are shown in Table 6. Based on the use of RVI values, 129 Relative AAHU's will be lost as a result of the project (Table 7). This indicates that an acceptable compensation plan must be developed to offset at least 129 relative or weighted HU's annually.

MITIGATION

The HEP team selected the same 45-acre site at the southern end of Prospect Island for mitigating unavoidable adverse impacts due to project construction as identified in our March 1980 report. The plan is to replace the loss of HU's for evaluation species by converting agricultural lands at the southern end of Prospect Island to tidal wetlands and riparian habitat. The basic plan is to construct a series of elongated mudflats, marsh, tree and shrub covered islands surrounded by open-water sloughs and levees. Based on management activities indicated in Table 8, the existing habitat values for evaluation species within the proposed mitigation area, the HEP team developed HSI values for key target years. Based on this development plan, there will be a gain of 88 AAHU's (Relative). In order to achieve compensation, 63 acres will be needed as shown in Table 9.

Table 3

Form B: Habitat Units Date: 06/07/1985

Study Name: SACRAMENTO SHIP CHANNEL HEP
Action: PA 1 (without project) WITHOUT PROJECT
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	BL SHOULDERED KITE	4464.00	0.53	2365.92
2	MEADOWLARK	4268.00	0.50	2134.00
3	RING-NECKED PHEASANT	4268.00	0.45	1920.60
4	CALIFORNIA VOLE	2029.00	0.70	1420.30
5	RED-WINGED BLACKBIRD	2257.00	0.50	1128.50
6	STRIPED SKUNK	221.00	0.69	152.49
7	BUSHTIT	221.00	0.50	110.50
8	RUFOUS-SIDED TOWHEE	221.00	0.30	66.30
9	BLACK PHOEBE	25.00	0.55	13.75
10	BELTED KINGFISHER	25.00	0.40	10.00
11	MUSKRAT	18.00	0.30	5.40
12	L-B MARSH WREN	18.00	0.20	3.60
13	GREAT EGRET	27.00	0.26	7.02
14	GREATER YELLOWLEGS	9.00	0.60	5.40
15	WESTERN SANDPIPER	9.00	0.70	6.30
				9350.08

Table 4

Form D: Net Change in AAHU's

Date: 06/07/1985

Study Name: SACRAMENTO SHIP CHANNEL HEP
Action: PA 2 (with project) WITH PROJECT
Compared To: PA 1 (without project) WITHOUT PROJECT
Period of analysis: 55

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	BL SHOULDERED KITE	2322.90	2365.92	-43.02
2	MEADOWLARK	2095.20	2134.00	-38.80
3	RING-NECKED PHEASANT	1885.68	1920.60	-34.92
4	CALIFORNIA VOLE	1394.48	1420.30	-25.82
5	RED-WINGED BLACKBIRD	1104.73	1128.50	-23.77
6	STRIPED SKUNK	131.54	152.49	-20.95
7	BUSHTIT	95.34	110.50	-15.16
8	RUFOUS-SIDED TOWHEE	57.21	66.30	-9.09
9	BLACK PHOEBE	7.84	13.75	-5.91
10	BELTED KINGFISHER	5.84	10.00	-4.16
11	MUSKRAT	3.17	5.40	-2.23
12	L-B MARSH WREN	2.12	3.60	-1.48
13	GREAT EGRET	2.39	7.02	-4.63
14	GREATER YELLOWLEGS	0.43	5.40	-4.97
15	WESTERN SANDPIPER	0.50	6.30	-5.80
		9109.37	9350.08	-240.71

Table 5

Relative Weights of Criteria From Pair-wise Comparison (Form E Results)

Date: 06/07/1985

Study Name: SACRAMENTO SHIP CHANNEL HEP
Form Number: EE1 SDWSC REL WTS

Ranking Criterion ID	Name	Relative Weight
1	SCARCITY	0.33
2	VULNERABILITY	0.23
3	REPLACEABILITY	0.20
4	AESTETIC VALUE	0.17
5	MGMT EFFORTS	0.07
	Total:	1.00

Pair-wise comparison of criteria

ID#	1	2	3	4	5
1	0.0	1.0	1.0	1.0	1.0
2	0.0	0.0	0.5	1.0	1.0
3	0.0	0.5	0.0	0.5	1.0
4	0.0	0.0	0.5	0.0	1.0
5	0.0	0.0	0.0	0.0	0.0

Table 6

Relative Value Indices From
Relative Weights (Form F Results)

Date: 06/07/1985

Study Name SACRAMENTO SHIP CHANNEL HEP
Form Number: FF 1 FF1
Source of Relative Weights: EE 1
Rescale Factor 1

Evaluation ID#	Species Name	Relative Value Index
1	BL SHOULDERED KITE	0.69
2	MEADOWLARK	0.39
3	RING-NECKED PHEASANT	0.54
4	CALIFORNIA VOLE	0.12
5	RED-WINGED BLACKBIRD	0.46
6	STRIPED SKUNK	0.30
7	BUSHTIT	0.76
8	RUFOUS-SIDED TOWHEE	1.00
9	BLACK PHOEBE	0.81
10	BELTED KINGFISHER	0.96
11	MUSKRAT	0.64
12	L-B MARSH WREN	0.91
13	GREAT EGRET	0.73
14	GREATER YELLOWLEGS	0.93
15	WESTERN SANDPIPER	0.91
16	CINNAMON TEAL	0.90

Species Rated by Criteria (Relative Importance Values)

Species ID#	Ranking Criterion ID 1	2	3	4	5
1	0.80	0.30	0.50	0.80	0.40
2	0.40	0.30	0.20	0.50	0.10
3	0.50	0.30	0.20	0.80	0.80
4	0.10	0.10	0.10	0.10	0.10
5	0.30	0.50	0.40	0.50	0.20
6	0.20	0.40	0.30	0.20	0.10
7	0.80	0.60	0.70	0.50	0.40
8	0.90	0.80	0.90	0.80	0.90
9	0.80	0.60	0.60	0.80	0.60
10	0.80	0.80	0.90	0.80	0.90
11	0.50	0.70	0.60	0.50	0.20
12	0.90	0.80	0.80	0.50	0.80
13	0.60	0.50	0.60	0.90	0.60
14	1.00	0.20	1.00	0.90	1.00
15	1.00	0.20	1.00	0.80	1.00
16	0.70	0.80	0.80	0.90	0.70

Table 7

Form G-1: Net Change in Relative AAHU's Date 06/07/1985

Study Name: SACRAMENTO SHIP CHANNEL HEP
Action: PA 2 (with project) WITH PROJECT
Compared To: PA 1 (without project) WITHOUT PROJECT
Period of analysis: 55
Source of Relative Value Indicies: FF 1

Evaluation Species ID#	Name	Net Change in AAHU's	Relative Value Index	Net Change in Rel. AAHU's
1	BL SHOULDERED KITE	-43.02	0.69	-29.84
2	MEADOWLARK	-38.80	0.39	-15.04
3	RING-NECKED PHEASANT	-34.92	0.54	-18.81
4	CALIFORNIA VOLE	-25.82	0.12	-3.00
5	RED-WINGED BLACKBIRD	-23.77	0.46	-10.87
6	STRIPED SKUNK	-20.95	0.30	-6.33
7	BUSHTIT	-15.16	0.76	-11.57
8	RUFOUS-SIDED TOWHEE	-9.09	1.00	-9.09
9	BLACK PHOEBE	-5.91	0.81	-4.81
10	BELTED KINGFISHER	-4.16	0.96	-4.00
11	MUSKRAT	-2.23	0.64	-1.42
12	L-B MARSH WREN	-1.48	0.91	-1.35
13	GREAT EGRET	-4.63	0.73	-3.37
14	GREATER YELLOWLEGS	-4.97	0.93	-4.61
15	WESTERN SANDPIPER	-5.80	0.91	-5.26
				-129.37

Table 8

Mitigation Alternatives, Management Activities
and Corresponding Habitat Conditions

Mitigation Site:	63-acre area at the southern end of Prospect Island.	
Management Activity:	Convert 63 acres of agricultural land to tidal mudflat, tidal marsh and riparian habitat.	
Habitat Conditions:	Years 1,4 :	Land in agricultural uses.
	Year 5 :	Construct shallow water areas and six islands. Plant riparian vegetation. Open area to tidal action. No habitat values.
	Year 12 :	Marsh vegetation provides <u>optimum</u> values for wetland species. Riparian values low.
	Year 15 :	Riparian vegetation provides some cover for nesting and foraging.
	Year 25 :	All trees and shrubs mature; provide <u>optimum</u> values for riparian-associated species.
	Years 26,55:	Same as year 25.

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C-090944

Table 9

Form G-1: Net Change in Relative AAHU's Date 06/07/1985

Study Name: SACRAMENTO SHIP CHANNEL HEP
Action: MP 2 (with project) MARSH RESTORATION
Compared To: MP 1 (without project) MARSH RESTORATION
Period of analysis: 55
Source of Relative Value Indicies: FF 1

Evaluation Species ID#	Name	Net Change in AAHU's	Relative Value Index	Net Change in Rel. AAHU's
1	BL SHOULDERED KITE	-20.32	0.69	-14.10
2	MEADOWLARK	-12.19	0.39	-4.73
3	RING-NECKED PHEASANT	-32.51	0.54	-17.51
5	RED-WINGED BLACKBIRD	-20.32	0.46	-9.29
7	BUSHTIT	31.05	0.76	23.71
11	MUSKRAT	29.05	0.64	18.46
12	L-B MARSH WREN	38.45	0.91	35.03
14	GREATER YELLOWLEGS	34.61	0.93	32.06
16	CINNAMON TEAL	26.92	0.90	24.31
				87.94

Area needed for compensation: 63.52 acres

C-090945

C-090945

APPENDIX I-I

(to HEP)

RUFOUS-SIDED TOWHEE -Riparian and Woodland (Reproductive cover)

Feeding - Feeds on insects and seeds by scratching in leaf litter and humus. Assume that 2 inches in depth would be optimal and bare ground 0.0.

Cover - Feeds or forages beneath overhanging vegetation or shrubs and thickets. A combination of lateral and overhead screening provided by trees and/or shrubs is preferred. Assume that 100 percent tree canopy and branches of trees that hang close to the ground in woodlands would be optimal. In shrub or brushland a ground cover of 50-60 percent and height of 3 to 6 feet would be suitable.

Reproductive Cover - Nests are built in self-made depressions on the ground concealed by surrounding vegetation, i.e., in dense brush, vine tangles and slash piles. The HSI will be a combination of the variables below:

Feeding (Combination of % ground cover and depth of litter/humus)

2 inches of litter/humus	- 1.0
1 inch of litter/humus	- 0.6
one-half inch "	- 0.3
Bare ground	- 0.0

Percent Tree or Shrub Canopy			Lateral screening (overhanging branches)	
Dense	(60-100%)	0.7-1.0	Ground to 1 foot	- 1.0
Moderate	(40-59%)	0.5-0.6	1-2 feet	- 0.8
Open	(25-39%)	0.3-0.4	2-3 feet	- 0.6
Sparse	(10-24%)	0.0-0.2	3-4 feet	- 0.4
			4-5 feet	- 0.2

These variables apply more to oak-woodland and conifer hardwood.

GREAT EGRET - Agriculture (Feeding/Resting); Tidal flat (Feeding)

Feeding - Feeds in shallow water and along shores of estuaries, lakes, slow-moving streams, mudflats and in irrigated croplands and pasture. Forages up to 20 miles but usually much closer.

Cover - Roosts communally in trees. Rests in same habitat it feeds.

Reproduction - Nests in groves of large trees, usually near water and isolated from human activity.

Reproductive cover (Nesting season: March-July)

Requires groves of large trees (willow, oak, cottonwood, eucalyptus)

Size of grove	Height of trees	
	40-80+	0.4 - 0.7
	20-40'	0.8 - 1.0(most nesting occurs)
	10-20'	0.2 - 0.7

Human disturbance(nesting season)

Isolated, restricted use	0.8 - 1.0
Light use	0.6.- 0.7
Moderate use	0.4 - 0.5
High intensity use	0.0 - 0.3

Project area may not have any nesting colonies nearby.

HSI will be determined for feeding.

WESTERN SANDPIPER - Tidal flat (Feeding, resting)

Feeding - Feeds mainly by probing into substrate (sandflats and mudflats) and picking from the surface.

Cover- Needs undisturbed areas for resting during high tides.

Reproduction - Non-breeder in California. Fall and spring migrant and winter visitor.

C—090949

C-090949

LONG-BILLED MARSH WREN - Tidal marsh (Reproductive cover)

Feeding - Gleans food from emergent stems and foliage, water surface and ground.

Cover - Prefers cattail and bulrush and sedge marshes with standing water during nesting season. Fall-winter season will use low-growing vegetation in water or damp ground.

Reproduction - Tall, straight-stemed marsh vegetation in standing water needed for successful nesting.

Reproductive cover: Height and density of cattail/tule marshes

Height		Density		
5-6'	0.8 - 1.0	Dense	(60-100%)	0.7-1.0
4-5'	0.6 - 0.7	Moderate	(40-59%)	0.4-0.6
3-4'	0.4 - 0.5	Open	(10-39%)	0.2-0.3
2-3'	0.2 - 0.3	Sparse	(2-9%)	0.0-0.1

Standing water during nesting season (April - August; peak May-June)

		Depth of water	
April - August	1.0	2'	- 1.0
April - July	0.9	1.5'	- 0.8
April - June	0.8	1'	- 0.6
April - May	0.4	.5'	- 0.3
		Moist	- 0.2

In tidal marsh stems should be at least 6-12" above high tide line and have moderate density for successful nesting.

Height above MHHW		Density of cover over nest		
12 inches +	- 0.7-1.0	Dense:	(60-100%)	0.7 - 1.0
8-12 inches	- 0.4-0.6	Moderate:	(40-60%)	0.4 - 0.6
less than 6"	- 0.0-0.3	Open:	(10-39%)	0.2 - 0.3

BUSHTIT - Riparian and Woodland (Reproductive cover)

Feeding - Gleans insects from foliage, twigs and branches. Also eats fruit. Feeds in flocks except during nesting season.

Cover - Found in open and dense brush in all stages of growth. In woodlands, generally prefers open areas with a dense understory.

Reproduction - Usually builds nests in trees and shrubs under 12 feet from the ground. Nesting season: February - early August with peak from: April - June.

Reproductive Cover: Breeding territory or range is about 1.0 acre in woodlands. Since the bushtit seems to prefer nesting in trees and shrubs under 12' we will assume a range from the ground to 20 feet.

Height		Canopy		
13 - 16 feet	0.6 - 0.8	Dense	(60-100%)	0.7-1.0
8 - 12 "	0.8 - 1.0	Moderate	(40-59%)	0.5-0.6
4 - 7 "	0.5 - 0.7	Open	(25-39%)	0.3-0.4
0 - 3 "	0.0 - 0.4	Sparse	(10-24%)	0.0-0.2

Density or percent of ground cover(shrubs, brush)

Dense	(60-100%)	0.7-1.0
Moderate	(40-59%)	0.5-0.6
Open	(25-39%)	0.3-0.4
Sparse	(10-24%)	0.0-0.2

GREATER YELLOWLEGS - Tidal flat (Feeding, resting)

Feeding - Feeds on small fish, crustaceans, aquatic insects. Feeds in shallow marshes, wet meadows, flooded fields and intertidal mudflats. Usually feeds by snatching and skimming water surface. Sometimes probes into substrate.

Cover - Needs undisturbed areas for resting during high tides.

Reproduction - Non-breeder in California. Fall and spring migrant and winter visitor.

RED-WINGED BLACKBIRD - Tidal marsh (Reproductive cover)
Agriculture (Feeding)

Feeding - Feeding areas may be a considerable distance from nest site or roosting areas. Grain and weed seeds taken during the fall and winter.

Cover - Roosts in fresh and brackish marshes, usually over open water.

Reproduction - Nests (March-July) in dense emergent vegetation (fresh and brackish) of cattail, tules, or sedges over or near water are usually more successful. Also nests in open moist areas. Suitability relates to the depth of water beneath the nest and density of nest cover over water.

In herb-dominated wetlands:

Abundant cattails and tules,	water depth less than 30"	0.8 - 1.0
Moderate " " ,	water depth over 30"	0.5 - 0.7 ?
Sparse " " ,	water depth, shallow	0.0 - 0.4

In wetland habitat:

Depth of water beneath nest:	10-20 inches	- 0.8 - 1.0
	10 inches	- 0.5 - 0.7
	20-29 inches	- 0.3 - 0.4 ?

In tidal marsh stems should be at least 6-12 inches above high tide line and have moderate density for successful nesting.

Height above MHHW		Density of cover over nest		
12 inches +	- 0.7 - 1.0	Dense:	(60-100%)	0.7 - 1.0
8-12 inches	- 0.4 - 0.6	Moderate:	(40-60%)	0.4 - 0.6
less than 6"	- 0.0 - 0.3	Open:	(10-39%)	0.2 - 0.3

? Draft WELUT model reduces quality when water depths exceeds 30 inches. Species notes states that nest predation is less as water depth increases.

BLACK-SHOULDERED KITE - Woodland (Reproductive cover): Agriculture and Grassland (Feeding/Roosting)

Feeding - Feeds mainly on small diurnal rodents in grassland, open fields, pasture and croplands. Suitable foraging areas should be within 7 miles of roosting sites. See below.

Cover - Kites communally roost in trees (oak, walnut, willow, cottonwood, eucalyptus) with dense canopies. Suitable sites should be available within 7 miles of feeding areas during the non-nesting season.

7 miles	7-20 miles	20+ miles
0.8	0.5	0.2

Perch sites for resting within feeding areas (fence posts, powerlines, telephone lines, shrubs, etc.) should be available within foraging areas.

Reproduction - Nesting (January through June) is near the top of oak, willow and other trees ranging from 20 to 100 feet but usually between 18-50 feet from the ground. There should be good cover from beneath and relatively open at the top. Foraging or feeding areas should be available within 1.25 miles of nesting areas.

Suitability		Distance	
Suitable groves of nest trees (18-50')	0.8 - 1.0	260 yards:	0.9 - 1.0
		260-340 yards:	0.7 - 0.8
Suitable nest trees but scattered and of medium density	0.3 - 0.7	340-440 yards:	0.5 - 0.6
		1.25 miles	0.0 - 0.2
Scarcity of suitable nest trees	0.0 - 0.2		

WESTERN MEADOWLARK - Grassland (Reproductive Cover, Feeding)

Feeding - A combination of animal and vegetable matter. Feeds in grassy open areas, pastures.

Cover - Requires relatively dense, grassy vegetation. Likes elevated perches for singing. Primarily a grassland species.

Reproduction - Nests (March - August) on ground in depressions in grasses and other low vegetation. Heavy or summer grazing reduces the quality of the nesting habitat.

Grass Height		
5-6"	:	0.8 - 1.0
4-5"	:	0.6 - 0.7
3-4"	:	0.3 - 0.5
1-2"	:	0.0 - 0.2

Grass Density	
Dense:	0.8 - 1.0
Moderate:	0.4 - 0.7
Sparse:	0.0 - 0.3

RING-NECKED PHEASANT - Agriculture (Reproductive cover) Grassland (Feeding)

Feeding - Food should be available within one mile. Feeds mainly on waste grain and weed seeds. Weed fields, roadside edges or food along drainage/irrigation ditches can compensate for the lack of grain.

Cover - Interspersion of tall grasses, brush or shrubs near feeding areas is preferred and is suitable habitat. For winter cover distances:

Up to 30'	30-90'	Over 90'
0.8 - 1.0	0.3 - 0.7	0.0 - 0.2

Reproduction - Same as cover requirements. Best cover is area which is not mowed, plowed or grazed during the nesting season. Alfalfa is a preferred nesting area but is usually mowed during the nesting season. Dry farmed wheat and barley are suitable nesting habitats.

a.	No mowing, plowing, flooding or grazing from: early April - late August	0.8 - 1.0
b.	No mowing, plowing, flooding or grazing from: early May - late June	0.5 - 0.7
c.	Moderately grazed during the entire nesting season:	0.2 - 0.4
d.	Heavily grazed during the entire nesting season or is mowed, plowed and irrigated from: late April to late June	0.0 - 0.4

The above practices can be compensated for to some extent if ditches, field borders or roadside edges are present and are not burned or mowed during the nesting season.

Height of nesting or herbaceous cover		Density of ground cover	
18 inches +	0.7 - 1.0	50 - 80%	0.8 - 1.0
10-18 inches	0.2 - 0.6	Less than 80% or 20-50%	0.3 - 0.7
less than 10"	0.0 - 0.1	Less than 20%	0.0 - 0.2

MUSKRAT - Tidal Marsh (Reproductive cover, Feeding)

Feeding - Primarily aquatic plants such as cattail and bulrush either from the bank or underwater. Feeds on roots and stems. Suitable food should be available within 300-400 feet in herb dominated wetland or 300-400 yards along a watercourse in tree dominated wetland.

Optimum :	0.8 (within 100 feet)
Suitable:	0.5 (within 200 feet)
Scarce:	0.2 (within 300 feet)

Cover and Reproduction - Escape cover is sought in lodges built above the water level or in burrows along waterways. Muskrats construct bank burrows instead of lodges over most of the Central Valley. Soil texture and slope are important factors.

Bank: Suitable enough to permit entrance below water and high enough to dig chamber above MHHW (high water line).

Suitable:	0.8 (medium to fine texture)
Fair:	0.5 (moderately sandy)
Poor:	0.2 (sandy or rocky)

Water regime is important, i.e., fluctuations such as the 5-6 foot tidal cycle along the man-made channel. Consider that entrance to burrows would be exposed during low tides and or lodges in marsh vegetation.

STRIPED SKUNK - Woodland (Reproductive cover); Riparian (Feeding, Cover)

Feeding - The striped skunk is omnivorous. Feeding areas should be within about 0.6 miles of reproductive cover and/or escape cover.

Reproductive cover: Den sites: Levees, ditches, brush, rock piles, fence rows, ground squirrel burrows, logs, slash piles. Prefers intermediate stages of brush and shrub types, deciduous woodlands. Interspersion of these type areas provides good quality habitat.

Abundant:	0.8-1.0	
Moderate:	0.4-0.7	Sites: S14 (Grand Island) and S16 (Rio Vista)
Sparse:	0.0-0.3	

Rest sites similar to den sites plus field crops, culverts, old buildings.

In Agricultural croplands: Quality related to amount and interspersion of uncultivates areas such as fencerows, field margins, ditches and canals.

Abundant:	0.8-1.0	
Moderate:	0.4-0.7	Uncultivated areas
Sparse:	0.0-0.3	

Crop types that provide protection from the air but do not restrict ground movement provide optimum habitat.

Good cover:	(corn, cotton, grain sorghum)	0.8-1.0
Suitable:		0.4-0.7
Poor:	(dense fields of hay,safflower)	0.0-0.3

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CALIFORNIA VOLE - Grassland (Reproductive cover)

Feeding - Mainly on leafy parts of grasses, sedges and herbs on the ground. Active during the day.

Cover - Dense grasses beneath plant residues, brushpiles, beneath logs and underground.

Reproduction - Nests in shallow, underground burrows in meadows or grasslands with friable soil.

Reproductive cover - Assume that needs have to be met within 100' or about .72 acre in open grasslands. Probably smaller range in areas along canals, ditches, levees and field edges.

In grasslands: Density, height and friable soils are necessary elements. Vole prefers layers of matted, dead grass for protection.

Height	
6 inches:	1.0
4 inches:	0.8
2 inches:	0.4
1 inch:	0.2

Density of ground cover		
Dense	(60-100%)	0.7 - 1.0
Moderate	(40-59%)	0.4 - 0.6
Open	(10-39%)	0.2 - 0.3
Sparse	(2-9%)	0.0 - 0.1

BELTED KINGFISHER - Riparian (Reproductive Cover and Feeding)

Feeding - Feeds on small fish, amphibians and crayfish. Prefers slow-moving, clear, shallow water. Optimum foraging occurs in clear water up to depths of 2 feet. Permanent water is optimum for foraging.

Cover - Prefers over-water perch sites, i.e, snags, unobstructed water surface and some protection from the wind such as embayments.

Reproduction - Earthen banks near water. Quality relates to soil texture and slope. Nest site has to be above high water line.

Feeding:	Slow moving, clear, shallow water	- 0.8 - 1.0
	Cloudy water	- 0.5 - 0.7
	Turbid water	- 0.2 - 0.4

Cover: Perch Sites

Numerous perch sites near permanent water	0.8-1.0
Moderate number perch sites " "	0.4-0.7
Few perch sites	0.0-0.3

Nest sites: Prefer bare, steep banks 5' or more above water and ground with sandy-clay soil.

Distance from permanent water

Within one mile:	0.8 - 1.0
Within two miles:	0.5 - 0.7
Within three miles:	0.3 - 0.4
Within 4-5 miles:	0.0 - 0.3

Bank height above Mean higher high water(MHHW)

5 feet or more:	0.8 - 1.0
3-5 feet :	0.4 - 0.7
1-3 feet :	0.0 - 0.3

BLACK PHOEBE - Riparian (Feeding cover)

Feeding - Feeds on insects by hawking from the air over grassy fields and open water.

Cover - Generally found in riparian in sparse to open habitat where perch sites and some shade is available.

Reproduction - Nests built of mud near or over water on cliff faces, wall of old buildings, under bridges and eaves near water.

For Cover assume that trees which have many lateral perch sites with unobstructed view over or near water body (stream, lake, pond) provides optimal perch sites. Some shade for resting is needed. Optimal cover would be over water and marginal would be 200 feet.

Proximity to water		Perch sites (relatively open, lateral branches)	
Over water	1.0	Abundant	1.0
25' from water	0.8	Moderate	0.6
50' from water	0.6	Fair	0.4
100' " "	0.4	Scarce	0.2
200'	0.2		

For Reproduction potential nest sites will not be evaluated but will be viewed in terms of distance from feeding areas and perch sites in riparian habitat. Cliff faces in project area may be limited. There are farm buildings and bridges relatively close the the channel but do not know how this relates to quality of overall habitat(HSI).

CINNAMON TEAL- Tidal marsh (Reproductive cover)

Feeding - 80 percent vegetable matter (sedges, pondweeds and grasses. Feeds in shallow water by skimming and sometimes by tipping.

Cover - Broods and moulting adults require good escape cover such as dense emergent vegetation.

Reproduction - Requires freshwater for nesting, either in dense emergent vegetation or in nearby dense grass. Prefers small, shallow bodies of water, slow-moving streams bordered by fairly dense aquatic vegetation.

Reproductive Cover (emergent vegetation) Mats of dead stems over water or near edge:

Height		Density (Ground Cover)		
4'	1.0	Dense	(60-100%)	0.7-1.0
3'	0.8	Moderate	(40-59%)	0.4-0.6
2'	0.6	Open	(10-39%)	0.2-0.3
1'	0.2	Sparse	(2-9%)	0.0-0.1

For Herbaceous vegetation/grasses: Assume waters edge optimum and 100 feet marginal. As distance from water increases so does predation.

Grass from waters edge to	10 feet	-	1.0
	30 "	-	0.8
	50 "	-	0.6
	70 "	-	0.4
	90 "	-	0.2

Grasses:

Height		Density (Ground Cover)		
14-18"	0.8 - 0.1	Dense	(60-100%)	0.7-1.0
10-14"	0.6 - 0.7	Moderate	(40-59%)	0.4-0.6
6-10"	0.4 - 0.5	Open	(10-39%)	0.2-0.3
Under 6"	0.2 - 0.3	Sparse	(2-9%)	0.0-0.1

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL
CALIFORNIA

FINAL SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT

APPENDIX F

FISH AND WILDLIFE TRADITIONAL MITIGATION ANALYSIS

APPENDIX F

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I. FISH AND WILDLIFE RESOURCES: TRADITIONAL ANALYSIS

A. Overview. The fish and wildlife resources for this project were independently evaluated using an integrated Traditional Analysis and the Fish and Wildlife Service Habitat Evaluation Procedures (HEP) Analysis. The decision was made in coordination with the recommendations of the Fish and Wildlife Service as specified in the Supplemental Fish and Wildlife Coordination Report to base the mitigation requirements for the project on the results of the HEP Analysis. Accordingly, the selected plan of improvement for the project includes the development of 63 acres of Prospect Island to wetland and riparian habitat to mitigate for project-induced impacts to fish and wildlife resources.

The two analysis procedures were conducted on the project as it appeared in August 1985. Since that time, minor changes in the construction schedule have occurred in order to facilitate the affordability of the local sponsor's share in project costs due to recent changes in cost sharing requirements. The construction schedule changes were compqared to the assumptions in each analysis and were insignificant enough to not warrant a reanalysis as changes in results would be inconsequential.

B. Introduction.

1. Purpose. This report is a critical reevaluation of the ecological resources in the Sacramento River Deep Water Ship Channel (DWSC) deepening and widening project area. The evaluation has four purposes:

- to evaluate the existing ecological resource values
- to estimate the amount of change to those resources over 5 years construction and 50 years post-construction time, with and without the project development
- to determine the need for mitigation of adverse changes that could occur
- to examine various measures to avoid or compensate for the adverse impacts of the development

2. Scope. Much of the background information on this project comes from the 1980 Feasibility Report and EIS (9). This reevaluation is required because the disposal sites have been modified.

Section C describes the method of analysis and the mitigation requirements for the 1980 project and the changes in the project design made subsequent to that analysis.

Section D provides the rationale, references, and sources for the integrated Traditional Analysis method of analytical evaluation used by the Corps. It gives examples of the types of calculations, criteria and assumptions used.

Section E is the results of the integrated Traditional Analysis in terms of ecological resources. Changes in these resources are examined over a study period of 55 years where these projections can be effectively estimated and where data is available to support the assumptions.

Section F is the mitigation concept plan based on the integrated Traditional Analysis. It also describes the Corps mitigation policy and the expressed concerns of the resource agencies regarding fish and wildlife resources. Several concepts of mitigation are proposed with the objectives of replacement of in-kind of habitat loss, avoiding damages through project modification, and intensive management of the natural resources within the project area.

C. Description of 1980 Proposed Action and Mitigation Plan.

1. Project Design. - The 1980 plan for the Sacramento River Deep Water Ship Channel provided for the deepening of the existing Suisun Bay and Sacramento River deep water channels from New York Slough to the Port of Sacramento from 30 to 35 feet. Approximately 30.3 million cubic yards of dredged material would have been excavated between New York Slough and Sacramento, requiring about 3,500 acres of land for disposal.

2. Ecological Losses. - As required by the Fish and Wildlife Coordination Act, the U.S. Fish and Wildlife Service (FWS) in its detailed project report dated March 20, 1980 described the impacts associated with the 1980 Selected Plan. The major impact on upland wildlife habitat would have been caused by the placement of 30.3 million cubic yards of material on the 3,500 acres of existing vegetation and wildlife habitat at the disposal sites. Portions of these disposal sites have been used for disposal in recent years as part of the maintenance dredging of the 30-foot deep channel and the sites have revegetated naturally. Disposal areas for the deepening project were also proposed on adjacent agricultural lands and in natural areas in the Montezuma Hills.

3. Evaluation Procedure. - In 1980, the FWS used a modified Habitat Evaluation Procedure (HEP) to determine the mitigation requirements of the proposed project. The HEP evaluation was accomplished by a team of Corps, FWS, and California Department of Fish and Game (DFG) biologists using a standard procedure developed by FWS and approved by the Corps.

The HEP analysis indicated that the temporary loss of wetland habitat along the manmade channel would have required about 45 acres of marsh and riparian vegetation mitigation. The temporary loss would have been mitigated by developing 45 acres of tidal wetland on a dredged material disposal site. The HEP also indicated that the temporary loss of upland wildlife habitat due to the disposal on the 3,500 acres would have required the improvement of habitat on 156 acres to a condition of higher wildlife value than the preproject condition. The logic behind this conclusion was to account for the temporary loss of wildlife values on the 3,500 acres. The temporary loss resulted from the relatively short period in which there would have been no wildlife habitat after disposal until the habitat naturally revegetated. Annualizing the temporary loss over a 100-year period resulted in a comparatively small number of acres for mitigation. This total loss of wildlife values was to be recovered by making a long term improvement on the 156 acres and creating 45 acres of wetland habitat (11).

4. Mitigation Plan. - The 1980 Plan proposed the creation of 45 acres of wetland habitat by levee construction and grading at Prospect Island. The location of the 156 acres of mitigation lands would have been chosen from the lands used for DMD. Generally, the mitigation lands would have been used for replacement of lost habitat and compatible uses such as grazing. Since there would still have been approximately 3,344 acres of DMD lands available for maintenance disposal, no significant conflict with future disposal needs was expected. If the originally selected mitigation lands were needed for other uses, substitute mitigation sites could have been designated and planted so that a total of 156 acres of improved habitat was always maintained somewhere on the 3,500 acres of project lands. One possibility was to select small areas or borders throughout the 3,500 acres of dredged material disposal sites.

5. Coordination. - The location of the 156 acres was to be determined in later studies. Under the 1980 Plan, a wildlife habitat planting plan would have been developed with assistance from the FWS, coordinated with the Port, and included in the construction program. Plantings on the 156 acres would have been made following dredged material disposal operations.

D. Evaluation Method for 1985 Traditional Analysis

Several evaluation approaches were examined: user-day method; modified HEP; species population estimates; the method developed by Reppert, et al (7) for habitat evaluation. Due to the disjunct locations and variety of the areas potentially affected by the project, there is no one method which could effectively analyze the fish and wildlife resources in the study area. Therefore, the Corps adopted an integrated approach using available numerical data where appropriate. This approach combines a variety of methods to critically evaluate the potential effects of a development on ecological resources. The study time period was chosen at 50 years past a 5 year period of construction and the results were averaged over the entire study time (55 years).

Recreation was not used as part of the traditional analysis for the following reasons:

(1) From data in the Delta Outdoor Recreation Survey (3), there is very little recreation use of the manmade portion of the ship channel (less than 0.5% of users surveyed). Recreation uses probably include boating, bank fishing, and relaxing, but there are no specific data on these uses in the manmade channel. Bank fishing and relaxing would be affected by the Selected Plan, but boating would not. Because the recreation use of this area is so low, it was not deemed significant in terms of user days lost.

(2) For the disposal sites not located along the manmade channel, recreation use is also low. There is no evidence of recreation use of S-13, S-20, S-21, and S-35. Prospect Island (S-12), Grand Island (S-14), and Decker Island (S-19) together were used by less than 1% of visitors recreating in the Delta. Site S-16 at Rio Vista is adjacent to an existing County Park, and its principal use is for bank fishing. Again, because the recreation use of the disposal sites is so low, it was not deemed significant in terms of user days lost.

For ecological resources, the Corps estimated the amount of each habitat type gained or lost due to dredging, dredge disposal, deposition, or erosion over the study period. The total change in amount of each habitat was estimated for both the No Action (no changes within the channel) and Selected Plan (deepening and widening the channel) by computing the average annual acreage of each habitat type (wetland or upland) existing over the 55 year study period. The 55 year study period is five years for the construction and 50 years post-construction. Because the habitat changes would not be spread evenly over the 55 years, but would mostly occur in the first eight years, it is necessary to calculate the weighted average over the 55 years. The weighted average of each habitat type is calculated with the following formulas:

$$\text{Weighted average annual acreage of habitat type (W or U) over total study period} = \text{Sum over incremental time periods} \; \frac{\text{average annual acres of W or U in incremental time period} \times \text{number of years in incremental time period}}{\text{Years in total study period}}$$

Where:

1. average annual acres of habitat type W or U in incremental time period (years A to B) = $\dfrac{\text{Acres W or U in year A} + \text{Acres W or U in year B}}{2}$

2. number of years in incremental time period (years A to B) = (B - A)

3. Years in total study period = 55

4. Habitat type W = Wetlands
   Habitat type U = Uplands

The incremental time periods used were as follows: every year from year 0 to year 11; years 11 - 15; years 15 - 20; years 20 - 40; and years 40 - 55 (see Table 5). By comparing the weighted average annual acreage of each habitat type for the No Action Plan and the Selected Plan, the Corps determined the annualized changes in habitat resulting from the Selected Plan (Table 5). Many of the criteria and assumptions used for this analysis are based on data collected for similar sites or actual on-site observation (Table 1).

D. Results of the Analytical Evaluation

1. Existing Conditions - Without the Project. Tables 2 and 3 summarize the habitats on the proposed disposal sites and in the area along the manmade channel. The number of acres of a particular habitat type is the unit measure

on which this analysis is based; the total average annual losses and gains of habitat are calculated for the 55 year study period. The habitats at S-21 and S-35 are expected to be eliminated over the 55 years due to industrial development in the Collinsville-Montezuma Hills area (8). Immature riparian growth exists along much of the channel; it is comprised of willows, young cottonwood trees, a few valley oaks and shrubs. Riparian habitat is ecologically valuable to a variety of fish, bird, and mammal species and it is important for aesthetic reasons. Its value increases as it matures approximately 30-40 years old) and the vegetative strata becomes more distinct (6). The riparian habitat along the channel, however, is sparse and immature even though it has essentially been growing since the initial construction of the channel.

Table 1. Assumptions and Criteria Used in the Traditional Analysis

Project Assumptions over the 55 Year Study Period:

Year	Assumption	Source
0	Construction dredging begins	COE
1-5	Incremental losses of habitat along manmade channel and on dredged material disposal (DMD) sites	COE
5	Construction dredging complete; maintenance dredging begins	
COE	COE	
10	All mudflat and tidal marsh habitats restored (baseline)	Harvey & Stanley
20	All immature riparian forest restored (baseline)	Jones & Stokes
40	Mature riparian forest fully established along channel	"
55	All habitats restored (baseline)	COE/Jones & Stokes

Ecological and Aesthetic Assumptions:

1. Construction widening of the manmade channel will affect tidal marsh, tidal mudflat, and immature riparian habitat between RM 18.6 and RM 42.0.

2. The erosion of the channel banks due to the current and ship wakes will approximately balance any sediment deposition from upstream sources; therefore, the changes associated with these factors were omitted from this analysis.

3. A natural successional change occurs in a continuum from open water to marsh to immature riparian forest to woodland.

4. There will be no net effect on the habitats along the channel between RM 0 and RM 18.6. These acreages have been deleted from either the <u>without project</u> (No Action) or <u>with project</u> (Selected Plan) analyses.

5. Maintenance DMD will occur <u>with</u> or <u>without</u> the project, in approximately the same amount and schedule on DMD sites S-1, S-14, S-16, S-19, S-31, and S-32. The projected use of DMD sites for maintenance and construction differs only during the five years required for construction (Table 4). The timing of maintenance DMD post year 11 is not critical or sensitive to project impacts because maintenance dredging frequencies or amounts do not differ with or without the project.

6. Recreational activities (i.e., sailing or fishing) will not be adversely affected by the dredging or DMD.

7. Industrial growth will take place in the Collinsville-Montezuma Hills area within 50 years post-construction. S-21 and S-35 will be developed as part of these industries. (Solano County Planning Department, 1983).

Table 1 Continued

Criteria for ecologically valuable habitat:

a. Wetlands are more valuable to fish and wildlife than uplands.

b. Linear habitat such as streamside vegetation is valuable as an ecotone between two adjacent habitats.

c. Habitat value to fish and wildlife increases as the immature riparian willow/herb/cottonwood community (5-40 years old) grows and diversifies to the mature mixed woodland community (>40 years old).

d. Aesthetic value increases as the riparian area matures, because humans using boats along the channel view a curvilinear landscape rather than a static straight edge.

Table 2. Habitat Type Area on each of the Disposal Sites within the Sacramento River Deep Water Ship Channel Project Area

HABITAT TYPES (acres)

Disposal Site No.	Total Area (acres)	Uplands Ag	Uplands Gr	Uplands Wd	Uplands B	Wetlands Ms	Wetlands Rp
1*	158	100	58				
4	137	130	7				
7	228	228					
9	173	173					
11	640	640					
12	241	241					
13	570		518		41	11	
14*	196		60	76[1]	60		
16*	149		55				
19*	590	162	422		94		6
20	98		95			3	
21	160		160				
31*	663	663					
32*	265		265				
35	196		161			35	
	4,464	2,337	1,801	76	195	49	6

Total Uplands: 4,409 Total Wetlands: 55

1> This 76 acres will be eliminated with or without the project due to maintenance dredging disposal.

*indicates future use as a maintenance DMD site with or without project

Ag = Agriculture
Gr = Grassland
Wd = Woodland
B = Barren
Ms = Seasonal Marsh
Rp = Riparian

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Table 3. Wetland Habitat Area Along the Manmade Sacramento River Deep Water Ship Channel Potentially Affected by the Project Construction

Project Reach	Habitat Types (acres)			Total Area
	F	Mt	Rp	
RM 0 to RM 18.6*	0	0	0	0
Manmade Channel RM 18.6 to RM 42.0	9	21.5	21.5	52

*See Table 1, Assumption #4

F = Tidal Mudflat
Mt = Tidal Marsh
Rp = Immature Riparian Woodland

2. Future Conditions - Without the Project. The analysis assumes that the existing immature riparian habitat would increase in ecological value and become mature riparian habitat within 25 years. The DMD's planned for use or currently being used for maintenance dredging will continue to be used for this purpose (all of S-1, S-14, S-16, S-19, S-31, and S-32). Table 4 lists the projected use schedule for construction and maintenance disposal without the project. No net change in wetland areas along the manmade channel is assumed to occur without the project for the deposition of sediments will approximately equal the erosional action of the stream (6).

There would be an annual average of about 102 acres wetland and 4,140 acres of upland existing in the project area over the 55 year analysis period (Table 5). The average amounts include the following losses and gains:

a. Construction impacts without the project. DMD will take place in sites (S-1, S-14, S-16, S-19, S-31, and S-31) as outlined in the projected use schedule (Table 4). Without the project, 76 acres of woodland will be cleared on Grand Island (S-14) and used for DMD. This loss is anticipated to occur within three to six years as part of the No Action Plan and it is included as year 5 in this analysis. S-14 is an important maintenance disposal site because the channel just downstream of the manmade channel from RM 15.0 to Decker Island RM 8.6 requires the most frequent maintenance dredging because of the high sediment deposition in that area.

b. System impacts without the project. The losses and gains were averaged using the amounts of each habitat type existing at the target years. It was assumed that any erosion from ship traffic wave action would be approximately equivalent to sediment deposition on downstream lands; therefore, no net change in the habitat along the channel would occur. The value of the riparian habitat would increase as the existing trees grow to maturity (40 years old) and form a dense canopy with crowns greater than 60 feet diameter. The continuous linear shape of the habitat makes it an ecotone and increases its ecologic value. Such habitats provide a boundary of ecologically valuable habitat between the open water and the upland. The streamside vegetation provides shade for the shallow water fish rearing and feeding habitat. It also provides feeding, resting, and nesting habitat and resources for a wide variety of birds, mammals, insects, reptiles, and amphibians.

3. Future Conditions - With the Project.

a. Construction impacts with the project. The channel widening is expected to remove a maximum of 52 acres of streamside vegetation. This includes 9 acres of tidal mudflat, 21.5 acres of tule marsh, and 21.5 acres of immature willow/cottonwood growth along the manmade channel. The riparian area will either revegetate to the baseline conditions within 15-20 years or it will be replanted to allow it to return to the existing immature stage more rapidly (within 10 years). This replanting option is discussed in the mitigation section of this report as part of

Table 4. Projected Use by Site Number and Habitat Area of DMD Sites Potentially Affected by Construction and/or Maintenance Disposal

Plan	0	1	2	3	4	5	6	7	8*	9	10	11
NO ACTION Without the Project			maintenance disposal only									
	-	31b 1	19a 16 14a	31b	-	19b 16 14b	-	-	19a 16 14a	-	31b 32b 1	19a 16 14b
Habitat Affected (acres)	0	430	391	272	0	563	0	0	391	0	539	423
SELECTED PLAN With the Project			construction disposal									
	-	31b 32b 1 4	14 13 16 19b	19a 19c 20 21 35	31a 32a 7 9	11 12 14						
							maintenance disposal					
						16 19b	-	-	19a 16 14a	-	31b 32b 1	19b 16 14b
Habitat Affected (acres)												
Upland	0	676	1198	706	948	1422	0	0	391	0	539	563
Wetland	0	0	17	38	0	0	0	0	0	0	0	0

* The disposal schedule for the project area after year 8 is the same for both the NO ACTION and SELECTED PLAN.

This table assumes acreage figures as listed in Table 2, except for partial DMD sites as
indicated below:

Site	Acres		Site	Acres
S-14a	82		S-31a	391
S-14b	114	(includes 76 acres Wd)	S-31b	272
S-19a	160		S-32a	156
S-19b	300	(includes 6 acres Rp)	S-32b	109
S-19c	128			

the compensation for the loss of habitat. The weighted annual average of wetland habitat (under natural revegetation conditions)is 47.5 acres or a loss of 54.5 acres when compared to the without project condition over the 55-year analysis period (Table 5).

b. System impacts with the project. In the worst-case analysis, the proposed project will temporarily eliminate 107 acres of wetland including: 49 acres seasonal marsh and 6 acres riparian on the DMD sites and the 52 acres described above along the channel. The project will also temporarily eliminate 4,409 acres of upland including: 76 acres of woodland, 1,801 acres of grassland, and 2,337 acres of agricultural land (see Tables 2 and 3). (Note: The woodland (76 acres) will be eliminated even under No Action by project year 5). Approximately 2,021 acres of the dredge disposal sites will be used for periodic maintenance DMD throughout the life of the project (Table 4). The upland sites used only for construction disposal (S-4, S-7, S-9, S-11, S-12, S-13, S-20, S-21, and S-35) are expected to return to the existing conditions within 2 growing seasons post-construction disposal. The 55 acres of wetland (seasonal marsh and riparian) on the dredge disposal sites are assumed to be converted to grassland by the construction within 2 growing seasons post-construction disposal. The wetland (Table 3) along the manmade channel (52 acres) will revegetate over time. The mud flat and tidal marsh will return within 2 growing seasons post-construction, and the immature riparian will regrow to baseline conditions within 15-20 years after construction. Table 5 reflects the changes in habitat based on this assumption and the projected dredging schedule in Table 4.

When annualized over the 55 year study period, the temporary loss of 21.5 acres of immature riparian vegetation along the manmade channel, the temporary loss of 4,409 acres of upland area on the DMD sites, and the elimination of 76 acres of woodland, 6 acres of riparian and 49 acres of marsh on the permanent maintenance DMD areas average about 3,990 acres upland and 47.5 acres wetland. When compared with the average annual habitat in the No Action Plan (4,208 acres upland and 102 acres wetland), this results in a net loss of about 55 acres wetland and 221 acres upland. The habitat loss will be mitigated by preserving, creating, or restoring habitats within the study area.

Various mitigation measures, discussed in Section F below, are designed to:

- avoid impacts to the existing habitat;
- create new wetland habitat;
- restore existing disturbed habitat, both upland and wetland; and
- enhance existing project habitat.

These migitation alternatives are based upon the most efficient application of accepted management techniques that require the minimum amount of additional land to replace significant resource losses. Some mitigating measures require no additional land (i.e. riparian revegetation); however, an extra time and cost factor must be added to the project construction. There are trade-offs in each of the following proposed mitigation concepts. In some instances it is a trade-off of ecological values such as fish rearing habitat vs. duck resting and breeding habitat. The numerical value of such trade-offs

Table 5. Changes in Wetland and Upland Habitat in the Project Area

PLAN	PROJECT YEAR	CHANGE IN HABITAT AREA (acres) Construction: Channel	Construction: DMD's	System: Maint. DMD	System: Wetland Conv.	System: Regrowth	TOTAL HABITAT (acres)	ANNUAL AVERAGE (acres)
1. NO ACTION w/o project		no significant change					107	
Wetland	55				-35[1]		72	
								102
2. SELECTED PLAN w/ project								
Wetland	0						107	
	1	-10.4[3]					96.6	
	2	-10.4	-17				69.2	
	3	-10.4	-38			+6.1[2]	26.9	
	4	-10.4				+6.1	22.6	
	5	-10.4				+6.1	18.3	
	6					+6.1	24.4	
	7					+6.1	30.5	
	8						30.5	
	9						30.5	
	10						30.5	
	15					+4.3[4]	34.7	
	20					+17.2[4]	51.9	
	40						51.9	
	55						51.9	
								47.5
3. NO ACTION w/o project								
Uplands	0						4409	
	1			-430			3979	
	2			-391			3588	
	3			-272			3316	
	4					+430	3746	
	5			-563[5]		+445	3628	
	6					+272	3900	
	7				no change		3900	
	8			-391		+409[5]	3918	
	9				no change		3918	
	10			-539			3379	
	11			-423		+445	3401	
	15					+1024[7]	4425	
	20						4425	
	40						4425	
	55					-321	4104	
								4208

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Table 5. (continued)

PLAN	PROJECT YEAR	CHANGE IN HABITAT AREA (acres) Construction Channel	Construction DMD's	System Maint. DMD	System Wetland Conv.	System Regrowth	TOTAL HABITAT (acres)	ANNUAL AVERAGE (acres)
4. Selected Plan (w/ project)								
Uplands	0						4409	
	1		-676				3733	
	2		-1198[5]				2535	
	3		-706				1829	
	4		-948			+676	1557	
	5		-1077	-345	+17	+1122[5]	1274	
	6				+38	+706	2018	
	7					+948	2966	
	8			-391		+1422[6]	3997	
	9				no change		3997	
	10			-539			3458	
	11			-563		+391	3286	
	15					+1120[7]	4388	
	20						4388	
	40						4388	
	55					-356[8]	4032	
								3987

1 Impact of Collinsville-Montezuma Hills Development; eliminates S-21 and S-35.

2 This 6.1 Ac reflects regrowth of 1.8 Ac mudflat and 4.3 Ac tidal marsh and approximately two growing seasons to re-establish.

3 Total wetland (including riparian) along channel (52 Ac) is pro-rated over the five year construction period (10.4 Ac per year), based on the location of proposed disposal sites for each year (Table 4).

4 Riparian habitat (21.5 Ac) is projected at 4.3 Ac regrowth per year with a regrowth period of 15 years.

5 76 Acres of woodland considered permanently eliminated by DMD, therefore eliminated from the analysis (no revegetation to baseline conditions).

6 Assumes both construction and maintenance DMD sites revegetated.

7 Reflects the combined regrowth of DMD sites disposed on in years 10 and 11.

8 This figure includes the addition of 35 acres of habitat from S-35 that has been converted from seasonal wetland to grassland during the construction DMD.

is difficult to derive unless actual field sampling data is collected for the key species in question. A combination of the proposed concepts will likely be required to adequately mitigate the impacts.

F. Mitigation Concept Plan.

1. Mitigation requirements. This analysis resulted in disturbance to about 55 acres of wetland habitat and 221 acres of upland habitat annualized over the 55-year study period as compared to 45 acres of wetland and 156 acres of upland to be replaced in the 1980 plan. The creation of wetland or the prevention of destruction of wetland would contribute more ecological and aesthetic value than the same activities on disturbed upland habitat. Although it is difficult to quantitatively evaluate a qualitative change, the alternative mitigation concepts for compensation of adverse effects, avoidance of habitat destruction, and intensive management of existing fish and wildlife habitat are discussed where possible in quantitative terms.

2. a. Coordination. The major emphasis of the Corps Mitigation Policy is on mitigation of adverse effects, but the policy also discusses planning actions as part of the overall treatment and evaluation of ecological resources. Some of the guidelines provided in the mitigation policy that pertain to this mitigation plan include:

- Districts must submit a separate or integrated traditional analysis for determining fish and wildlife mitigation. A FWS-HEP analysis should supplement damage estimates using a traditional analysis.

- During impact assessment and development of a mitigation plan, appropriate treatment and consideration will be given to key habitats and/or key species.

- Accepted wildlife management techniques should be used to plan the most efficient, least costly, and least land required to replace significant resource losses.

- At least one mitigation plan should be employed that emphasizes the best management techniques to replace losses to key fish and wildlife species, regardless of whether or not that plan can fully mitigate or compensate for the overall wildlife losses.

- Projects should prevent damage to fish and wildlife resources to the extent practicable by good planning and design. In some instances it may be more desirable to mitigate for losses by avoiding damages through project modification. However, the project benefits foregone or added cost should be justified by the losses to be prevented.

- Measures for mitigation/compensations should be "in-kind" whenever possible and provided adjacent to or in the immediate vicinity of the area where losses occur.

- In determining mitigation and/or compensation measures, the district must consider the monetary value of the fish and wildlife resources. If a project will result in damage to fish and wildlife, the economic value of such damage will be evaluated to the extent that such damages

are subject to evaluation in monetary terms and displayed under the National Economic Development (NED) account.

. Nonmonetary damages, including those impacts affecting the ecosystem and environmental quality, will be given full consideration in formulating recommendations and will be described in sufficient detail to support a judgment as to the cost that would be justified to prevent or offset such damages.

. When damages can be prevented or reduced, justified compensatory measures will be included in the project plan. In addition to the costs of such measures, residual damages to the fish and wildlife resource will be treated as a cost to the economy and to the environment in project evaluation.

. One type of fish and wildlife benefit will not be used as an offset for another type of fish and wildlife damage, nor will only the net effect be shown. Thus, if a project results in a net damage to one category of fish or wildlife and benefit to another category, the damage should not be said to be cancelled out. The damage to the first category should appear on the cost side and the benefits to the latter on the benefit side and both effects adequately discussed during the trade-off analysis.

. A mitigation plan need not have measured economic outputs equal to or exceeding its costs. But the description of tangible losses (i.e., commercial and/or recreational resources) plus the intangible losses (e.g., an important rookery) must be clearly reported in a way convincing to a reasonable person that the proposed Federal expenditure to replace these losses is justified.

b. U.S. Fish and Wildlife Service - Fish and Wildlife Coordination Act and Endangered Species Act. The FWS, DFG, NMFS, and the Corps have conducted a HEP analysis on the project area. The results of this investigation were used by the FWS in preparation of the Fish and Wildlife Coordination Act Report. The HEP analysis and the results of the investigation are reported in Appendix E of this FSEIS. A biological data report on the potential for endangered species within the project area has been prepared. The report and biological assessment of the potential impact of the project on listed and candidate species has been formally submitted to the Fish and Wildlife Service, Office of Endangered Species. The biological assessment and other pertinent correspondence reguarding this topic are included in Appendix D to the FSEIS.

3. Mitigation Options

a. Avoidance of Adverse Impact. The adverse effects of the proposed project has been mitigated to a certain degree through the modification of the project design from the original 1980 plan. One change in the design involves modifying the locations and size of the dredge disposal areas. The amount of wetland habitat required for dredge material disposal has been decreased by 145 acres since the original 1980 plan. The design has been modified to avoid some of the adverse effects on the fish and wildlife resources in the project area

prior to construction. To avoid impact on wetlands, most of the dredge disposal sites that contain wetland areas have been eliminated from the proposed action. This action resulted in the recouping of 35 acres of marsh habitat that was once proposed for dredged material disposal. No open water disposal will take place and no dredging will occur between New York Slough and Collinsville.

b. New Wetland Creation. Prospect Island (45 acres) would be used as a compensation site for the loss of fish and wildlife habitat associated with the channel widening and dredged material disposal.

Prospect Island is currently used for agricultural purposes. During extreme high tides, the entire island floods to an average of 5 feet of water (F. Meyer, DFG, personal communication, 1984). Wildlife use includes species such as black-shouldered kites and pheasants. The island is a feeding area for egrets, herons and blackbirds during the fall and winter.

An objective of the mitigation plan would be to convert 45 acres of irrigated cropland to tidal wetlands and riparian habitat. The plan requires that the area be excavated to elevations from MLLW to MHHW for mudflats and emergent vegetation and the excavated material be placed in mounds from 10-12 feet above MLLW for upland and riparian habitat. Excess material could be placed on adjacent levees or agricultural lands. Material dredged from the channel could be used to construct a levee on the north side of the compensation area. The proposed wetland development would include:

Habitat Type	Area
Open water, subtidal: -3.0 to -5.0 ft. MLLW	5 acres
Mudflats, MLLW to MSL+	10 acres
Emergent vegetation, MSL to +3.0 ft.	15 acres
Riparian, MHHW+	15 acres

Development could coincide with project construction when widening and deepening is being done in the manmade channel adjacent to Prospect Island. The area would be planted with wetland and riparian vegetation after the development of the landscape is complete. The levees would then be breached in one or two locations to allow flooding of the area. Some riprapping may be necessary in the area(s) to be breached to prevent erosion.

c. Upland Restoration. Disturbed upland sites, including disposal areas that have historically been overgrazed or consistently cultivated, could be improved and intensively managed for wildlife. The areas that seem most appropriate for this type of mitigation are those that are not used for maintenance dredging and are adjacent to the water or other relatively undisturbed habitats. S-13, S-35, S-20, and S-21 (1,024 acres) all have potential for wildlife habitat improvement and management. These sites could be partially used for dredged material disposal and although site S-21 and S-35 are zoned for industrial use they could be partially replanted with food species for birds and mammals that frequent the

region. A major improvement in the habitat would result from preventing livestock on these sites and allowing the native grass species and trees/shrub longer to revegetate.

d. Wetland Restoration. This feature capitalizes on the tendency of riparian areas to revegetate more quickly from initial plantings after disturbance. The immature riparian habitat eliminated by the dredging could be restored by planting native willow and cottonwood species on the berms that exist below high water mark. This measure would be most effective if additional soil was excavated from the sides of the channel to create a shallow submerged terrace between the levees and the open water. This idea is only feasible if the area between the channel water and the permanent levee is wide enough to accommodate the excavation and the additional sloughing that would take place from the extra soil removed. This mitigation feature would restore the riparian area to baseline conditions within 4-5 years post-planting rather than 15-20 years under natural revegetation time.

e. Enhance Existing Project Habitat. The disposal of dredged material on lands which are below mean sea level elevation provides the opportunity for enhancement of the fish and wildlife resources of the study area. Section 150 of the Water Resources Development Act of 1976 (PL 94-587) directs the Corps of Engineers to consider establishment of wetland areas, where appropriate, in connection with dredging required for water resource development projects, with costs up to $400,000 borne by the United States. The establishment of wetland areas was investigated as part of the Feasibility Report in 1980. Interest by the FWS, DFG, NMFS and others was expressed at that time. However, interest waned until recently, when support for the development of wetlands on Sherman Island was received from several agencies. The support was expressed at a point where the preparation of this project document was too far along to include a formal plan. Therefore, this topic will be further investigated prior to construction in the area.

4. Summary of Mitigation Plan Using Traditional Analysis.

Using a sensitivity analysis of the construction and system impacts over a 55 year study period, the primary impact on the fish and wildife resources of the project area was determined to be the temporary loss of 54.5 acres wetland and 221 acres upland habitat. According to the Corps Fish and Wildlife Mitigation Policy, one mitigation plan should be proposed that emphasizes the best management techniques to replace key losses to fish and wildlife species. In-kind habitat replacement is the most appropriate type of compensation.

The loss of 54.5 acres of wetland habitat can be primarily compensated for by the Prospect Island (45 acres) wetland creation alternative. This plan, as described above, would create a mosaic of high quality fish and wildife habitat in an area that would receive high fish and wildlife use because it is relatively isolated from other river activity. The additional 10.5 acres of wetland habitat required for mitigation could be added to the Prospect Island plan or could be along the channel. The planting in the channel would be preferred in that the disturbed habitat would be replaced "in-kind" under this alternative.

The loss of 221 acres of upland habitat could be compensated by restoring the habitat selected disposal sites. The location of these sites would be coordinated with the Port of Sacramento and the Federal and State fish and wildlife agencies. Again, it is stated, that the mitigation for the project will be based on the recommendations of the HEP analysis. The mitigation plan is presented in Appendix I of the GDM.

G. References

(1) California Department of Parks and Recreation, December 1983. Demand on Counties for Various Recreation Activities, PARIS III.

(2) California Department of Parks and Recreation, June 1982. Recreation Activity in California, Executive Summary and Volume I.

(3) California Department of Water Resources, March 19880. Sacramento-San Joaquin Delta Outdoor Recreation Survey.

(4) California Department of Water Resources, January, 1981. Sacramento-San Joaquin Delta Recreation Concept Plan.

(5) California Department of Water Resources, June 1981. Sacramento-San Joaquin Delta Outdoor Recreation Implementation Plan.

(6) Jones and Stokes, 1983. Riparian Vegetation in the Sacramento River.

(7) Reppert, et al., 1979. Wetland Values. U.S. Army Corps of Engineers Waterways Station, Vicksburg, MS.

(8) Solano County Planning Department, 1979. Collinsville-Montezuma Hills Area Plan and Program.

(9) U.S. Army Corps of Engineers, July 1980. Sacramento River Deep Water Ship Channel, Feasibility Report and Environmental Impact Statement for Navigation and Related Purposes.

(10) U.S. Army Corps of Engineers, October 1982. Sacramento-San Joaquin Delta, California, Draft Feasibility Report and Draft Environmental Impact Statement.

(11) U.S. Army Corps of Engineers, 1983. Memorandum from working files on the Sacramento River Deep Water Ship Channel Project.

GENERAL DESIGN MEMORANDUM

SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

APPENDIX A

COMMENTS AND RESPONSES

MARCH 1986

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

GENERAL DESIGN MEMORANDUM
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

APPENDIX A

COMMENTS AND RESPONSES

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COMMENTS AND RESPONSES TO DRAFT GENERAL DESIGN
MEMORANDUM AND DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

GENERAL

The Draft General Design Memorandum (DGDM) and Draft Supplemental Environmental Impact Statement (DSEIS) on the proposed plan of improvement was distributed in August 1985 for review and comments by many Federal, State, and local agencies as well as groups, organizations, and individuals with an interest in the project. This appendix contains all comments which were received specifically as a result of coordination of the GDM and SEIS, as well as responses to comments received. Copies of the original correspondence are also included in this appendix.

COMMENTS RECEIVED FROM FEDERAL AGENCIES

1. Comments received from the **U.S. Department of the Interior, Office of the Secretary, Pacific Southwest Region** dated October 25, 1985.

a. Comment: "The DSEIS addresses the opportunity to enhance wetland habitat on Sherman Island. We recommend that this mitigative measure be included as part of the project plan. Since there is a Federal cost limit of $400,000, the plans determining the amount of habitat that may be improved should be closely coordinated with the U.S. Fish and Wildlife Service (Service) and the California Department of Fish and Game. The Service has previously provided their recommendations to you in the form of a Draft Supplemental Fish and Wildlife Coordination Act Report (Page A-20, Draft General Design Memorandum Appendices to DSEIS). We believe that the detailed plans for this enhancement feature could be developed during advanced engineering and design studies."

Response: The words "mitigative measure" in the above comment actually are referring to a possible enhancement area. The lower Sherman Island wetlands area would be an enhancement - it is not required as mitigation for unavoidable loss of habitat like the 63 acres of mitigation discussed in the GDM. The Corps is continuing to examine the possibility of a wetlands enhancement at Sherman Island and is coordinating its efforts with the U.S. Fish and Wildlife Service, California Department of Fish and Game and NOAA, National Marine Fisheries Service. To date, a reconnaissance trip has been taken to explore the Sherman Island site with representatives of the above agencies. Elutriate testing will be conducted at the site during early 1986 to assist in examining the environmental effects of creating the wetlands habitat. Should the wetlands enhancement appear to be feasible and supported by the Federal and State water quality and fish and wildlife agencies, the necessary design, funding and environmental documents will be completed at a later date.

2. Comments received from the **U.S. Environmental Protection Agency Region IX** dated October 28, 1985.

a. Comments: "It is unclear in the DEIS discussion of increased flows and the firm yield whether or not increased flows would be used to meet the salinity standard. The FSEIS should include a definite commitment to meet the salinity standard and describe the mitigation methods that will be used."

Response: The CVP/SWP are required by the State Water Quality Control Board Decision 1485 to meet the Delta Water Quality criteria, including salinity. This requirement will not change with the project. The CVP/SWP system will be operated to meet the salinity standards with or without the project. The Corps, USBR and DWR have agreed to a monitoring program to determine whether or not there is an impact to the CVP/SWP firm yield due to the project. The GDM includes a definite commitment to mitigate any significant and measurable impact identified by the salinity monitoring program. See also the response to comment "b." received from the Regional Water Quality Control Board dated October 21, 1985.

b. Comment: "The leachate from the dredge spoils should be further addressed in the FSEIS. The DSEIS assumes that zinc will be the only probable cause for water quality degradation. Constituents other than heavy metals should also be considered (i.e., pesticides). Plans for monitoring of leachate and a mitigation commitment should be included in the FEIS."

Response: Recent expert examination by personnel at the U.S. Army Engineer Waterways Experiment Station (WES) of the prior elutriate tests results presented in the Draft GDM indicated that there were procedural errors in the analysis of the samples. The WES experts outlined these four major procedural errors:

1) There are no background water samples to compare the elutriate test results with. The background water samples are needed in order to determine the source of any contamination levels (i.e. background water or sediment).

2) The elutriate samples were not filtered. When testing for hydrocarbons the samples should not be filtered, however for many of the parameter tests (heavy metals) filtering is standard procedure. This is because even small amounts of fine-grained sediment can considerably raise the apparent heavy metal concentration.

3) The elutriate test detection limit for mercury was higher than the EPA's acute and chronic limit. This means that the test results for mercury may or may not have exceeded the criteria, since the detection limit was not accurate enough to determine low levels of mercury.

4) The appropriate tests for confined dredged disposal is the modified elutriate tests, not the standard elutriate tests that were conducted. The standard elutriate tests are used for open water disposal sites and the test procedures are not applicable for the disposal sites being considered for this project.

These errors likely lead to results indicating concentrations of parameters that were much higher than is actually present in the project area. In light of this, The Corps has designed an extensive elutriate/modified elutriate testing program which will completed in mid 1986. The sampling will be carried out throughout the project area (including the man-made portions) and will utilize accepted methods. Modified elutriate tests will be conducted for all confined disposal sites being considered for the project. Elutriate tests will be conducted only for 3 possible sites near Sherman Island being examined as a potential wetlands enhancement area. The testing will closely examine all parameters of interest to EPA and State water quality criteria. In addition to chemical testing, column settling tests will be performed to further aid in

the design of disposal sites to settle out solids. The test results will be available well in advance of start of construction. In the unlikely event that the testing indicates a potential for exceeding any water quality criteria, design changes to the disposal areas can easily be accommodated to provide the proper settling/mixing zone characteristics needed to ensure compliance with the criteria. We will seek water quality certification prior to start of construction. Recent experience with the Stockton Deep Water Ship Channel under similar circumstances indicates there should not be any problems associated with construction of this project.

3. Comments received from the **U. S. Department of Commerce, National Oceanic and Atmospheric Administration** dated October 28, 1985.

a. Comment: "Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments."

Response: Investigation of the project area for known monuments by the Corps' Sacramento District Surveys Section failed to turn up any NOS Geodetic control survey monuments that would be impacted by the project. However, should any NOS monuments be located which would be impacted, the Corps will work with NOS to ensure their correct relocation. Project funding will accommodate such a relocation should it become necessary.

4. Comments received from the **U.S. Department of the Interior, Bureau of Reclamation** dated November 5, 1985.

a. Comment: "Page V-7, next to last paragraph - The statement that the impact was considered not negligible' is a subjective opinion and should not be stated here. Later studies show that this is not true."

Response: (NOTE - This statement is mis-quoted. The actual statement on page V-7 of the DGDM reads "Although a statistical change was noted, the magnitude was so small that the actual impact was considered negligible.") This statement refers to the magnitude of the change in relation to the overall salinity measurements taken at Station 23 (Rio Vista) and other locations. It states that in the opinion of qualified experts closely involved in the modeling tests, a salinity change of such a small magnitute will not have any real impact on water quality at Rio Vista. The statement is referring only to the results of the physical model tests. There were no later physical model studies than those presented, therefore, it is incorrect that Later studies show that this is not true.

b. Comment: "Page V-7, last statement - It was not shown anywhere in the document that the total salinity in the Delta remained constant. This is not a logical conclusion from the data presented here."

Response: The report does not state that "total salinity in the Delta remained constant". Page V-7 of the DGDM states "Model results also showed some statistically significant decrease in salinity in the same general vicinity, which indicates a slight shifting in salinity distribution with no change in overall Delta salinity". The data clearly shows both decreases and

increases in salinity levels throughout the study area. The implication of the report is that although there are some statistically significant increases and decreases in salinity for the base model for both rare and extremely rare dry conditions, these potential changes are not significant enough to impact overall Delta salinity conditions. This implies that there will no impacts at all during normal or wet conditions. This statement in the Final GDM has been revised for clarity.

c. Comment: "Page V-10, last paragraph - Salinity increases resulting from deepening the ship channel are downplayed before the studies on the impacts are presented."

Response: The referenced paragraph is entitled "Summary of physical model test results" and is summarizing the discussion that has been presented throughout Paragraph 20. It does not "downplay" salinity "increases". It summarizes the results of the physical model test results which do not indicate any significant adverse salinity impacts due to the project under rare or extremely rare dry conditions.

d. Comment: "Page V-11, second paragraph - How do you justify that "that physical model tests are the most reliable indicator of project deepening impacts?"

Response: In a February 1981 letter from Brigadier General Homer Johnstone (then Division Engineer for the Corps' South Pacific Division), to Ronald Robie (then Director, Department of Water Resources, State of California) this topic was discussed. The letter was a "letter of agreement" on several issues discussed during a meeting held in Sacramento on January 20, 1981. The agreement states: "The South Pacific Division and DWR agree that the San Francisco Bay-Delta Model at Sausalito is the best tool available to evaluate changes in rates of sea water salinity incursion into the Delta that may result from the channel deepening projects.".

Physical model testing, if correctly performed, has several advantages over mathematical modeling. If the dimensions of the physical model are correctly defined, a more realistic simulation of the prototype can be achieved since complex interactions between many physical variables are automatically established due to the nature of the physical model. A physical model can establish greater detail of the physical characteristic of the system being studied than can a mathematical model. In a mathematical model, many assumptions must be made in order to model the physical attributes of the system, and in many cases, these parameters are necessarily over simplified, as the actual physics may be unknown. The Corps' Bay-Delta model has been time tested and has a proven track record. The repeatability studies conducted for this project ensure reliability of the results. Often mathematical models use data derived from physical models as input, since they are unable to calculate certain parameters. For example, DWR's mathematical model uses parameters first determined by the Corps' Bay-Delta model (such as salinity gradients) for input data.

e. Comment: "Page V-13, last paragraph - The statement "the measured impact of 16% at 4480 cfs exaggerates the project impacts" is unsubstantiated and undocumented."

Response: The referenced paragraph in the Draft GDM is a summary paragraph and is supported by documentation presented in the paragraphs directly proceeding it. Steady state tests cannot indentify actual impacts to a dynamic system. Therefore, models such as DWR's are generally designed to be conservative and overpredict (or exaggerate) the potential increase. Results from the Corps' dynamic tests conducted in 1978, using critically dry 1977 hydrology, indicated a potential salinity increase at Emmaton Station of only 3 to 4%. This range is well within the detectability limits of the model (model noise) and indicates the the steady state tests results of a 16% impact is overly conservative.

DWR has since upgraded its mathematical model to more accurately reflect the project system and its response to certain input data. The revised model and its results are discussed in Chapter V of the GDM. In light of this, the referenced statement has been revised.

f. Comment: "Page V-13, last paragraph - Decreases in salinities at some stations do not offset violations of salinitiy standards at others for the CVP and SWP."

Response: This statement is true, but misses the intent of the statement. Salinity decreases (which were not used in the DWR operation studies) could actually increase the firm yield of the SWP/CVP, by decreasing the volume of water quality releases required to meet standards. This could in turn, help to offset any potential decrease in firm yield due to salinity impacts at Emmaton Station. The report does not state or imply that decreases in salinity at some stations can be used to circumvent the requirements of SWRCB Decision 1485.

g. Comment: "Page V-15, second to last paragraph - The statement that the Corps' physical model is the best tool for analysis of potential impacts is extremely subjective, undocumented, and should be eliminated."

Response: See the response to comment "d" above.

h. Comment: "Page V-15, second to last paragraph - First three lines are incorrect. Impacts were clearly delineated and defined in DWR studies."

Response: DWR agrees that salinity impacts due to the project are not definable at this time. A letter to Sacrament District Commander Colonel Wayne Scholl dated February 14, 1986 from David Kennedy, Director of DWR states "we agree with your staff that the impacts are not clearly definable at this time.". This letter is included in GDM Appendix J.

i. Comment: "Page V-16, paragraph 2 - Has the proposed sill been documented to be environmentally sound?"

Response: The submerged sill is not included as a project feature. It is one of several salinity mitigation measures under consideratio by the Corps should a salinity impact due to the project be defined by the prototype salinity monitoring program. See the response to comment "c" received from the National Wildlife Federation dated November 11, 1985.

5. Comments received from **U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service,** dated December 4, 1985.

a. Comment: "The effects of disposing dredged materials on wetland habitats appears to be described well. Considerable discussion relates to the effects of the wetland losses and the mitigation proposed to compensate for those losses. However, if it is determined subsequently that mitigation still is inadequate, we would discourage the loss of aquatic areas important to fish resources if mitigation requires filling these areas to create wetlands. Further examination of potential sites would be needed to address this concern. We encourage the creation of new wetlands, but prefer that these habitats be created by altering the elevations of existing upland areas."

Response: If unforeseen circumstances require any mitigation plan revisions, any changes will be coordinated with USFWS, NMFS, and the California Department of Fish and Game.

b. Comment: "We note with concern that the impact of new dredging on benthic habitats is not addressed. By this we mean the bottom substrates on each side of the existing ship channel that have never been dredged. A rough estimate (based on a five-foot cut and a side slope of 4 horizontal to 1 vertical) indicates that about 150 acres of soft mud and sand substrate would be altered by dredging and subsequently maintained by further dredging. The EIS should discuss the areal extent of the impact, and the in-faunal organisms that are expected to occur in these substrates, and the effect of permanently modifying these habitats. Past studies indicate that bottom-associated organisms such as amphipods (*Corophium* sp.) and midge larvae are consumed by young striped bass. We suspect the same to be true for young salmon migrating and feeding in these areas."

Response: The supplemental EIS on page 29 states "The impacts on fish, plankton, and benthic organisms of the dredging necessary to widen and deepen the channel were analyzed in the 1980 EIS. This analysis is still valid..." The 1980 EIS extensively examines the impacts of the project dredging on the benthic community in Section 4.10 (Appendix 3, p. 3-14). The report states that "Most benthic organisms would be removed from the manmade portion of the channel during the dredging operation." However, the report concludes that not all organisms are removed and repopulation by those remaining and migrating into the area is rapid. One study cited noted that repopulation to pre-dredging levels could be as short as 14 days, but complete recovery might take as long as 2 years.

The U.S. Fish and Wildlife Service provided information on the project's effects on benthic organisms in their "Detailed Report on Fish and Wildlife Resources" dated March 20, 1980. This report is included in Appendix 2 of the 1980 Feasibility Report and EIS. Page 15 of this report states "Losses to the benthic community attributable to dredging, while severe, are temporary and would be offset over the life of the project due to the fact that the channel deepening and widening has the effect of creating benthic area. Preliminary calculations indicate that channel enlargement would increase benthic habitat in the project area by about212 acres (1,537 acres vs. 1,749 acres)." For further information regarding project effects on benthic organisms, including maintenance dredging, refer to the above referenced pages in the 1980 Feasibility Report and EIS.

c. Comment: "A clear description of the water depths to be increased is lacking. For instance, it would be helpful to know the areal extent of habitat at 0-5, 5-10, 10-15, 15-20, 20-25, and 25-30 feet (MLLW data) that would be modified. Although these depth ranges are subjective, they could help assess the potential impact of altering these strata on Corophium populations in the project area."

Response: To obtain this type of detailed information would be extremely difficult, particularly since the channel geometry is constantly changing due to sediment transport. The Draft GDM Appendices contain information of interest in Appendix F, Sediment Engineering Investigations. Included in Addendum VI of this section are diagrams of several cross section surveys of the channel bottom at MLLW. In addition, information is presented concerning physical characteristics of the sediment and water quality information taken during the survey. In addition, Plate II of the Draft GDM presents sample cross sections of the existing channel and areas which will be dredged in both the natural and manmade portions of the channel. More detailed information will become available as future soundings are obtained in preparation for dredging contracts and design. In the 1980 Detailed Report on Fish and Wildlife prepared by the U.S. Fish and Wildlife Service, page 11 states "Dredging to deepen the channel would remove organisms in the annelidan, molluscan, and arthropodous groups from about 1,540 acres of benthic habitat. Reestablishment of benthic communities is, however, normally accomplished within 2 years." In addition, see the response to the proceeding comment.

d. Comment: "The schedule of in-water work may be included in the EIS, but it was not apparent in our cursory review. Intensive studies have occurred in the Pacific Northwest of effects of entraining small salmon in hydraulic dredge suction/cutter heads. It is known that there is some entrainment. This impact or measures to minimize the impact is not discussed."

Response: The construction schedule appears on Plate III of the Draft GDM. This schedule has been revised and the latest version appears in the Final GDM. The 1980 Detailed Report on Fish and Wildlife Resources prepared by the U.S. Fish and Wildlife Service listed several "Requests". Request 2 (page ii) asks that dredging operations be coordinated with the California

Department of Fish and Game, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service in order to "minimize interference with the migration, spawning and rearing of fish species." The Corps will provide information and notification of contracts for this project as requested.

e. Comment: "Our final comment relates to the potential intrusion of higher salinity water into delta reaches. Although the topic is discussed extensively, proposed remedial action (should intrusion indeed be an impact requiring mitigation) is vague. An underwater sill is suggested, but its location, elevation and construction are not discussed. In fact, the EIS leaves the issue open to subsequent interpretation that increased salinity in the delta could be that of increased ballast discharges from ships and, perhaps, not intrusion; therefore remedial action would not be appropriate. Perhaps this reasoning appears somewhat skeptical but it illustrates the need for a more thorough plan to acknowledge and correct saltwater intrusion impacts."

Response: The submerged sill is but one of the possible mitigation methods under consideration by the Corps should a salinity impact due to the project be defined by the monitoring program. See also the response to comment "a" received from the Environmental Protection Agency dated October 28, 1985 and the response to comment "c" received from the National Wildlife Federation dated November 11, 1985. For a response to the issue of salt water ballast discharges, see the response to comment "a" received from the California Regional Water Quality Control Board Central Valley Region, dated October 21, 1985.

6. Comments received from the **California Regional Water Quality Control Board Central Valley Region**, dated October 21, 1985.

a. Comment: "The Corps acknowledges that there are elevated salinity concentrations in the Port and the Deep Water Channel from discharges of saline ship ballast, but believes that the correction of this problem is not a concern of this project since expansion of the Channel is not supposed to increase the use of the Channel. We disagree. The saline brine discharges in the Deep Water Channel are solely the result of the presence of the Channel. Therefore modifications to the Channel should work towards mitigation of the problem. The Port's policy of having ships recirculate their ballast water in the lower Delta is not enforced by the Port, so is not effective. An evaluation of alternatives for control or mitigation of ballast discharges should be performed."

Response: This is a regulatory problem, and is not the responsibility of the project. The 1980 Feasibility Report responded to similar comments. It stated in response to comments by the U.S. EPA that "Control of ballast discharge is the responsibility of the Environmental Protection Agency and the Regional Water Quality Control Board as indicated in the EIS. Water Quality problems have developed out of enforcement problems, not project operation, and are not the responsibility of the project." (Appendix 6, p. 6-4). The Port of Sacramento has attempted to help solve this regulatory problem. In a letter sent to the Corps with attachments, John Christian, Chief Engineer for the Port outlined the policies of the Port on this issue. The Port has recently sent a letter to all licensed pilots who sail to Sacramento seeking cooperation in recirculating saline ballast water in the lower Delta where it will mix and disperse. In addition, the Port has updated their Pilot's Report (see attachement to letter) to help determine which ships comply with this request and which do not. The letter and both attachments are enclosed in the "Pertinent Correspondence", Section of this report (Appendix J). In addition, Mr. Christian stated in his letter that he believes that the incidences of salt water ballast discharges have decreased significantly during the last few years.

b. Comment: "The Corps has proposed to monitor Delta salinity concentrations and mitigate any increases. Of the mitigation alternatives discussed, only the release of Central Valley Project (CVP) water could be implemented quickly to counteract salinity increases. The Corps or the Bureau of Reclamation should determine whether an extra 40,000 AF of CVP water will be available for release during dry years."

Response: The CVP/SWP are required by the State Water Quality Control Board Decision 1485 to meet the Delta Water Quality criteria, including salinity. This requirement will not change with the project. The Corps, USBR and DWR have agreed to a monitoring program to determine whether or not there is a salinity impact due to the project. The Final GDM notes that DWR has reevaluated maximum potential impacts on CVP/SWP firm yield using a more theoretical approach. This approach is discussed in the GDM. There is currently enough of a surplus in firm yield to meet the supplemental releases DWR indicates may be necessary to meet salinity standards.

c. Comment: "The digital model was unable to quantify dry year salinity increases caused by this project. Without this predictive capability, how will the necessary CVP water releases be calculated if Delta salinity standards are exceeded?"

Response: As stated above, the salinity standards must be met by the CVP/SWP. The salinity standards are not instantly exceeded. In other words, there is some lead time available for operational adjustments to ensure that the standards are not violated. This lead time is due to the current salinity monitoring system already in place. The current method of CVP/SWP operations is not expected to change because of the project. This method uses salinity data measured in the field along with hydrologic assumptions as input to the DWR digital model to determine the reservoir releases required to meet the salinity standards at various locations. The ability of the CVP/SWP to adjust releases to meet the specified salinity standards will not be adversely affected by the project.

d. Comment: "The heavy metals tests, particularly the elutriate tests, indicate a serious potential for exceeding water quality criteria. Elutriated copper is 39 times the EPA acute water quality criteria. No data is presented to support the Corps' conclusion that sedimentation basins and dilution in the receiving water will prevent metal concentrations from exceeding water quality standards. Elutriate tests should be performed on agitated then settled sediment samples to better simulate settling basin effluent. If elutriate samples are still above receiving water limitations, bioassays should be conducted on the return water and zones of dilution should be calculated. We are particularly concerned with the limited mixing which will occur in the constructed portions of the Deep Water Channel."

Response: See response to comment "b." received from the U.S. Environmental Protection Agency Region IX dated October 28, 1985.

7. Comments received from the **California Department of Fish and Game** dated October 21, 1985.

a. Comment: "The Department recommends Lower Sherman Island be pursued further as a potential enhancement site for the DWSC Project. We would be pleased to meet with your staff to discuss and develop site specific disposal plans for the open water portion of the island."

Response: We agree, see response to comment "a." received from the U.S. Department of the Interior, Office of the Secretary, Pacific Southwest Region dated October 25, 1985.

8. Comments received from the **California Department of Water Resources** dated October 28, 1985.

NOTE: A subsequent letter was received from **DWR** in order to clarify issues raised in the above referenced letter. This letter should be reviewed in conjunction with the following comments and responses. The letter is dated February 14, 1986 and is included in Appendix A to the FSEIS and Appendix J of the GDM Appendices.

a. Comment: "We are concerned with the discussion of impacts on State Water Project (SWP) and Central Valley Project (CVP) yield due to deepening the channel.

This discussion does not reflect the latest analysis we completed and submitted to the Corps of Engineers staff prior to publication of its report. The curves illustrated in Figure V-2 of the report and described on page V-12 were considered inappropriate since they show high salinity increases at Emmaton during very low Delta outflows. In reality, the impact on salinity due to the deepening should be zero at zero Delta outflow, then increase to a point at low Delta outflow, then decrease again to zero at high Delta outflow.

Our new approach was developed and incorporated into the Department's Statewide Operation Study Model to determine the salinity impact at Emmaton. This method utilizes an empirical salinity-flow relationship at Collinsville developed by the Department and a salinity gradient relationship between Collinsville and Emmaton as derived using the Corps' physical model results for the base and channel deepening cases."

Response: The lastest analysis referred to in the above comment was not available in time to incorporate into the Draft GDM. The Final GDM has been updated to reflect the lastest analysis provided by DWR. The earlier analysis is still presented in order to provide background information, as are post feasibility study Bay-Delta model salinity tests. This means that the salinity impact curves are still incorporated into the report. However, the report states on page V-18 that "DWR, USBR and the Corps agree that the second more theoretical method is a more reasonable approach to calculate potential reductions in firm yield of the CVP and SWP system.". This implies that more credibility should be given to the latest analysis over the ealier studies first presented in the Draft GDM.

b. Comment: "The Department feels that the latest approach is a more realistic way of determining the impact than the methods previously used and presented in the report. This approach showed an average impact to the CVP and SWP of approximately 34 TAF per year during critical periods. This impact could be as high as 55 TAF per year but no lower than 15 TAF per year. Although it is true that this impact is a small percentage of total CVP and SWP yield, we feel that it is a definable impact. Therefore, we disagree with the statement in the last paragraph on page V-15, third paragraph:

> Discussions with DWR and USBR personnel indicate the impact is not clearly definable at this time.'

and the statement on the same page, second paragraph:

> Based upon reasonable estimates to date, the impact to the firm yield of the SWP and CVP could vary from zero to as much as 40,00 acre-feet.'"

Response: See the response to comment "a" of this letter. In addition, DWR has since provided a letter to the Corps clarifing its position on this issue. Although still expressing concern about potential salinity impacts due

to the project, the letter states "...we agree with your staff that the impacts are not clearly definable at this time.". The letter is referenced above and can be viewed in Appendix J of this volume.

c. Comment: "Regarding the monitoring program that will be established to better define salinity impacts of the deepening project, the Department would like this program to be started as soon as possible. This would allow a sufficient period of historic record before the project is started. This monitoring program could be set up to supplement the monitoring network that is in place by the on-going interagency Ecological Study Program. The Department will work with the Corps to implement the monitoring program."

Response: The Corps has, and will continue to coordinate the salinity monitoring program with DWR and USBR. On September 20, 1985 a meeting was held between the Corps, DWR and USBR to discuss the proposed salinity monitoring program. A second meeting was held on January 13, 1986 with DWR to further discuss the monitoring program refinements. Suggestions were obtained from both DWR and USBR and incorporated into the recommended monitoring program. Details of the recommended monitoring program were provided to DWR and USBR for their review and comments in letters dated February 20, 1986. The letters provide specifics of the monitoring locations, equipment types and depths of sampling stations. In addition, the letter proposes involving USBR's Tracy Field Division and the USGS in all aspects of the monitoring program.

d. Comment: "In addition, paragraph 23 addresses seepage from the channel and indicates that the effect of the deepening will be negligible and probably undifferentiable from other influences on local ground water conditions. The Design Memorandum indicates sandy formations of unknown continuity at moderate depths below the channel. Ground water conditions in the east Yolo County area are variable and generally not well understood. Depending on the local natural or man-caused ground water gradient, the channel deepening may have an effect on the ground water quality and ground water levels in wells of the area."

Response: The seepage study as referenced in paragraph 23 of the DGDM indicated that conservative assumptions were used for the seepage calculations. These included the assumptions that sediments were completely removed from the channel bottom, and that low-permeability formations that exist above the intermittent sandy formations would be reduced in thickness by five feet. Even with these conservative assumptions, the study still showed minor (if any) impacts on seepage or, therefore, groundwater levels. Concerning water quality, no significant salinity or other water quality impacts are expected to occur due to the recommended channel improvements. Therefore, any minor impacts on ground water (which are expected to be undetectable) are not expected to affect water quality. Additionally, the dredged channel will re-silt over any exposed sandy layers and therefore any minor impacts to groundwater that may occur would be short term.

9. Comments received from **The Planning and Conservation League** dated September 4, 1985.

a. Comment: "We believe that the conclusions and recommendations on the subject of salinity intrusion are inadequate and misleading. Based on the information in the Supplement, we would have to oppose project construction until adequate mitigation for the inevitable salinity intrusion is proposed."

Response: We do not agree that salinity intrusion is inevitable. As stated in the GDM, a salinity monitoring program is being implemented to determine whether or not there is a salinity impact due to the project. Even if the project does cause a salinity impact, the impact will not result in a failure to meet the salinity criteria. This is due to the fact that the CVP/SWP must still meet the salinity standards under the criteria established by the State Water Resources Control Board Decision 1485. This decision requires that salinity criteria be met at Emmaton and other locations in the Delta by release of CVP/SWP water if necessary. In addition, the Corps has clearly stated in the FSEIS and GDM that if the monitoring program shows a salinity impact due to the project, mitigation will be provided by the Corps.

b. Comment: "Despite a variety of attempts to downplay the problem, the report concludes that the project would cause a loss of CVP/SWP yield of from 30 to 153,000 acre feet per year. Since the report does not indicate which hydrology the Department of Water Resources used to draw these conclusions, it is possible that the actual yield loss could be much higher. This is because year 2020 hydrology is more sensitive to salinity intrusion than 1980 hydrology (due to reduced Delta inflow caused by upstream depletions). It is also likely that the DWR methodology assumed Auburn Dam in place, an assumption which now appears unlikely."

Response: The report does not claim a loss of 30 to 153,000 acre feet per year. It is simply reporting on possible scenarios presented by DWR's math model. The Corps believes that the project impact on salinity may well be zero. The Corps, DWR, and USBR all agree that the best way to determine actual impact (if any) is by the salinity monitoring program. The 30 to 153,000 acre feet annual yield loss figures as quoted above indicates the commentor did not fully understand the information presented in the supplement. First, the term "yield" should actually be "firm yield" - the amount of water which can be delivered to users during the critical dry period. The critical dry period is the driest historical period on record (May 1928 through October 1935) for California. The DWR methodology utilizes the critical dry period hydrology and hence reflects a "worst case" scenario, not an annual effect. In addition, the Draft GDM points out the severe exaggerations associated with the particular scenario curves A, B, and C that produced these high results (pages V-11 through V-16). Both DWR and the Corps agree that these results are overly conservative. The Department of Water Resources has since used a more theoretical approach to determine potential maximum firm yield impacts. The results of these new firm yield studies have been presented in the GDM. Neither the results presented in the Draft GDM nor the GDM assume that Auburn Dam is in place. See also the discussion paragraph 20 of the GDM and paragraph 5.3 of the FSEIS.

c. Comment: "The statement on page V-15 that spending from a half million to several million dollars to further study this problem is ridiculous, given the potential costs of making mistake."

Response: The reviewer has taken this statement out of context. The Draft GDM states that it is likely that additional physical model tests would not yield conclusive results. This means that the expenditure of this amount of money on additional physical modeling would likely be wasted since no additional insight would be gained.

d. Comment: "The mitigation proposed is what we have learned to expect from the Corps: nothing. No mitigation at all is proposed despite the studies which show a definitive loss of yield. Monitoring will at best lead to disputes about responsibility, which the Corps will win because there is no mitigation agreement or requirement."

Response: The studies do not indicate a definitive impact on salinity due to the project. The Corps, DWR and USBR have agreed that the best way to define the impact, if any, is to conduct a salinity monitoring program. As stated in the Draft GDM and GDM, the Corps will mitigate for salinity intrusion if a significant and measurable impact is identified. A formal mitigation plan cannot be implemented until an impact is defined. As stated in the GDM, studies and/or modeling tests of alternative mitigation measures will be conducted concurrently with the monitoring program.

10. Comments received from the **Port of Sacramento**, dated October 24, 1985.

The following comments refer to the Draft General Design Memorandum.

a. Comment: "1. Page I-3. Fourth paragraph. The mitigation acreages of 45 and 156 acres listed are out of date."

Response: This paragraph refers to features presented in the 1980 Feasibility Report, and is included for informational purposes.

b. Comment: "2. Page IV-6. Paragraph 16.b. Acreages listed for fish and wildlife facilities are inconsistent with latest information available to us."

Response: Concur. The paragraph has been revised to reflect the current acreages needed for the fish and wildlife mitigation plan.

c. Comment: "3. Page X-1. Paragraph 47. Benefit-cost ratio listed is incorrect."

Response: Concur. The benefit-cost ratio has been revised.

The following comments refer to the Draft Supplemental Fish and Wildlife Coordination Act Report.

d. Comment: "1. Page 4. Paragraph 2. The references to Wetlands at Lake Washington are inappropriate in this context. These areas are being treated seperate from this project."

Response: This reference has been eliminated from the report.

e. Comment: "2. Page 6. Paragraph 1. Where is the justification for requiring mitigation for upland habitat? Which law?"

Response: Reference Fish and Wildlife Coordination Act (16USC 61 et seq.) and U.S. Fish and Wildlife Service Mitigation Policy (Federal Register, Volume 46:15, January 23, 1981).

f. Comment: "3. Page A1-8. No. 4. This statement is not necessarily a true assumption."

Response: This may occur as a seperate action and is not a project feature.

g. Comment: "4. Page A1-10. No. 8. Second sentence. We do not agree with this statement."

Response: This is the opinion of the Habitat Evaluation Team (HEP), which included representatives of the Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, and the Port of Sacramento.

h. Comment: "5. Page A1-11. First sentence. Repeat our comments on page 6, paragraph 1. See no. 2 above."

Response: Reference Fish and Wildlife Coordination Act (16USC 61 et seq.) and U.S. Fish and Wildlife Service Mitigation Policy (Federal Register, Volume 46:15, January 23, 1981).

i. Comment: "6. Pages 9 and 10 of McKevitt letter:

References to cost of $1,000,000 to provide mitigation site should be qualified as a preliminary estimate."

Response: The FWS intends this estimate to be preliminary. Corps of Engineers estimates were unavailable at the time the FWS Coordination Act Report was written. Updated Corps estimates are provided in the GDM.

The following Comment is a general comment regarding Fish and Wildlife mitigation.

j. Comment: "We want to address an alternative site for consideration as mitigation. The Port owns about 150 acres on Prospect Island, west of the ship channel. We have chosen to allow most of this property to revert to wetlands by means of not repairing a levee. It is possible the Port would consider dedicating this land in fee for a wildlife refuge in place of the 63 acres suggested by USF & WS."

Response: The wetlands area west of the ship channel already exists, therefore the wetlands values are already protected by the Clean Water Act Section 10 404 process. Therefore, no benefits could be gained for its use as a mitigation feature.

11. Comments received from **The Bay Institute of San Francisco** dated October 24, 1985.

a. Comment: "Comparing the findings and recommendations of this report, and the Draft General Design Memorandum Appendices, to the original (1980) reports on this project reveals that the effect of the channel deepening on salinity intrusion is no longer considered to be an important issue.

The downplaying of this factor is noted in the section (p. IV-3) of the EIS describing salinity mitigation plans, which states only:

- A monitoring program is being established to define salinity impacts of the deepening project, if any. If an impact is defined, a mitigation plan will be developed.' (emphasis supplied)"

Response: (NOTE - The above quote was actually obtained from the Draft GDM not the Draft Supplemental EIS as indicated.) The project's effect on salinity is not being downplayed. Several modeling tests were run in order to determine the project's effect on salinity. The results were not clearcut. A formal mitigation plan cannot be implemented until it is known to what extent, if any, a project impact exists. DWR, USBR and the Corps agree that the best method to define whether there is a salinity impact due to the project was to conduct an in-depth salinity monitoring program. We feel this is the best approach towards this issue as it would not be cost effective to mitigate for a problem if it does not exist. As stated in the GDM, the Corps has agreed to mitigate for salinity intrusion if the monitoring program indicates a significant and measurable impact. Studies and/or modeling tests of mitigation measures will be conducted concurrently with the monitoring program. We believe that this is the best environmentally and economically sound approach to this issue.

b. Comment: "Similarly, the General Design Memorandum section (p. E-16 ff) on test results for salinity changes relies upon conclusions from Bay Model testing to go so far as to state that the deepening project could decrease salinity. Given the Bay Model's known limits for chemical and biological testing, this could be an egregious error."

Response: (NOTE - This comment refers to the Draft GDM Appendices pages E 16-18.) This statement is taken out of context. The GDM does not state that the project will result in lowered salinity levels. The GDM is simply stating the actual results of the physical model testing. The GDM indicates that the decreases are due to "a slight shifting in salinity distribution with no change in overall Delta salinity." To clarify this issue, the emphasis added to the word "decrease" in the Draft GDM has been removed in the GDM. In addition, a detailed analysis was conducted on the results of the physical model testing, as well as the sampling scheme and analysis by experts at the Corps' Waterways Experiment Station (WES). This analysis was presented in the Draft GDM Appendices as "Attachment a" to Appendix E. The analysis concluded that the model was operated well within its limitations. The repeatability of the results, sample size, test length, number of tests and model noise were all considered in the hypothesis testing of the data. This method helps to avoid accepting data results which are below the detectability and functionality limits of the model. For a detailed discussion of the model and its limits in regard to this study, see the above referenced report.

c. Comment: "The reference to water quality in the EIS (p. II-4) states that total dissolved solids generally exceed the 500 parts per million (ppm) objective between Mile 35 and the Port of Sacramento.' Linking this increase primarily to salt water ballast discharges from the ships at the port' implies that this is an easily controllable source, but practice does not ever meet expectations in such matters. At any rate, any improvement in enforcement on this source will probably be wiped out by increased use of the port due to the deepening project."

Response: (NOTE - The above comment actually refers to the Draft GDM page II-4 not the Draft EIS as indicated.) The report states that little or no increase in ship traffic is expected for the first 20 years of the project. Therefore, the ballast discharges should not be worsened and any enforcement improvement should lessen the problem. See also the response to comment "a" received the California Regional Water Quality Control Board Central Valley Region, dated October 21, 1985.

12. Comments received from **Murray, Burns and Kienlen** Consulting Engineers to Reclamation District 2084 (Egbert Tract right bank between mile 15.0 and 18.6) in a letter transmitted by **Coblentz, Cahen, McCabe & Breyer** dated October 28, 1985.

a. Comment: "Spoil site S14 on the tip of Grand Island is a very important source of material for levee repair of the Delta islands. Material has been removed from this site for many years to rehabilitate the levees in the Delta. The use of this area as a spoil site should be continued. Any plans to establish a recreation area on this site should be discouraged."

Response: As was stated in DGDM paragraph 14 c.(2) the recreation facility at this site is not being considered at this time because there is no local sponsor. Even if at a future date a local sponsor did come forward for recreation, the Grand Island site would continue to be used as a dredged material disposal site as the permanent recreation facilities being considered would only occupy a portion of the site (one conceptional proposal was to develop 10 acres of the 196 acre disposal site).

b. Comment: "Flooding of the Reclamation District No. 2084 is very rare. Seepage does occur during the winter months when Cache Slough is high adjacent to the District. If increased seepage does occur during the spring and summer months, then there is a definite concern to Reclamation District No. 2084 and the landowners. Any increase in seepage should be mitigated."

Response: A seepage study was completed as is referenced in paragraph 23 of the DGDM. The assumptions made in this analysis are considered conservative and therefore actual influences of dredging on seepage can be expected to be much less than estimated and shown in the DGDM. The consultant who prepared the seepage analysis concluded that actual increases in seepage as a result of the project would be so small as to be undetectable over most of the project reach. A similar concern about seepage was addressed for the Stockton Ship Channel deepening project that is currently under construction. Through seepage monitoring stations established adjacent to the channel, it has been shown that adjacent dredging can temporarily increase piezometric

levels on lands adjacent to the channel but indications are that within 1 to 2 years resiltation of the channel cut would bring levels back to predredging conditions. The dredging on the Stockton channel has largely been completed in the reaches where the channel is near adjacent levees with no noticeable increases in seepage along these reaches. Since the elevations of adjacent ground near the Stockton Channel are much lower than in RD 2084 along the Sacramento River Deep Water ship channel, no measurable effects on seepage along RD 2084 are expected. Because of the many influencing factors in monitoring seepage such as water surface levels, precipitation amounts and irrigation practices, additional monitoring stations would not be conclusive in defining increases in seepage. Additionally, the channel in this reach is being aligned so as to minimize any horizontal cuts that would decrease seepage paths to the adjacent lands. In this reach of mile 15.0 to 18.6 the existing channel width of 300 feet is being maintained.

c. Comment: "As mentioned previously, this spoil site (Grand Island) is a very important source of material for the Delta islands. By continued removal of material from the site, it allows for a deposit area for dredged material that periodically must be removed near the junction of the Sacramento River and Cache Slough. This site should be retained as a spoil site for the dredged material and any use for recreation purposes should be discouraged."

Response: See response to comment "a" of this letter.

d. Comment: "In 1982 a 1,350-foot reach of the right bank levee in this narrow reach slipped on the waterward side. The existing rock revetment and the waterward slope of the levee slipped vertically a minimum of 3 feet and a maximum of 7 feet. Reclamation District No. 2084 repaired this portion of the levee at a cost to the District of nearly $27,000. It was the District's opinion that this damage was caused by a combination of the depth of the channel adjacent to the levee and the movement of large ships using the channel. It appears that a 300-foot channel width in this narrow area adjacent to Reclamation District No. 2084 may produce some adverse effects to the levee and stone protection maintained by the District. This concern should be addressed by the U. S. Army Corps of Engineers in their final design and construction plans for the deepening of the ship channel."

Response: Paragraph 33 d.(4) of the DGDM addresses effects on bank erosion. Analysis of the proposed conditions shows that no significant change in ship generated wave effects on bank erosion will occur. The channel width in this reach is not being widened in part so as not to cause problems with adjacent levees in this narrow reach. Alignments are being refined to minimize any channel side cuts. The projected ship traffic is not expected to increase in number or size of ships traversing the channel for the first 20 years after deepening (benefits primarily occur from more efficient utilization of existing ships) and it is not expected that the proposed dredging will affect the existing bank protection along RD 2084. However,it is expected that continued maintenance of the bank protection will require placement of some stone protection with either the existing channel or the deepened channel.

e. Comment: "In this narrow channel this increase of speed and the crabwise position of the ship could have an adverse effect on the levee along

Reclamation District No. 2084 on the right bank of Cache Slough." (Note: in paragraph 33 d.(5) of the DGDM, Capt. Atthowe is referenced as saying, that in Cache Slough at the mouth of the manmade channel, swift currents require ships to increase speed and that the ship becomes somewhat crabwise to the channel).

Response: This is an existing condition that is present because of the narrowing of the channel and the confluence with the Yolo Bypass and resulting swifter currents especially during high flow conditions. Captain Atthowe's comment on increased speed is in reference to the ship's power and not the relative speed of the ship. As the current increases, the ship must increase power to maintain a constant speed. Additionally, the proposed dredging may in fact reduce this problem by increasing the flow conveyance area in this reach and therefore reduce the velocities.

f. Comment: "This area is of particular concern to Reclamation District No. 2084. Any plans for a levee setback in this area should be carefully reviewed by the District. The proposed channel deepening appears to be very close to the District's levee. This deepening could undercut the existing rock revetment. The channel deepening should be moved more to the center of the channel. Additional rock protection should be added to the levee and bank in this area. Perhaps the maintenance obligation for the levees and rock protection in these narrow locations should be the Corps of Engineers and not the local District."

Response: Through refinement of the channel alignment in this reach there will be no need for levee setbacks. Channel side cuts will be minimized in this reach so as not to require levee setbacks. Maximum horizontal cut is expected to be less than 25 feet and the levees are still an average of 480 feet from the centerline of the channel. The proposed dredging will not affect the existing banks or revetment. Therefore, there will be no change in the responsibilities for maintenance.

g. Comment: "This concern (of undermining the existing revetment) should be addressed by the Corps of Engineers in their final design and construction plans for the deepening of the ship channel."

Response: See the response to comment "f" of this letter. Revised paragraph 37 in this final GDM addresses this concern. Refinement of the channel alignment will continue into preparation of plans and specifications to minimize any adverse affects on existing banks.

h. Comment: "In particular, the main concerns to Reclamation District No. 2084 and the property owners in the portion of the channel located between Miles 15.0 and 18.6 are indicated as follows:

1. This is the narrowest portion of the natural waterway and the ship channel is very close to the right bank levee.

2. The close location of the channel to the right bank levee could be a concern due to large ships which could cause damage to the revetment and levee by propeller wash, the pressure created by the hydraulic compression of the

water as it is "squeezed" between the vessel and the bank, and the need by the ship to provide more speed to compensate for water velocity and wind. Proper bank clearance should be provided in the design and construction of the channel.

3. Possible increase in seepage to the lands in Reclamation District No. 2084. Any increase in seepage should be mitigated.

4. The "design vessel" used for the design of the 35-foot deep channel has a beam of 83 feet and a length of 600 feet. It is noted that vessels of much larger size have made calls to the Sacramento Port in the past.

Perhaps Reclamation District No. 2084 should negotiate a new agreement with the Corps of Engineers or Port District whereby the Corps or Port would be responsible for maintenance of the right bank levee and revetment works between Miles 15.0 and 18.6."

Response:

1., 2. & 4. See response to comments "d", "e", "f" and "g" of this letter.

3. See response to comment "b" of this letter.

4. The "design vessel" is the hypothetical vessel which represents the size range of vessels that would most commonly use the waterway (see paragraph 33 of the GDM). It is recognized that larger vessels do use the existing waterway. Therefore, channel designs were reviewed for the larger vessels. The designs chosen can safely and efficiently allow travel of ships with a 31.2- foot saltwater draft when deepened to 35 feet below MLLW without use of tides. However, larger draft vessels can be accommodated through use of tide levels. The limiting factor on the larger ships all ready exists due to the radius of curvature of the bends upstream in the manmade portion of the channel. The maximum sizes of ships traveling to the port is not expected to increase in the future. In the reach, mile 15.0 to 18.6, there are no characteristics of the banks, bottom sediment or alignment which necessitate the need for a design based on a vessel larger than the most commonly used vessel. Additionally, because of the adjacent levees in this reach a wider channel would not be desirable in light of the attempt to minimize adverse effects on the adjacent banks.

13. Comments received from the **National Wildlife Federation** dated November 11, 1985.

a. Comment: "The DGDM (page II-12) states that vessel calls at the Port of Sacramento decreased in 1982, and in 1983, due to world-wide recession and the United State's Payment-in-Kind program. The document then asserts that vessel calls are expected to increase as agricultural constraints are relaxed and the economic situation continues to improve.' The SEIS (page 31) states that very little increase in traffic is expected for at least twenty years.' The stated need for the project is based on speculation. Since no substantial traffic increase is anticipated within the next generation, the channel project should be deferred until until evidence exists that it is needed."

Response: The reviewer states that since there is no increase in ship traffic, there is no need for the project. This statement is misleading since most of the benefits of the project for the first 20 years are derived from an increase in net tonnage of shipped goods and a decrease in costs for ocean transportation of these same goods, not by an increase in shipping traffic. The deepening and widening of the deepwater channel would allow the same number of ships currently using the channel to more efficiently transport goods by taking advantage of economies of scale. The project would allow ships to sail more fully loaded and avoid costly tidal delays because of the deeper channel. In addition, increased costs due to intermodal transportation of goods to other ports and "topping off" could be avoided for the same reason. The above factors substantially reduce the costs of shipping per ton and when combined with the other benefits and compared to the project costs, show that this project is justified and needed. Chapters IX and X in the GDM explain the derivation of the benefits and the project justification. The need for this project has been addressed throughout the documentation - from the 1980 Feasibility Report and Environmental Impact Statement, through this Final GDM and Final Supplemental EIS. A large percentage of the contents of these documents have been devoted to demonstrating need and economic justification for this project. The benefit to cost ratio of 2.0 : 1.0 indicates that the project is currently needed and justified.

b. Comment: "The Corps anticipates that the San Francisco Bay to Stockton Ship Channel deepening project is to be completed in 1987, according to Mr. Welsh. Stockton is less than 50 miles south of Sacramento and may compete with the Sacramento channel for deep-draft traffic. The DGDM states (page IX-1) that A thorough discussion of the methodology and procedures used in deriving the navigational benefits was presented in July 1980.' The 1980 document said of the Stockton channel: ... only limited construction has been accomplished on this project pending completion of evaluation of the Stockton channel.' (page 14) In light of the recent completion of 3 out of 4 contracts on the Stockton Channel, this statement is no longer valid. The U.S. Water Resources Council's Economic and Environmental Principals and Guidelines for Water Resources and Related Resources Implementation Studies state that ... in the final delineation of the economic study area for a given (Deep- Draft Navigation) improvement, there should be adequate discussion of the trade area relative to adjacent ports and any commonality that might exist.' Neither the 1985 nor the 1980 document adequately addresses this point."

Response: The use of intermodal transportation of goods to the Port of Stockton (as well as Bay area ports) has been examined in the 1980 Feasibility Report. Page 21 of the 1980 report discusses this topic and concludes that "Transporting commodities to either the bay area or the Port of Stockton would increase transportation and handling costs by at least $5.00 per ton." Appendix 1 pages D-7 through D-8 of the same report discusses this alternative in greater detail. It concluded that a savings of $2.00 per ton in ocean transportation costs would result in the use of the 35 foot Stockton Channel over the current 30-foot Sacramento Channel. This cost savings figure would be more than offset, however, by the increase in transportation and handling costs of at least $5.00 per ton due to intermodal transportation. Given this information and the figures showing that the 35-foot Sacramento Channel has been shown to be economically justified over the current 30-foot Channel - it is clear that the 35-foot channel is a superior alternative to intermodal transportation of goods to the 35-foot Stockton Channel.

The comment also raises the point regarding inclusion of adjacent ports in the discussion of the project's trade area. The 1980 Feasibility Report does adequately address this point. Appendix 1, Section B is entirely devoted to the Resources and Economy of the study area. It is true that the Stockton and Bay area ports were not directly included in the study area. This is mainly due to the fact that the ports are not really in direct competition with one another. Each port was developed and designed around its own trade area so that it could handle it's own important commodities. San Francisco for example handles mainly containerized shipping. Stockton and Sacramento do sometimes handle similar commodities, but the area of origin is different and storage facilities and space are not available at either port to handle the combined quantities of goods economically. The two ports are currently viable with 30-foot channels without economic damage to one another. As discussed in the above comment "a", an analysis was conducted using intermodal transportation to the 35-foot Stockton Port versus the 30-foot Sacramento Channel (1980 Feasibility Report, Appendix 1, pps. D-7 - D-8). The analysis concluded that the costs of $5.00/ton versus benefits of $2.00/ton does not justify the use of the 35-foot Stockton Channel for the shipment of goods originally destined for shipment out of Sacramento's 30-foot channel.

Similar comments were raised by The Resources Agency of California, the City and County of San Francisco, and the Association of Bay Area Government in response to the Draft Feasibility Report (1980). Responses to these comments were published in the 1980 Feasibility Report on pages 62-63 and 68-69.

c. Comment: "Neither the DGDM nor the SEIS considers the hydrologic effects of a submerged sill if further salinity studies indicate that such a structure is needed. The U.S. Fish and Wildlife Service, in cooperation and concurrence with the California Department of Fish and Game, stated in its 1980 report on fish and wildlife resources pursuant to the Fish and Wildlife Coordination Act relative to the Sacramento River Channel that given additional information on the probable effects of a submerged sill on such phenomena as the Delta's nutrient zone and the movements of aquatic organisms, it is conceivable that the disadvantages to fish and wildlife resources assignable to the submerged sill might be judged to outweigh the benefits to be gained by all interests through restoration of salinity levels to the pre-project condition' (page ii). The report recommended that 3 steps be taken by the Corps prior to installing a sill:

a) Funding of a special study by the Fish and Wildlife Service to ascertain the probable impacts of such a structure on fish and wildlife resources;

b) full and equal consideration of the recommendations of the Fish and Wildlife Service, based on the said study, in arriving at a decision concerning the advisability of constructing the submerged sill;

c) preparation of a supplemental Environmental Impact Statement addressing construction of the submerged sill and incorporating the information obtained from said study.

These recommendations were not addressed in the DGDM or in the SEIS; the documents give no indication that such studies will be conducted if a salinity problem arises."

Response: A salinity monitoring program is being established in cooperation with the U.S. Bureau of Reclamation and the California Department of Water Resources to define whether or not there is a salinity impact due to the project. The submerged sill is only one of several alternatives being considered as a possible mitigative technique should an impact be defined. The Corps will study the sill and other possible alternatives during final design and construction of the project. The salinity criteria established by the State Water Resources Control Board in Decision 1485 will not be violated as the CVP/SWP releases will be made (if necessary) to ensure compliance. If an impact is defined the Corps will mitigate utilizing the selected alternative. The selected alternative would only be implemented after approval and certification of all necessary additional design and environmental documentation. The approval process would include public review by all interested parties as with all environmentally significant issues.

f. Comment: "No surveys have been released on the upper portion of the project area for endangered and candidate species even though critical habitats for several such species have been identified on the lower portion of the Sacramento-San Joaquin Channel (SEIS, page 41). In order to preserve a disposal site, an alternative site must be chosen. It would be prudent to identify the habitat of endangered and candidate species and potential alternative disposal sites before the project is authorized for construction."

Response: An Endangered Species Biological Data Report was completed by consultants for the Corps in September, 1985. This report (and addendum) are included with the Final SEIS. Page 7 of the report details the field studies and states "Field surveys of the selected portions of the study area were made on numerous occasions during the months from November 1984 through August 1985. The surveys were conducted as appropriate to the plant or animal species being investigated. The entire study area was generally surveyed by car and on foot in February, 1985 and by boat in June, 1985 to identify potential important habitats, specifically, high quality wetland, riparian, and sand dune habitats. Ground surveys were made to check all of the known species locations and to identify other potentially important areas." In addition, the Corps has prepared a Biological Assement as required by Section 7(c) of the Endangered Species Act (16 USC 1533). The BA used the information compiled in the consultant's Endangered Species Biological Data Report and recent information provided by the U.S. Fish and Wildlife Service Endangered Species Office (ESO), to conclude that "...formal consultation pursuant to Section 7(c) of the Endangered Species Act is not necessary.". This is due to the fact that the ESO provided a Revised List of Endangered and Threatened Species to the Corps on December 20, 1985. The revised list included only the Salt Marsh Harvest Mouse as being potentially effected by the project at Dredged Material Disposal (DMD) Sites S21 and S35. As stated in the BA on page 1 "Project boundaries were realinged for DMD sites 21 and 35 to avoid permanent impacts to existing wetlands, much of, but not all of which contain known and potential salt marsh harvest mouse habitat. These wetlands will not be used for DMD disposal. Contract plans and specifications will require that the wetland on DMD site 21 be entirely avoided." The BA indicates that temporary impacts may occur at site S35 due to discharge and outlet pipes crossing the wetlands, but the impact should be minimal and will be coordinated with the ESO to ensure that only the least environmentally sensitive areas are affected. For further information regarding Endangered Species, refer to the above mentioned reports attached to the Final SEIS.

e. Comment: "Dredged material will be contained by dikes (DGDM, pp.VII-23 through VII-25) to prevent toxic heavy metals from washing into the river. The Corps found, in its Dredged Material Research Program conducted from 1973 to 1978, that spoil disposal on well-drained upland sites can lead to an oxidizing, acidic environment which is conductive to the leaching of contaminents, particularly heavy metals. Samples of materials dredged from the project area show levels of cadmium, chromium, copper, lead and mercury above the 1984 EPA acute criteria (SEIS, page 34). Some investigation into the fate of these metals, should they leach into the groundwater table, should be executed before project authorization."

Response: The DGDM on pages VII-23 through VII-25 does not state that the disposal of dredged material in containment dikes is to "prevent toxic metals from washing into the river." The disposal sites have been designed using acceptable methods as the most economically efficient and environmentally sound method of containment for disposal of dredged material. The pages listed above in the DGDM outline the methodology and references utilized in the design of these dredged material disposal sites.

Since the publication of the DGDM, examination by experts at the Corps Waterways Experiment Station (WES) Dredged Material Research Program of the prior elutriate tests results presented in the Draft GDM indicated that there were some procedural errors in the analysis of the samples. These errors likely led to results indicating concentrations of parameters that were much higher than is actually present in the project area. In light of this, The Corps has designed an extensive elutriate/modified elutriate testing program which will be completed in mid 1986 to retest these and other parameters. See response to comment "d." received from the California Regional Water Quality Control Board Central Valley Region, dated October 21, 1985 for more information on this issue.

14. Comments received from the **San Francisco Bar Pilots**, dated November 21, 1985.

a. Comment: "We urge the bends in the reaches from mile 18.6 to the port be expanded to accepted design specifications consistent with the economies involved."

Response: The bends in the man made portion of the channel (mile 18.6 to the port) will be widened from 200 to 250-feet. This increase in width is consistent with the economic considerations as well as being an acceptable design.

b. Comment: "We appreciate the Port's position with respect to funding and support a two phased construction schedule. For safety we also endorse their consideration of special operating restrictions or measures in the interim period after deepening and prior to widening."

Response: Concur. We will work with the Pilot's Association, the Port of Sacramento, and the Coast Guard to develop any special operating restrictions necessary after deepening, but prior to widening.

DESIGN MEMORANDUM NO. 1
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

COMMENTS OF SACRAMENTO SHIP CHANNEL PILOTS

COMMENTS FROM FEBRUARY 1985 INTERVIEW

The Sacramento Ship Channel Pilots were contacted by telephone on February 2, 1985, through February 28, 1985. The Pilots were informed of the changes to the project since the Feasibility Report was published and asked for their comments. Their opinions are summarized and reported below.

Captain Bob Atthowe was contacted on 2 February 1985 and expressed enthusiasm for the proposed channel widening and deepening. He indicated the proposed project would facilitate the passage of the larger vessels that are now calling at the Port and expressed a concern about two problem areas. First, he indicated that prevailing crosswinds near the Cache Slough Ferry at the entrance to the manmade reach were a problem and vessels had to increase speeds in this vicinity to compensate for the winds. He stated that channel pilots had to move crabwise 2 to 3 degrees off course to compensate for prevailing winds between Rio Vista and Cache Slough. Second, Captain Atthowe indicated that the Rio Vista Bridge crossing and the approaches to it were the most significant navigation problems along the channel. He noted that the channel is only about 25 feet deep at MLLW in the vicinity of Rio Vista and ships can only navigate this area at high tides.

Captain Atthowe suggested that the channel be widened at least 100 feet from the turning basin to two miles downstream. He also recommended "rounding" of curves upstream from Steamboat Slough, at lights 60 (Channel Mile 26) and 70 (Channel Mile 36), and at Channel Mile 42 to facilitate passage of ships longer than 650 feet.

Captain Ken Hulme was contacted by phone on 14 February 1985 and stated that a vessel with a 100-foot beam or less can safely navigate the existing channel. However, he noted that bank suction occurs at Toland's Landing (CM 6.2), and (even at full power) maximum vessel speed heading upstream in the manmade channel is 3.5 knots. The speed restriction is due to the Venturi effect (wave) caused by the restricted channel. These problems could be minimized with the proposed channel improvements.

Captain Hulme recommended that the navigation aids be spaced closely together on the manmade portion of the channel (currently 2 miles apart). He stated that it was difficult to locate the beacons on a rainy night and difficult to know if the vessel deviates from the channel centerline.

Captain Sam Davies (a pilot on the channel since it opened in 1963) was contacted on 28 February 1985 and indicated two major problem areas: the shoaling at Rio Vista and the difficulty in maneuvering through the 20 degree turn in the manmade channel. Captain Davies did not have any recommendations concerning the channel.

Captain Carl Bowler was contacted on 28 February 1985 and expressed his concerns and recommendations in four areas. Captain Bowler stated that the proposed 250-foot width for the deepened channel is adequate, although he would prefer a 300-foot width in the manmade portion of the channel. He

advised that deepening the channel without increasing the width would make the larger vessels more difficult to control. Also, he thought the long turn before entering the turning basin is the most difficult bend for the larger vessels since the bow obscures vision. He recommended initiation of the proposed project and widening the 20 degree bend near Beacons 69 and 70 (CM 35.0). Another area of concern is the reach near the Rio Vista Bridge. Captain Bowler stated that it is difficult navigating in the reach due to the continual shoaling problem (currently 24 feet deep). When navigating downstream, shoaling on the right edge of the channel and adverse currents make it difficult to stay in the center of the channel. For a vessel heading upstream, navigation is even more difficult. This difficulty is due to the turn downstream of the Rio Vista Bridge. The longer ships have not fully straightened their course prior to heading into the bridge. Radical rudder movements must be made due to this shoaling problem. Captain Bowler recommended that the Corps consider widening the channel near the bridge to act as a sediment trap. Visibility is often poor due to fog between Collinsville and Rio Vista; thus, the location with respect to the channel centerline of a moving vessel is hard to determine and maintain. Captain Bowler stated that besides the fog, the fishermen along or in the channel make it difficult to find the beacons on radar. He recommends that more navigational aids be placed along the channel. Captain Bowler stated that cross currents and fog in the reach from Avon to New York Slough complicate navigation, but no major problems exist. He recommends that the guidelines established be used to determine channel width with additional navigational aids placed along the channel with a marked anchorage point near New York Slough.

DESIGN MEMORANDUM NO. 1
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

SACRAMENTO SHIP CHANNEL PILOTS QUESTIONNAIRE
JANUARY 1986 INTERVIEW QUESTIONNAIRE

The Sacramento Ship Channel Pilots were again contacted by telephone on January 8, 1986, through January 13, 1986. The Pilots were informed of the changes to the project since the draft GDM was published and were then asked the following questions. The pilots responses are on the following pages.

1. Do you foresee any problems with the two-phase approach to construction?

2. Are there any specific locations where there may be problems for the larger ships without a wider channel during the time between deepening and widening?

3 a. How common is it for incoming ships to take on salt water as ballast and then discharge this ballast at the Port when the ship is loaded?

b. What measures could be taken to correct this in light of salinity problems at the Port? Example: Recycling with brackish water before traveling up to the Port.

4. Are the navigation aids adequate? If not, are there specific locations where aids need to be placed?

5. Is there a need for any measures/actions to be taken to insure better safety between the deepening and widening phases? Examples: Day-only travel, speed restrictions, restrictions due to weather conditions, etc.

6. What are the trends in ship sizes? Will the delay in widening cause delays in use of newer, larger ships?

7. How long have you been a pilot on the Sacramento Ship Channel?

CAPT BOB ATTHOWE 1/8/86

1. No. The problems will depend on the size of the ships. He feels that the width of the channel will limit the size of the ships anyway.

2. The two upstream curves will still be a problem for longer ships even at the increased width.

3. This practice is very common for the woodchip vessels. When these ships are empty, they are so buoyant that the rudder and propeller are out of the water so they need the ballast to get to the Port. The Port has recently (last 3-5 years) requested ships to discharge the salt water and then take on brackish water in the Pittsburg area before heading upstream to the Port. The number of woodchip vessels has decreased significantly in the last few years, so it is hard to determine how well this practice has worked.

4. The Coast Guard took out 28 aids-to-navigation downstream of the manmade channel 4 years ago. He feels that the light 1 to 1-1/2 miles downstream of the Rio Vista Bridge should be replaced and also one in Cache Slough.

5. They are currently trying to get the Port to limit ships above a certain size to daytime travel.

6. Ship size is getting larger.

CAPT SAM DAVIES 1/9/86

1. No safety problems but the sides of the channel may slough in before widening does occur.

2. Hard to say. It depends on the size of the ships using the channel.

3. A common practice with wood chip vessels since they started coming to Sacramento in 1968. If the ships did not have some sort of ballast, they would be hard to control and keep in the channel. It would take at least 8 hours to pump the ballast out and another 8 hours to pump freshwater back on. The newer ships can pump off and pump on without anchoring but not many of these call at the Port. They discharge about 20,000 tons of salt water at the Port.

4. Feels aids-to-navigation are adequate.

5. No.

6. Ships are still getting larger toward Panama size. Staged approach will not delay use of newer, larger vessels. The larger vessels will not come to Sacramento until the downstream channels are deepened.

7. Capt. Davies has been a pilot for 26 years and on the Sacramento Ship Channel since it opened in 1963.

CAPT GEORGE JAHN 1/9/86

1. He is concerned that shoaling areas will fill in between the time that deepening is completed and the time that widening is completed. He also stated the side cuts on the manmade channel tend to slip into the channel, creating a "bathtub" effect. The width of the channel, therefore, is reduced from 200 to 150 feet.

2. No specific problems.

3. A common practice to use salt water as ballast. The pilots make sure ballast is dumped in the San Francisco Bay. If the ships still need ballast to be able to fit under power lines, bridges, etc., they fill with brackish water. Another solution might be to have the ships pump salt water into a holding tank at the Port.

4. Need more aids on the long curve just before the Port. The long curves are harder to maneuver than shorter, sharper curves.

5. The larger ships should always be limited to daylight travel, not just during the improvement project.

6. Ship sizes are getting larger but they cannot get much larger than the largest used today due to the limitations of the world's ports.

7. Has piloted on the Sacramento Ship Channel since it opened in 1963.

CAPT CARTER 1/9/86

1. Does not anticipate any problems.

2. None.

3. Was more prevalent in the past with wood chip ships. The pilots are instructed to dump salt water in the San Francisco Bay before heading upstream. If they need ballast to get upstream, they pick up brackish water along the way if conditions are favorable (no wind, weak currents, etc.). If unfavorable conditions, they must anchor to pump water on board.

4. Need more lights between Tolen's Landing and light 18-19, since existing lights are far apart.

5. Day-only travel should be instituted for the larger ships anyway, not just for the project.

6. The ship sizes are getting larger, over 600 feet long. Maximum size is 750 feet long. Ship size will be limited by channel size and the overhead clearances.

7. Has been a pilot on the Sacramento Ship Channel since 1979.

CAPT SPRY 1/10/86

1. No. Does not see any problems with the staged construction approach.

2. No.

3. It was a common practice particularly with the wood chip ships. They will not be able to do this anymore. The Coast Guard had a meeting with the pilots and port representatives on 18 December 1985 where they stated that no ballast water will be dumped at the ports unless the ports provide holding tanks.

4. Aids are adequate.

5. No.

6. Ships getting bigger. The maximum size to get to Sacramento is 750 feet. Currently, average size is around 620 to 660 feet.

7. Has been a barge pilot for 20 years and certified ship pilot for 18 months.

CAPT CARL BOWLER 1/13/86

1. No. Supports this approach since it will help out the Port financially.

2. No problems that can be foreseen since the two curves will be Widened in the first reach during the deepening phase.

3. Yes. Ballast is taken enroute to San Francisco. Sometimes discharge this ballast in the S.F. Bay before going upstream. The larger the ship, the higher the ship. Not only do they need the ballast for better control of the ship but also to get it under bridges, etc. Time to take ballast on and off would make it uneconomical for ships to go to Sacramento.

4. Positions and numbers need to be reviewed and revised. Pilots and Coast Guard had meeting the week of 5 January to discuss. They will be taking care of this themselves.

5. This is something that should be considered but is hard to determine right now. Many factors are involved, and this issue should be looked at after the channel is deepened and the pilots have had some experience on the new channel.

6. Trends in ships are getting bigger. Delay in widening will limit the larger ships. Depth and width control size of ships coming to Sacramento.

7. A pilot on the Sacramento Ship Channel for 7 years and a Bay pilot for 10 years.

GENERAL DESIGN MEMORANDUM
SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

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UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION
BOX 36098 • 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102
(415) 556-8200

OCT 25 1985

ER 85/1378

Colonel Wayne J. Scholl
District Engineer, Sacramento District
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Dear Colonel Scholl:

The Department of the Interior has reviewed the Draft Supplement to the Final Environmental Impact Statement (DSEIS), Sacramento River Deep Water Ship Channel, Sacramento County, California. The following comments are provided for your use and consideration when preparing the final document.

General Comments

The DSEIS addresses the opportunity to enhance wetland habitat on Sherman Island. We recommend that this mitigative measure be included as part of the project plan. Since there is a Federal cost limit of $400,000, the plans determining the amount of habitat that may be improved should be closely coordinated with the U.S. Fish and Wildlife Service (Service) and the California Department of Fish and Game. The Service has previously provided their recommendations to you in the form of a Draft Supplemental Fish and Wildlife Coordination Act Report (Page A-20, Draft General Design Memorandum Appendices to DSEIS). We believe that the detailed plans for this enhancement feature could be developed during advanced engineering and design studies.

Summary Comments

We believe that the DSEIS adequately discusses fish and wildlife resources of the project area, impacts of the project on these resources, and mitigative measures to compensate unavoidable impacts.

We appreciate this opportunity to provide review comments on this DSEIS.

Sincerely,

Patricia S. Port

Patricia Sanderson Port
Regional Environmental Officer

cc: Director, (w/original incoming)
OEPR
Reg. Dir., FWS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
215 Fremont Street
San Francisco, Ca. 94105

OCT 2 8 1985

Colonel Wayne J. Scholl
District Engineer
U.S. Army Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento, CA 95814-4794

Dear Colonel Scholl:

The Environmental Protection Agency (EPA) has reviewed the Draft Supplemental Environmental Impact Statement (DSEIS) titled SACRAMENTO RIVER DEEP WATER SHIP CHANNEL. We have the enclosed comments regarding this DSEIS.

We have classified this DSEIS as Category EC-2, Environmental Concerns - Insufficient Information (see attached "Summary of Rating Definitions and Follow-Up Action"). This DSEIS is rated EC-2 because of water quality concerns. The classification and date of EPA's comments will be published in the Federal Register in accordance with our public disclosure responsibilities under Section 309 of the Clean Air Act.

We appreciate the opportunity to review this DSEIS. Please send three copies of the Final Supplemental Environmental Impact Statement (FSEIS) to this office at the same time it is officially filed with our Washington, D.C. office. If you have any questions, please contact Roberta Blank, Federal Activities Branch, at (415) 974-8187 or FTS 454-8187.

Sincerely yours,

Charles W. Murray, Jr.
Assistant Regional Administrator
for Policy and Management

Enclosure (1 page)

SUMMARY OF RATING DEFINITIONS AND FOLLOW-UP ACTION*

Environmental Impact of the Action

LO—Lack of Objections
The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC—Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO—Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU—Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

Adequacy of the Impact Statement

Category 1—Adequate
EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2—Insufficient Information
The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3—Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From: EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment

Water Quality Comments

Additional commitments for mitigation to protect water quality should be provided in the FSEIS, as follows:

1. It is unclear in the DSEIS discussion of increased flows and the firm yield whether or not increased flows would be used to meet the salinity standard. The FSEIS should include a definite commitment to meet the salinity standard and describe the mitigation methods that will be used.

2. The leachate from the dredge spoils should be further addressed in the FSEIS. The DSEIS assumes that zinc will be the only probable cause for water quality degradation. Constituents other than heavy metals should also be considered (i.e, pesticides). Plans for monitoring of leachate and a mitigation commitment should be included in the FSEIS.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

OFFICE OF THE ADMINISTRATOR

October 28, 1985

Wayne J. Scholl
Colonel, Corps of Engineers
Department of the Army
Sacramento District
650 Capitol Mall
Sacramento, California 95814

Dear Mr.Scholl:

This is in reference to your draft environmental impact statement for Sacramento River Deep Water Ship Channel Project. Enclosed are comments from the National Oceanic and Atmospheric Administration.

We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

David Cottingham

David Cottingham
Ecology and Conservation Division

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Washington, D.C. 20230

N/MB2:CMS

October 25, 1985

TO: PP2 - David Cottingham

FROM: N - Paul M. Wolff

SUBJECT: DEIS 8509.03 - Sacramento River Deep Water Ship Channel Project

The subject DEIS has been reviewed within the areas of the National Ocean Service's (NOS) responsibility and expertise, and in terms of the impact of the proposed action on NOS activities and projects.

Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days notification in advance of such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments. For further information about these monuments, please contact Mr. John Spencer, Chief, National Geodetic Information Branch (N/CG17), or Mr. Charles Novak, Chief, Network Maintenance Section (N/CG162), at 6001 Executive Boulevard, Rockville, Maryland 20852.

United States Department of the Interior
BUREAU OF RECLAMATION
MID-PACIFIC REGIONAL OFFICE
2800 COTTAGE WAY
SACRAMENTO, CALIFORNIA 95825

IN REPLY REFER TO: MP-780

NOV 5 1985

Colonel Wayne J. Scholl
District Engineer
Sacramento District Corps of Engineers
Attn: Civil Design Section D
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Scholl:

This letter is to transmit to you our comments on the "Draft General Design Memorandum and Supplemental Environmental Impact Statement for the Sacramento Deep Water Ship Channel." If you have any questions, feel free to contact Mr. Robert Schroeder of my staff at (916) 978-4923.

Sincerely,

F. Phillip Sharpe

F. PHILLIP SHARPE, CHIEF
DIVISION OF PLANNING & TECHNICAL SERVICES

Attachment

Comments on "Draft General Design Memorandum
and Supplemental Environmental Impact Statement
for the Sacramento Deep Water Ship Channel"

Page V-7, next to last paragraph - The statement that "the impact was considered not negligible" is a subjective opinion and should not be stated here. Later studies show that this is not true.

Page V-7, last statement - It was not shown anywhere in the document that the total salinity in the Delta remained constant. This is not a logical conclusion from the data presented here.

Page V-10, last paragraph - Salinity increases resulting from deepening the ship channel are downplayed before the studies on the impacts are presented.

Page V-11, second paragraph - How do you justify that "the physical model tests are the most reliable indicator of project deepening impacts?"

Page V-13, last paragraph - The statement "the measured impact of 16% at 4480 cfs exaggerates the project impacts" is unsubstantiated and undocumented.

Page V-13, last paragraph - Decreases in salinities at some stations do not offset violations of salinity standards at others for the CVP and SWP.

Page V-15, second to last paragraph - The statement that the Corps' physical model is the best tool for analysis of potential impacts is extremely subjective, undocumented, and should be eliminated.

Page V-15, last paragraph - First three lines are incorrect. Impacts were clearly delineated and defined in DWR studies.

Page V-16, paragraph 2 - Has the proposed sill been documented to be environmentally sound?

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
3150 Paradise Drive
Tiburon, CA 94920

December 4, 1985 F/SWR33:JRB

Colonel Arthur E. Williams
District Engineer
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Williams:

The National Marine Fisheries Service reviewed the Draft General Design Memorandum and Supplemental Environmental Impact Statement for the Sacramento River Deep Water Ship Channel project (August 1985).- Although the comments herein are well after the response deadline of October 28, your staff requested late comments for their consideration. Thank you for the opportunity to participate in this planning process.

Sincerely yours,

James R. Bybee
Environmental Coordinator
Northern Area Office

Enclosure: (1)

cc: SPD, Gen. Palladino

ATTACHMENT

Re: Draft General Design Memorandum and Supplemental Environmental Impact Statement for the Sacramento River Deep Water Ship Channel (August 1985)

The effects of disposing dredged material on wetland habitats appears to be described well. Considerable discussion relates to the effects of the wetland losses and the mitigation proposed to compensate for those losses. However, if it is determined subsequently that the mitigation still is inadequate, we would discourage the loss of aquatic areas important to fish resources if mitigation requires filling these areas to create wetlands. Further examination of potential sites would be needed to address this concern. We encourage the creation of new wetlands, but prefer that these habitats be created by altering the elevation of existing upland areas.

We note with concern that the impact of new dredging on benthic habitats is not addressed. By this we mean the bottom substrates on each side of the existing ship channel that have never been dredged. A rough estimate (based on a five-foot cut and a side slope of 4 horizontal to 1 vertical) indicates that about 150 acres of soft mud and sand substrate would be altered by dredging and subsequently maintained by further dredging. The EIS should discuss the areal extent of the impact, the in-faunal organisms that are expected to occur in these substrates, and the effect of permanently modifying these habitats. Past studies indicate that bottom-associated organisms such as amphipods (Corophium sp.) and midge larvae are consumed by young striped bass. 1/ We suspect the same to be true for young salmon migrating and feeding in these areas.

A clear description of the water depths to be increased is lacking. For instance, it would be helpful to know the areal extent of habitat at 0-5, 5-10, 10-15, 15-20, 20-25, and 25-30 feet (MLLW data) that would be modified. Although these depth ranges are subjective, they could help assess the potential impact of altering these strata on Corophium populations in the project area.

The schedule of in-water work may be included in the EIS, but it was not apparent in our cursory review. Intensive studies have occurred in the Pacific Northwest of effects of entraining small salmon in hydraulic dredge suction/cutter heads. It is known that there is some entrainment. This impact or measures to minimize the impact is not discussed.

Our final comment relates to the potential intrusion of higher salinity water into the delta reaches. Although the topic is discussed extensively, proposed remedial action (should intrusion indeed be an impact requiring mitigation) is vague. An underwater sill is suggested, but its location, elevation, and construction are not discussed. In fact, the EIS leaves the issue open to subsequent interpretation that increased salinity in the delta could be that of increased ballast discharges from ships and, perhaps, not intrusion; therefore remedial action would not appropriate. Perhaps this reasoning appears somewhat skeptical but it illustrates the need for a more thorough plan to acknowledge and correct saltwater intrusion impacts.

1/ Skinner, John E. 1872. Ecological Studies of the Sacramento-San Joaquin Estuary. Calif. Dept. of Fish and Game, Decennial Report No. 8.

STATE OF CALIFORNIA GEORGE DEUKMEJIAN, *Governor*

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
CENTRAL VALLEY REGION
3201 S STREET
SACRAMENTO, CALIFORNIA 95816-7090
PHONE: (916) 445-0270

21 October 1985

Colonel Wayne J. Scholl
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

SACRAMENTO DEEP WATER SHIP CHANNEL - DRAFT GENERAL DESIGN MEMORANDUM AND EIS, YOLO COUNTY

We have reviewed the subject documents and have the following comments. The EIS needs to be improved before it is acceptable.

1. The Corps acknowledges that there are elevated salinity concentrations in the Port and the Deep Water Channel from discharges of saline ship ballast, but believes that correction of this problem is not a concern of this project since expansion of the Channel is not supposed to increase the use of the Channel. We disagree. The saline brine discharges in the Deep Water Channel are solely the result of the presence of the Channel. Therefore modifications to the Channel should work towards mitigation of the problem. The Port's policy of having ships recirculate their ballast water in the lower Delta is not enforced by the Port, so is not effective. An evaluation of alternatives for control or mitigation of ballast discharges should be performed.

2. The Corps has proposed to monitor Delta salinity concentrations and mitigate any increases. Of the mitigation alternatives discussed, only the release of Central Valley Project (CVP) water could be implemented quickly to counteract salinity increases. The Corps or the Bureau of Reclamation should determine whether an extra 40,000 AF of CVP water will be available for release during dry years.

3. The digital model was unable to quantify dry year salinity increases caused by this project. Without this predictive capability, how will the necessary CVP water releases be calculated if Delta salinity standards are exceeded? (We presume that the Corps will not take responsibility for any and all violations of the salinity standard.)

4. The heavy metals tests, particularly the elutriate tests, indicate a serious potential for exceeding water quality criteria. Elutriated copper is 39 times the EPA acute water quality criteria. No data is presented to support the Corp's conclusion that sedimentation basins and dilution in the receiving water will prevent metal concentrations from exceeding water quality standards. Elutriate tests should be performed on agitated then settled sediment samples to better simulate settling basin effluent. If elutriate samples are still above receiving water limitations, bioassays should be conducted on the return water and the zones of dilution should be calculated. We are particularly concerned with the limited mixing which will occur in the constructed portions of the Deep Water Channel.

5. Appropriate agencies, including this office, will need to review the proposed salinity monitoring program.

If you have any questions, please contact Karen O'Haire at (916) 323-7459 or Kenneth Landau at (916) 322-1587.

WILLIAM H. CROOKS
Executive Officer

cc: Department of Fish & Game, Region II, Rancho Cordova
Department of Water Resources, Central District, Sacramento
State Water Resources Control Board, Sacramento
Water Quality Control Board, Region 2, Oakland
Mr. Melvin Shore, Yolo Port District, West Sacramento

Memorandum

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD • CENTRAL VALLEY REGION
3201 S Street Sacramento, California 95816 Phone: 445-0270

TO: Karen A. O'Haire
Chief, North Valley Regulatory

FROM: Kenneth D. Landau
Area Engineer

DATE: 21 October 1985

SIGNATURE: Kenneth D. Landau

SUBJECT: SACRAMENTO RIVER DEEP WATER SHIP CHANNEL

The following is a summary and comments on the water quality aspects of the "Draft General Design Memorandum and Supplemental Environmental Impact Statement (August 1985)" and "Draft General Design Memorandum Appendices (August 1985)" prepared by the U.S. Army Corps of Engineers (COE) for expansion of the Sacramento River Deep Water Ship Channel. These documents include updated Delta model studies and sediment sampling.

PROJECT DESCRIPTION

The project consists of widening and deepening the Ship Channel from Pittsburg to the Port of Sacramento. Two major revisions to the project have occurred: the submerged sill in the Carquinez Straits has been eliminated unless later found necessary for salinity control, and the design width of some portions of the channel has been reduced.

SALINITY STUDIES

Additional salinity impact studies have been conducted using COE's Bay-Delta hydraulic model and computer models, concluding that there will be no overall salinity impact from the project. Model resolution was generally 10 mg/l to 30 mg/l TDS, with the greater accuracies in the upper Delta and Sacramento River. The model was run under average and critically dry hydrologic conditions, with several different water export scenerios. Deepening of both the Sacramento and Stockton Channels was included in the model. The models showed a 20 mg/l TDS increase at Rio Vista and decreases in TDS of similar magnitude in the general vicinity. These changes were not considered statistically significant. COE concluded that there might be some slight shifting in salinity distribution in the Delta, but no overall change in Delta salinity.

Because of these conclusions, COE has dropped the construction of the submerged sill for Delta salinity control, proposing instead to monitor Delta salinities to verify that no adverse changes occur. The Corps proposes to construct the sill or take other action if needed, but funding is no longer included in the project. There are no details of the proposed salinity monitoring program or the criteria for determining that mitigating action should be taken.

Computer modeling indicates that during critically dry years additional fresh water may have to be released through the Delta to maintain minimum salinity levels. Several computer runs were performed with various "worst case" assumptions, resulting in additional releases from zero to 40,000 acre-feet/year. COE proposes to use Central Valley Project water for this purpose, although correspondence between COE and the Bureau of Reclamation does not demonstrate a committment by the USBR for the releases. COE is proposing to not study this matter any more since the Corps believes it unlikely that the results will be definitive. (Comment: If COE and USBR cannot figure out the salinity increases due to the Ship Channel deepening, it seems unlikely that they will be able to determine whether CVP or SWP water should be released to maintain standards during critically dry years.)

SHIP BALLAST

The report acknowledges that salinity levels are elevated near the Port of Sacramento due to ship ballast discharges, but proposes no controls for current or projected discharges. There are currently 100 to 150 ships/year using the Port of Sacramento, increasing to 450 to 475 ships/year in 2037. COE believes that this increase in shipping will occur whether or not the project is done, so they feel consideration of ship ballast discharges is not pertinent to this project. The only control on these discharges is a Port of Sacramento recommendation that ships recirculate ballast water in the lower Delta to minimize saline discharges in Sacramento. The Port authorities do not, however, police ballast discharges.

SEEPAGE

Analyses indicate that seepage would increase in the most unfavorable areas by no more than ten percent due to deepening of the Channel. COE concluded that increased seepage will be undetectable in most locations.

HEAVY METALS

Six six-foot deep bottom cores were collected in 1975 along the ship channel. Four bottom cores were collected in 1983 for elutriate analyses. No elutriate tests were performed on samples from the man-made portions of the ship channel as there were no apparent sources of contamination and there was little time for accumulation. According to COE the elutriate test was designed for open water disposal and does not allow for settling of particular matter as is proposed. COE says that a "high percentage" of heavy metals are bound to sediments and are removed by settling, particularly copper, lead and cadmium.

For total metals in the sediments, only mercury exceeded either the STLC or EPA criteria. For total mercury, all 22 samples exceeded the EPA chronic concentrations, and eight of the 22 samples exceeded the EPA acute concentration. For the elutriate tests, one or more of the samples exceeded EPA criteria for Cadmium, Chromium, Copper, Lead, Mercury and Zinc. The maximum copper concentration was 39 times the EPA acute water quality criteria. The other metals were only twice the acute criteria. COE believes there will be no problem given the "significant" reduction of metals in the settling basins and an unspecified allowance for a mixing zone in the receiving waters.

KDL:lj1

STATE OF CALIFORNIA—THE RESOURCES AGENCY GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814
(916) 445-3531

October 21, 1985

Colonel Wayne J. Scholl
District Engineer
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Scholl:

The Department of Fish and Game has reviewed the August 1985 Draft Supplement to the Final Environmental Impact Statement for the Sacramento River Deep Water Ship Channel (DWSC) Project. The Department concurs with and supports the fish and wildlife mitigation plan developed using the Habitat Evaluation Procedures Methodology.

The Department recommends Lower Sherman Island be pursued further as a potenital enhancement site for the DWSC Project. We would be pleased to meet with your staff to discuss and develop site specific disposal plans for the open water portion of the island.

If the Department can be of further assistance, please contact Paul T. Jensen, Regional Manager, Region 2, 1701 Nimbus Road, Rancho Cordova, CA 95670, telephone (916) 355-0922.

Sincerely,

Pete Bontadelli
for Jack C. Parnell
Director

Resources Building
1416 Ninth Street
95814

(916) 445-5656

Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Boating and Waterways
Department of Parks and Recreation
Department of Water Resources
California Conservation Corps

GEORGE DEUKMEJIAN
GOVERNOR OF
CALIFORNIA

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

Air Resources Board
California Coastal Commission
California Waste Management Board
Colorado River Board
Energy Resources Conservation and Development Commission
San Francisco Bay Conservation and Development Commission
State Coastal Conservancy
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards

Colonel Wayne Scholl
Army Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

October 28, 1985

Dear Colonel Scholl:

The State has reviewed the draft general design memorandum and supplemental EIS, Sacramento River Deep Water Ship Channel, Sacramento/Yolo/Solano Counties, submitted through the Office of Planning and Research. Review was coordinated with the State Lands Commission, Water Resources Control Board, and Departments of Boating and Waterways, Fish and Game, Parks and Recreation, Water Resources, Health Services, and Transportation.

The Department of Fish and Game concurs in the fish and wildlife mitigation plan developed using the Habitat Evaluation Procedures Methodology. The Department also recommends pursuing Lower Sherman Island further as a potential enhancement site. Department staff would be pleased to meet with Corps personnel to discuss and develop site-specific disposal plans for the open water portion of the island. Contact person is Paul Jensen, Regional Manager, 1701 Nimbus Road, Rancho Cordova 95670 or (916) 355-0922.

The State Lands Commission and Regional Water Board have already responded directly to you on this matter by letters of October 21, 1985.

Attached are comments received from the Department of Water Resources.

Sincerely,

Gordon F. Snow

Gordon F. Snow, Ph.D
Assistant Secretary for Resources

Attachment

cc: Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814

(SCH 85091719)

C—091037

C-091037

State of California

The Resources Agency

Memorandum

To : Gordon F. Snow, Ph.D.
Assistant Secretary for Resources
The Resources Agency
1416 Ninth Street, Room 1311
Sacramento, CA 95814

Date : OCT 24 1985

File No.:

Subject: SCH 85091719 - Draft General Design Memorandum and Supplemental Environmental Impact Statement, Sacramento River Deep Water Ship Channel

From : Department of Water Resources

We have reviewed the subject Draft General Design Memorandum and Supplemental Environmental Impact Statement which was transmitted by the State Clearinghouse Notice dated September 20, 1985, and have the following comments and recommendations.

We are concerned with the discussion of impacts on State Water Project (SWP) and Central Valley Project (CVP) yield due to deepening the channel.

This discussion does not reflect the latest analysis we completed and submitted to the Corps of Engineers staff prior to publication of its report. The curves illustrated in Figure V-2 of the report and described on page V-12 were considered inappropriate since they show high salinity increases at Emmaton during very low Delta outflows. In reality, the impact on salinity due to the deepening should be zero at zero Delta outflow, then increase to a point at low Delta outflow, then decrease again to zero at high Delta outflow.

Our new approach was developed and incorporated into the Department's Statewide Operation Study Model to determine the salinity impact at Emmaton. This method utilizes an empirical salinity-flow relationship at Collinsville developed by the Department and a salinity gradient relationship between Collinsville and Emmaton as derived using the Corps' physical model results for the base and channel deepening cases.

The Department feels that the latest approach is a more realistic way of determining the impact than the methods previously used and presented in the report. This approach showed an average impact to the CVP and SWP of approximately 35 TAF per year during critical periods. This impact could be as high as 55 TAF per year but no lower than 15 TAF per year. Although it is true that this impact is a small percentage of total CVP and SWP yield, we feel that it is a definable impact. Therefore, we disagree with the statement in the last paragraph on page V-15, third paragraph:

> "Discussions with DWR and USBR personnel indicate the impact is not clearly definable at this time."

and the statement on the same page, second paragraph:

> "Based upon reasonable estimates to date, the impact to the firm yield of the SWP and CVP could vary from zero to as much as 40,000 acre-feet."

OCT 24 1985

Regarding the monitoring program that will be established to better define salinity impacts of the deepening project, the Department would like this program to be started as soon as possible. This would allow a sufficient period of historic record before the project is started. This monitoring program could be set up to supplement the monitoring network that is in place by the on-going Interagency Ecological Study Program. The Department will work with the Corps to implement the monitoring program.

In addition, paragraph 23 addresses seepage from the channel and indicates that the effect of the deepening will be negligible and probably undifferentiable from other influences on local ground water conditions. The Design Memorandum indicates sandy formations of unknown continuity at moderate depths below the channel. Ground water conditions in the east Yolo County area are variable and generally not well understood. Depending on the local natural or man-caused ground water gradient, the channel deepening may have an effect on the ground water quality and ground water levels in wells of the area.

Thank you for the opportunity to review and comment.

David N. Kennedy
Director
ATSS 485-6582

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THE PLANNING AND CONSERVATION LEAGUE

909 12TH ST., SUITE 203 • SACRAMENTO, CA 95814 • (916) 444-8726

September 4, 1985

Colonel Wayne Scholl
Army Corps of Engineers

Dear Colonel Scholl:

Thank you for sending us the Draft Supplement to the Final EIS for the Sacramento River Deep Water Ship Channel. In this letter we will limit our comments to the question of salinity intrusion caused by the project.

We believe that the conclusions and recommendations on the subject of salinity intrusion are inadequate and misleading. Based on the information in the Supplement, we would have to oppose project construction until adequate mitigation for the inevitable salinity intrusion is proposed. Despite a variety of attempts to downplay the problem, the report concludes that the project would cause a loss of CVP/SWP yield of from 30 to 153,000 acre feet per year. Since the report does not indicate which hydrology the Department of Water Resources used to draw these conclusions, it is possible that actual yield loss could be much higher. This is because year 2020 hydrology is much more sensitive to salinity intrusion than 1980 hydrology (due to reduced Delta inflow caused by upstream depletions). It is also likely that the DWR methodology assumed Auburn Dam in place, an assumption which now appears unlikely.

Even assuming the hydrology methodology was conservative, the loss of 30,000 to 153,000 acre feet of yield is of tremendous consequence. The cost of constructing facilities to replace this yield would be between $200,000,000 and $1,000,000,000 given the cost of new multipurpose water projects. The statement on page V-15 that spending from a half million to several million dollars to further study this problem is ridiculous, given the potential costs of making a mistake.

The mitigation proposed is what we have learned to expect from the Corps: nothing. No mitigation at all is proposed despite the studies which show a definitive loss of yield. Monitoring will at best lead to disputes about responsibility, which the Corps will win because there is no mitigation agreement or requirement.

We believe that further study of this problem is mandatory, and that mitigation in advance of construction is required. Loss of yield for the CVP and SWP is of critical concern, not only to the Contractors, but to those who believe that the projects must protect the Bay and Delta with project yield.

Thank you for considering our comments.

sincerely,

Gerald H Meral

Gerald H. Meral
Executive Director

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THE PLANNING AND CONSERVATION LEAGUE

909 12TH ST., SUITE 203 • SACRAMENTO, CA 95814 • (916) 444-8726

September 4, 1985

Congressman George Miller

Dear George:

Enclosed is a letter we have sent to the Corps of Engineers regarding the deepening of the Sacramento Deepwater Ship Channel. It is obvious from the report that the project could have a significant impact of the SWP/CVP yield, or on Delta water quality. We urge you to review the report, especially pages V 1-16, and to oppose any project authorization or construction until the question of mitigating this damage to the Delta is settled. It is obvious that the Corps currently intends to provide no mitigation at all, and simply place a greater burden on the SWP and CVP.

This project is politically popular in the Sacramento area, but that is no reason to inflict considerable damage on the Bay-Delta ecosystem, or to use up very expensive and valuable yield from the CVP and SWP.

best regards,

Jerry

Gerald H. Meral
Executive Director

cc; Tom Graff
David Kennedy
David Houston
Congressman Vic Fazio
Congressman Bob Matsui
Colonel Wayne Scholl
Alvin Greenberg

PORT OF SACRAMENTO

California's Capital Port

SACRAMENTO-YOLO PORT DISTRICT WORLD TRADE CENTER WEST SACRAMENTO, CALIFORNIA 95691 TWX 910-367-3581 TEL (916) 371-8000

October 24, 1985

File No. 5030

Colonel Wayne Scholl
District Engineer
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Scholl:

Attn: SPK-ED-D

Following are comments on the Draft General Design Memorandum for the Sacramento River Deep Water Ship Channel:

1. Page I-3. Fourth paragraph. The mitigation acreages of 45 and 156 acres listed are out of date.

2. Page IV-6. paragraph 16.b. Acreages listed for fish and wildlife facilities are inconsistent with latest information available to us.

3. Page X-1. Paragraph 47. Benefit-cost ratio listed is incorrect.

See appendices: Draft Supplemental Fish and Wildlife Coordination Report:

1. Page 4. Par.2. The references to Wetlands at Lake Washington are inappropriate in this context. These areas are being treated separate from this project.

2. Page 6. Par.1. Where is justification for requiring mitigation for loss of upland habitat? Which law?

3. Page A1-8. no. 4. This statement not necessarily a true assumption.

4. Page A1-10. no. 8. Second sentence. We do not agree with this statement.

PORT OF SACRAMENTO

5. Page A1-11. First paragraph. Repeat our comments on page 6, paragraph 1. See no. 2 above.

6. Pages 9 and 10 of McKevitt letter:

References to cost of $1,000,000 to provide mitigation site should be qualified as a preliminary estimate.

We want to address an alternate site for consideration as mitigation. The Port ownes about 150 acres on Prospect Island, west of the ship channel. We have chosen to allow most of this property to revert to wetlands by the means of not repairing a levee. It is possible the Port would consider dedicating this land in fee for a wildlife refuge in place of the 63 acres suggested by USF & WS.

Sincerely,

John T. Christian
Chief Engineer

JTC/ns

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Colonel Wayne Scholl
Department of Army
Corps of Engineers
Sacramento District
650 Capitol Mall
Sacramento CA 95814

October 24, 1985

re: Sacramento River Deep Water
Ship Channel-- Supplemental EIS

Dear Colonel Scholl:

This letter responds to the request for comments on the above cited document.

Comparing the findings and recommendations of this report, and the Draft General Design Memorandum Appendices, to the original (1980) reports on this project reveals that the effect of the channel deepening on salinity intrusion is no longer considered to be an important issue.

The downplaying of this factor is noted in the section (p. IV-3) of the EIS describing salinity mitigation plans, which states only:

> " - A monitoring program is being established to define salinity impacts of the deepening project, <u>if any</u>. If an impact is defined, a mitigation plan will be developed." (emphasis supplied)

Similarly, the General Design Memorandum section (p. E-16 ff) on test results for salinity changes relies upon conclusions from Bay Model testing to go so far as to state that the deepening project could <u>decrease</u> salinity. Given the Bay Model's known limits for chemical and biological testing, this could be an egregious error.

Increasing salinity of the Bay-Delta aquatic system must be regarded more seriously in terms of effects on human health, through domestic water supply intakes located in the Delta, and in terms of effects on fish and wildlife. The reference to water quality in the EIS (p. II-4) states that total dissolved solids "generally exceed the 500 parts per million (ppm) objective between Mile 35 and the Port of Sacramento." Linking this increase "primarily to salt water ballast discharges from the ships at the port" implies that this is an easily controllable source, but practice does not ever meet expectations in such matters. At any rate, any improvement in enforcement on this source will probably be wiped out by increased use of the port due to the deepening project.

Please understand that the Bay Institute is not criticising the GDM or the EIS failures to regard the salinity intrusion subject

William T. Davoren,
Executive Director
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94920

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adequately as support for the objections of the Bureau of Reclamation or the Department of Water Resources to the deepening project.

Indeed, the water diversion actions of the past 50 years by these two agencies, and the drainage water problems resulting from the activities of the Bureau of Reclamation for the past 30 years, are the factors which make any additional salinification of the Sacramento-San Joaquin Bay-Delta system a critical matter. The ocean is marching to Sacramento.

The Sacramento River Deep Water Ship Channel's effect on salinity intrusion must be considered in the context of the following major problems of this river-bay system which have become documented only since 1980 when the earlier project report was published:

1. Salinity and tds have been documented as major deterrents to successful striped bass, and probably salmon, spawning in the lower San Joaquin River.

2. The San Joaquin River has become an agricultural waste drain for many months of the year, with heavy metals as well as herbicide and pesticide residues, and increasing tds.

3. Populations of striped bass, salmon, steelhead, and Dungeness crab now stand at approximately 15 percent of 1960s populations, and increasing salinity, toxins and heavy metals must be considered major contributing factors.

4. The interim standards of the State-Federal water quality control plan (Delta Plan -- the Water Quality Control Plan for the Sacramento-San Joaquin Delta and Suisun Marsh, SWRCB 1978) designed to protect fisheries have failed every year since 1978 to attain the promised Striped Bass Index of 79.

5. There is not yet in place any effective legal control to place a cap on the amounts of Sacramento River water which may be diverted or exported from the system by the federal Central Valley Project and the State Water Project, a condition which promises to exacerbate the deepening channel's impact on salinity intrusion in the years ahead. Note exhibit attached.

6. Similarly there is not any quantum amount of river flow set aside for yet undefined needs of San Francisco Bay, for economic as well as environmental purposes.

7. The long established, and respected, Striped Bass Index this year has dipped to its lowest point in history, 6.3. I am attaching an explanation of this factor, along with a chart adapted from the Department of Fish and Game data, so that the seriousness of this event will be recognized by you and your staff. The end of natural reproduction of the striped bass in the Bay-Delta system is apparently at hand.

8. The latest "drain" on the freshwater flows of the Sacramento River comes in the form of the heralded Cooperative Operating Agreement between the Bureau of Reclamation and the Department of Water Resources. This agreement removes, in almost every year, another 800,000 acre feet of Sacramento River flows for export to the San Joaquin Valley or the Southland.

Due to all of the above, Colonel Scholl, it is vital that the problem of salinity intrusion be treated more adequately in the subject report and the EIS. However, I do not want to encourage you in the belief that effects of the project on salinity intrusion can be mitigated successfully -- or should be mitigated. The no-project alternative is advisable at this time.

The collapse of the Bay-Delta system, biologically, is the direct result of unilateral projects by many federal, several state and a host of local and private developments already in place. Many more projects are proposed, to continue the century old trend of total exploitation of the freshwater resources of the Sacramento River.

Although the Bay Institute places primary blame for the degradation of the Bay-Delta system on water diversion and export projects, with the added insult of toxic drainwaters discovered to be emanating from irrigation of the western San Joaquin Valley for 30 years, it is unfortunately true that we have reached the point where no additional projects should be approved until the deleterious effects of past projects have been recognized and corrected.

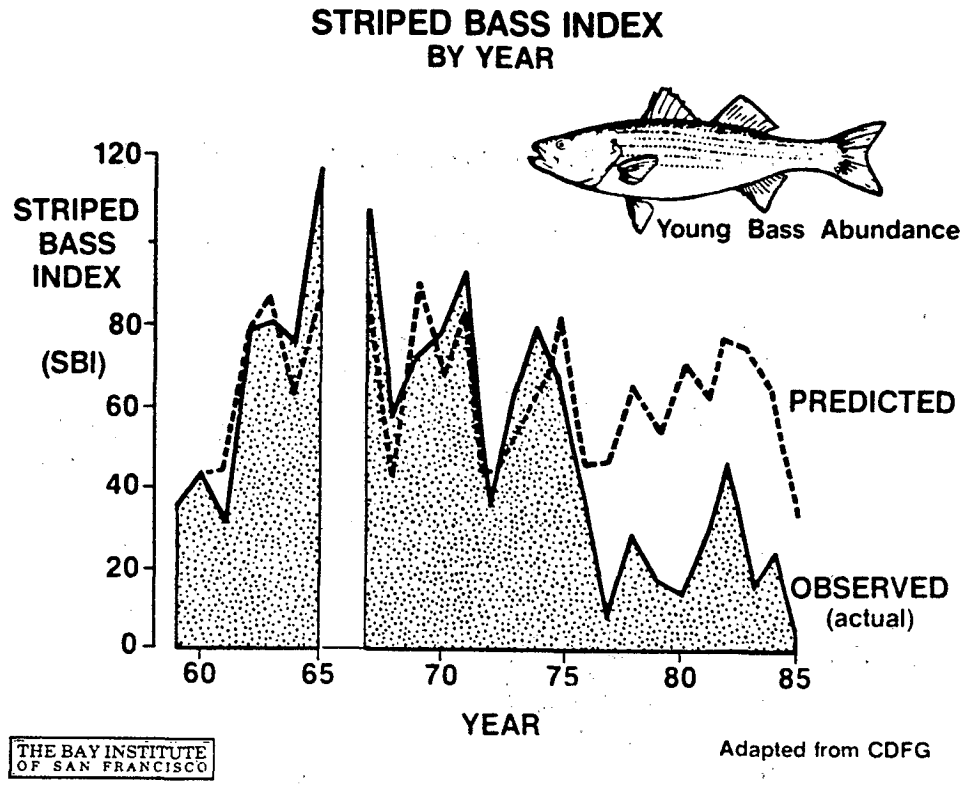
In my opinion, even so-called remedial projects, such as the Montezuma Slough construction of the Plan of Protection for the Suisun Marsh, should not be seriously considered at this time. The federal government and the State of California need to rest on their oars for a decade or two, while the impacts of the past 50 years on the most important and complex estuarine system of the west coast of the United States are evaluated and -- if and where possible -- "mitigated" at the expense of the major public projects, for financial support, and expense of the earlier private and municipal projects, for water supply support.

The public has come to not trust government agency planning on rivers, especially the Sacramento-San Joaquin system. The collapse of the Striped Bass Index -- and the fishery it measured -- offers a prime example of placing trust unwisely in a "scientific" measurement designed specifically to gage impacts of water projects on natural values.

Consider that several decades of work went into devising the Peripheral Canal with the technical assurance that it would result in a Striped Bass Index of 110 on a scale of 120. From 1959 to 1976 the predicted and the observed measurements of striped bass abundance were very close. Since 1976 this applied science related to water flows and project diversions has not worked. The biologists and engineers who fashioned the SBI cannot now explain why it no longer functions as a reliable predictor of striped bass abundance and is indeed instead the Dow-Jones of defeat for man's 40 years of effort to maintain the striped bass in co-existence with water development.

Respectfully submitted,

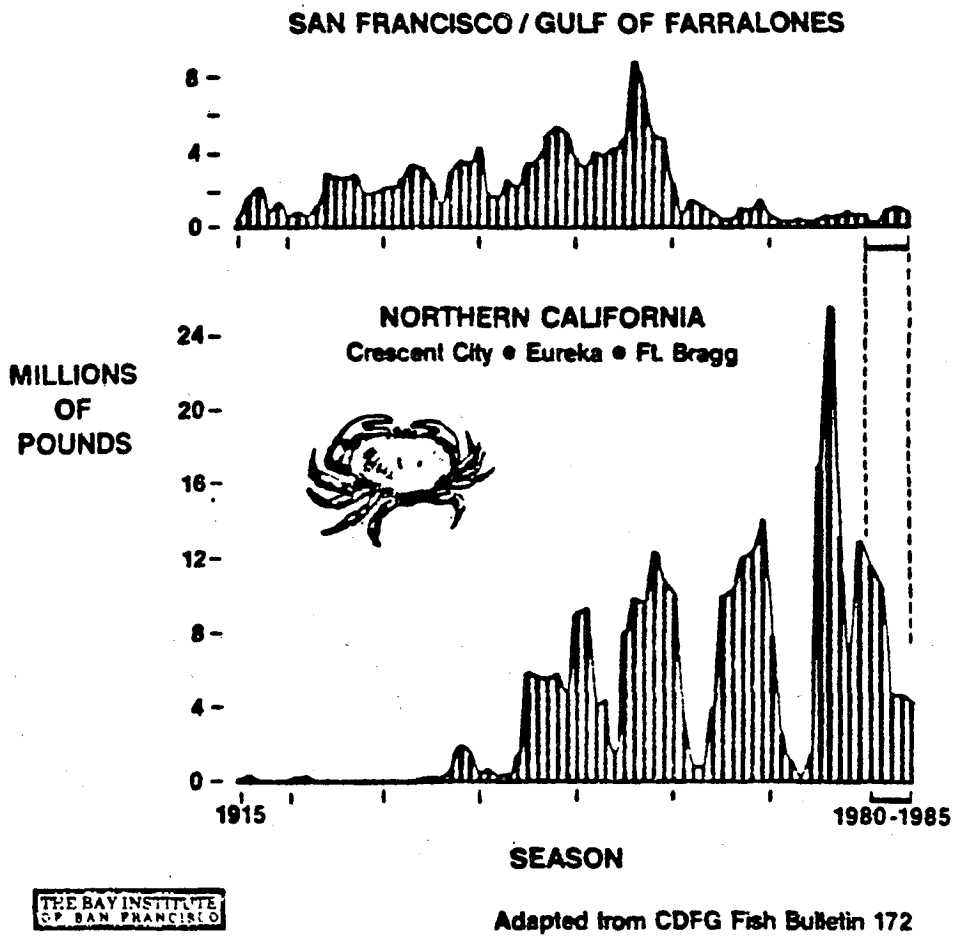
William T. Davoren, Executive Director



The Striped Bass Index correlated well with river flows and big water project diversions from 1959 to 1976, but has mystified biologists and engineers since. The lowest index figure since 1959 (6.3 SBI) was recorded in July 1985 -- despite average weather runoff flows, despite controls in an approved federal-state water quality plan for the Delta and Suisun Marsh that calls for the Central Valley Project and the State Water Project to meet an SBI of 79. This 79 level is calculated to reflect the young-of-the-year populations of striped bass if the two projects had never been built, these are the "without project" conditions. The same data base created by federal and state biologists and engineers estimates that the average Striped Bass Index for the period 1922-67 was 106 SBI units.

All such calculations represent the bygone era of basing all fisheries planning on obtaining "mitigation" measures from the state and federal projects. The scientific adequacy of such methods is now exposed as limited, single-species, project-oriented and totally incapable of considering the multiple biological, chemical, physical and hydrodynamic factors that comprise a naturally productive and healthy estuarine system. The late and unlamented Peripheral Canal, for example, was projected to achieve an SBI of 110. In retrospect, such assurance seems preposterous: the government biologists responsible for operating the SBI have not been able to explain its failures to function since 1976! The effects of toxics on striped bass reproduction, as an illustration of historic shortfalls, was not even considered seriously until a special task force report in 1982. Now we know the striped bass may not survive another reproductive cycle in the San Francisco Bay-Delta system. We are wiser, but sadder.
Prepared and submitted by the Bay Institute of San Francisco

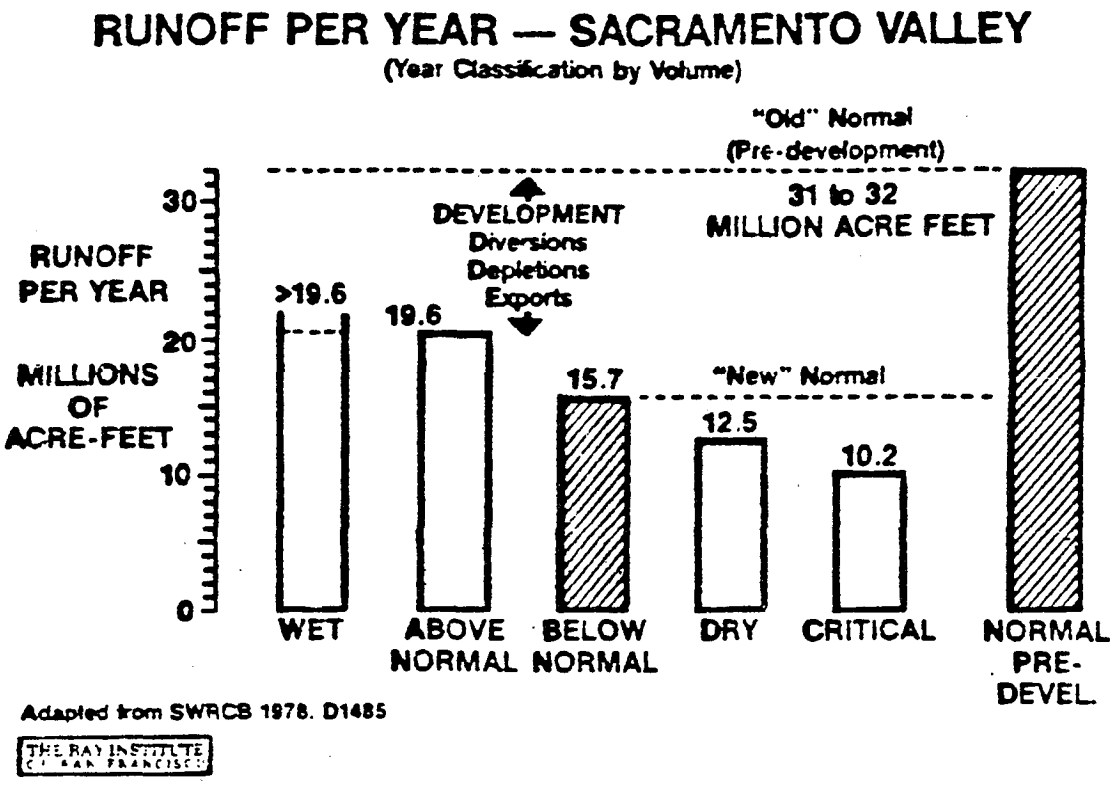
THE DECLINE OF THE DUNGENESS CRAB IN THE BAY



Adapted from CDFG Fish Bulletin 172

The Department of Fish and Game does not believe the sustained population decline of the Gulf of Farralones crab fishery relates directly to deteriorating conditions in the estuarine environment of San Francisco Bay. Many Dungeness crabs enter the Bay at a very early stage of development, and return to the Pacific Ocean 12 to 15 months later. The number of crabs entering the Bay is probably a direct reflection of Delta outflow in that the more Bay waters that discharge to the ocean at Golden Gate the more strong are the ocean currents entering the bay. The heavier ocean waters scour the bottom of the bay, distributing the very small crabs and other marine-estuarine forms of life throughout the Bay system.

Prepared and submitted by the Bay Institute of San Francisco



As described in this rendering of the SWRCB's official "Year Classification" diagram, water development already has captured at least one-half of average year runoff flows, and undoubtedly much more than one-half in below normal,dry and critical years. Developments planned to expand the State Water Project and the federal Central Valley Project will capture at least another 25 percent of average year flows, according to the Bay Institute of San Francisco. (No flows have yet been reserved for San Francisco Bay's economic and/ or environmental needs by the State Water Resources Control Board.)

Prepared and submitted by the Bay Institute of San Francisco

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* A PROFESSIONAL CORPORATION

October 28, 1985

Department of the Army
Sacramento District Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814-4794

Attention: SPKED-W

Re: Sacramento River Deep Water Ship Channel EIS

Gentlemen:

I enclose a copy of a letter dated October 21, 1985 from John F. Wright of Murray, Burns and Kienlen, civil engineers, addressed to the undersigned. I submit this letter as comments on the DSEIS for the above-referenced project.

Thank you for your attention to these comments.

Very truly yours,

Harry O'Brien

HOB:gsk
Enclosure

MURRAY, BURNS AND KIENLEN
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October 21, 1985

Mr. Harry O'Brien
Coblentz, Cahen, McCabe & Breyer
Attorneys at Law
Thirty-fifth Floor
One Embarcadero Center
San Francisco, California 94111

Dear Mr. O'Brien:

By letter dated October 9, 1984, and received October 15, 1985, Mr. George Biagi, Jr., transmitted a copy of "Design Memorandum No. 1, Sacramento River Deep Water Ship Channel, Draft General Design Memorandum and Supplemental Environmental Impact Statement" dated August 1985, for review and direct comment to you.

I have reviewed Design Memorandum No. 1 and my comments are as follows:

1. Page II-2.b. Climate
   Line 4 - "water months"

   Comment
   It appears that "water months" should be winter months.

2. Page IV-1 14.b(1)

   Comment
   This section does not include the spoil site on Sherman Island - designated as S 20.

3. Page IV-3 (2)

   Comment
   Spoil site S 14 on the tip of Grand Island is a very important source of material for levee repair of the Delta islands. Material has been removed from this site for many years to rehabilitate the levees in the Delta. The use of this area as a spoil site should be continued. Any plans to

establish a recreation area on this site should be discouraged.

4. Page V-17 and Page V-18, Table V-5

In the area along Cache Slough adjacent to Reclamation District No. 2084 the report indicates that "this area is at a lower elevation and may have seepage increased by the dredging. Flow net analysis indicates a maximum increase of 8 percent in seepage after dredging. However, if this area is subject to flooding as part of the Yolo Bypass, this theoretical increase may be of no significance."

Comment

Flooding of Reclamation District No. 2084 is very rare. Seepage does occur during the winter months when Cache Slough is high adjacent to the District. If increased seepage does occur during the spring and summer months, then there is a definite concern to Reclamation District No. 2084 and the landowners. Any increase in seepage should be mitigated.

5. Page VI-2

It is stated that the Sacramento County, Department of Parks and Recreation is interested in park development on the spoil site on Grand Island.

Comment

As mentioned previously, this spoil site is a very important source of material for the Delta islands. By continued removal of material from the site, it allows for a deposit area for dredged material that periodically must be removed near the junction of the Sacramento River and Cache Slough. This site should be retained as a spoil site for the dredged material and any use for recreation purposes should be discouraged.

6. Page IV-3 (2). The Design Memorandum indicates that the narrow portion of the channel in Cache Slough between Mile 15.0 and 18.6 will remain at a 300-foot width.

Dredging work on this portion of the channel would not be initiated until the third year after the start of construction. It is estimated that 0.5 million cubic yards of material will be removed from this reach to deepen the channel to the required depth.

Page VII-10 (3)(b). It is stated that the reach between Mile 15.0 to 18.6 "is the narrowest portion of the natural waterway. This portion of the channel carries high winter flows from the Yolo Bypass and is hence subject to high current velocities."

Page VII-10 (4) states "For comparison, also shown in Table VII-4 are channel widths for a vessel with a 100-foot beam and 800-foot length since it is known that ships exceeding these dimensions have previously called at the port."

Figure VII-2 and Table VII-4 both indicate that the minimum bottom width for large vessels, 100-foot beam, is 340 feet.

Comment

In 1982 a 1,350-foot reach of the right bank levee in this narrow reach slipped on the waterward side. The existing rock revetment and the waterward slope of the levee slipped vertically a minimum of 3 feet and a maximum of 7 feet. Reclamation District No. 2084 repaired this portion of the levee at a cost to the District of nearly $27,000. It was the District's opinion that this damage was caused by a combination of the depth of the channel adjacent to the levee and the movement of the large ships using the channel.

It appears that a 300-foot channel width in this narrow area adjacent to Reclamation District No. 2084 may produce some adverse effects to the levee and stone protection maintained by the District. This concern should be addressed by the U. S. Army Corps of Engineers in their final design and construction plans for the deepening of the ship channel.

7. Page VII-13 Note 1/

Comment

A hyphen should be added after 1- engths.

8. Page VII-14 Note 1/

Comment

Same as 7 above.

9. Page VII-15 Note 1/

Comment
Same as 7 above.

10. Page VII-16 Note 1/

Comment
Same as 7 above.

11. Page VII-19.
Capt. Atthowe noted that ships have to increase speeds opposite Reclamation District No. 2084 because of wind and move crabwise 2 to 3 degrees off course to compensate for wind.

Comment
In this narrow channel this increase of speed and the crabwise position of the ship could have an adverse effect on the levee along Reclamation District No. 2084 on the right bank of Cache Slough.

12. Page VII-25. 37.
It is stated that at this time that no levee setbacks are planned. However, surveys in the Cache Slough project reach (Channel Mile 15.0 to 18.6) are being conducted to determine the exact location of the channel in relation to the low levee along Egbert Tract.

Comment
This area is of particular concern to Reclamation District No. 2084. Any plans for a levee setback in this area should be carefully reviewed by the District. The proposed channel deepening appears to be very close to the District's levee. This deepening could undercut the existing rock revetment. The channel deepening should be moved more to the center of the channel. Additional rock protection should be added to the levee and bank in this area. Perhaps the maintenance obligation for the levees and rock protection in these narrow locations should be the Corps of Engineers and not the local District.

13. Page VII-25. 38. Bank Protection
Line 8 refers to paragraph 20.

Comment
This should refer to paragraph 16.

14. Plate II Cross Section 960+80.
The cross section indicates that the channel will be deepened to elevation -35 feet with 1-foot allowable over-depth. This excavation will be very close to the right bank levee, Reclamation District No. 2084. The proposal may undermine the existing rock revetment on the levee.

Comment
This concern should be addressed by the Corps of Engineers in their final design and construction plans for the deepening of the ship channel.

15. Plate IV

Comment
U. S. Bureau of Reclamation overhead powerline crossing the channel near Mile 4.0 is not indicated.

In particular, the main concerns to Reclamation District No. 2084 and the property owners in the portion of the channel located between Miles 15.0 and 18.6 are indicated as follows:

1. This is the narrowest portion of the natural waterway and the ship channel is very close to the right bank levee.

2. The close location of the channel to the right bank levee could be a concern due to large ships which could cause damage to the revetment and levee by propeller wash, the pressure created by the hydraulic compression of the water as it is "squeezed" between the vessel and the bank, and the need by the ship to provide more speed to compensate for water velocity and wind. Proper bank clearance should be provided in the design and construction of the channel.

3. Possible increase in seepage to the lands in Reclamation District No. 2084. Any increase in seepage should be mitigated.

4. The "design vessel" used for the design of the 35-foot deep channel has a beam of 83 feet and a length of 600 feet. It is noted that vessels of much larger size have made calls to the Sacramento Port in the past.

Perhaps Reclamation District No. 2084 should negotiate a new agreement with the Corps of Engineers or Port District whereby the Corps or Port would be responsible for maintenance of the right bank levee and revetment works between Miles 15.0 and 18.6.

Sincerely,

MURRAY, BURNS and KIENLEN

By: John F. Wright
John F. Wright

cc: Reclamation District No. 2084
c/o Joyce Holmes
P. O. Box 785
Rio Vista, CA 94571

NATIONAL WILDLIFE FEDERATION
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November 11, 1985

Colonel Wayne J. Scholl, District Engineer
Sacramento District
U.S. Army Corps of Engineers
650 Capitol Mall
Sacramento, California 95814-4794

Dear Colonel Scholl:

We appreciate the opportunity to comment on the Draft General Design Memorandum (DGDM) and Supplemental Environmental Impact Statement (SEIS) for the proposed plan to deepen the Sacramento River Channel between Pittsburg and Sacramento, California to a depth of 35 feet. We also appreciate the extension on the comment period which Mr. Mike Welsh of your office granted to us by phone on Oct. 24, 1985. The National Wildlife Federation is the nation's largest conservation organization, with over 4.8 million members and supporters.

There are several aspects of the proposed plan which are cause for concern. First, the DGDM and SEIS fail to adequately demonstrate the need for the project. Second, the documents propose the construction of a submerged sill if the project triggers salinity intrusion in the Sacramento River, but do not consider the potential impacts of the sill on anadromous fish and other aquatic organisms. Third, the DGDM and SEIS propose the disposal of dredged material on areas which may harbor endangered and candidate plant species. Additionally, the dredged material contains heavy metals which may leach into the groundwater system in the project area. The National Wildlife Federation believes that this project should not be authorized until:

- The need for deepening of this channel is documented;
- The potential impacts of the submerged sill on the aquatic environment are investigated;
- Alternative disposal sites are identified to replace the proposed sites if surveys indicate the presence of endangered or candidate plant species.

Project Need Not Demonstrated

The DGDM (page II-12) states that vessel calls at the Port of Sacramento decreased in 1982 and 1983, due to world-wide recession and the United State's Payment-in-Kind program. The document then asserts that "vessel calls are expected to increase as agricultural constraints are relaxed and the economic situation continues to improve." The SEIS (page 31) states that "very little increase in traffic is expected for at least twenty years." The stated need for the project is based on speculation. Since no substantial traffic increase is anticipated within the next generation, the channel project should be deferred until evidence exists that it is needed.

The Corps anticipates that the San Francisco Bay to Stockton Ship Channel deepening project is to be completed in 1987, according to Mr. Welsh. Stockton is less than 50 miles south of Sacramento and may compete with the Sacramento channel for deep-draft traffic. The DGDM states (page 1X-1) that "A thorough discussion of the methodology and procedures used in deriving the navigation benefits was presented in July 1980." The 1980 document said of the Stockton channel: "... only limited construction has been accomplished on this project pending completion of evaluation of the effects of deepening the Stockton Ship Channel." (page 14) In light of the recent completion of 3 out of 4 contracts on the Stockton Channel, this statement is no longer valid. The U.S. Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Resources Implementation Studies state that "... in the final delineation of the economic study area for a given [Deep-Draft Navigation] improvement, there should be adequate discussion of the trade area relative to adjacent ports and any commonality that might exist." Neither the 1985 nor the 1980 document adequately addresses this point.

Potential Impacts of Submerged Sill Not Addressed

The documents fail to adequately address problems associated with increased salinity intrusion which might result from channel deepening. Neither the DGDM nor the SEIS considers the hydrologic effects of a submerged sill if further salinity studies indicate that such a structure is needed. The U.S. Fish and Wildlife Service, in cooperation and concurrence with the California Department of Fish and Game, stated in its 1980 report on fish and wildlife resources pursuant to the Fish and Wildlife Coordination Act relative to the Sacramento River Channel that "Given additional information on the probable effects of a submerged sill on such phenomena as the Delta's nutrient entrapment zone and the movements of aquatic organisms, it is conceivable that the disadvantages to fish and wildlife resources assignable to the submerged sill might be

judged to outweigh the benefits to be gained by all interests through the restoration of salinity levels to the pre-project condition" (page ii). The report recommended that 3 steps be taken by the Corps prior to installing a sill:

a) Funding of a special study by the Fish and Wildlife Service to ascertain the probable impacts of such a structure on fish and wildlife resources;
b) full and equal consideration of the recommendations of the Fish and Wildlife Service, based on the said study, in arriving at a decision concerning the advisability of constructing the submerged sill;
c) preparation of a supplemental Environmental Impact Statement addressing construction of the submerged sill and incorporating the information obtained from said study.

These recommendations were not addressed in the DGDM or in the SEIS; the documents give no indication that such studies will be conducted if a salinity problem arises.

Endangered Species Need More Consideration

No surveys have been released on the upper portion of the project area for endangered and candidate plant species even though critical habitats for several such species have been identified on the lower portion of the Sacramento-San Joaquin Channel (SEIS, page 23). The SEIS simply says that "if it is found ... that any special plant or animal exists on any of the dredged disposal areas, the site should be preserved to the extent possible" (SEIS, page 41). In order to preserve a disposal site, an alternative site must be chosen. It would be prudent to identify the habitat of endangered and candidate species and potential alternative disposal sites before the project is authorized for construction.

Toxic Heavy Metals Could Leach from Spoils

Dredged material will be contained by dikes (DGDM, pp. VII-23 through VII-25) to prevent toxic heavy metals from washing into the river. The Corps found, in its Dredged Material Research Program conducted from 1973 to 1978, that spoil disposal on well-drained upland sites can lead to an oxidizing, acidic environment which is conducive to the leaching of contaminants, particularly heavy metals. Samples of materials dredged from the project area show levels of cadmium, chromium, copper, lead and mercury above 1984 EPA acute criteria (SEIS, page 34). Some investigation into the fate of these metals, should they leach into the groundwater table, should be executed before project authorization.

Conclusion

In conclusion, inadequate study has been made of the possible environmental impacts of this complex project. Since the need for a 35-foot navigation channel to Sacramento has not been demonstrated, the National Wildlife Federation opposes construction of this project.

Sincerely,

Constance E. Hunt

Constance E. Hunt
Water Resources Program

E. R. Osann

Edward R. Osann, Director
NWF Water Resources Program

cc: Janice von Dohlen, President
California Natural Resources Federation

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November 21, 1985

U.S. Army Corps of Engineers
Sacrmento District
650 Capitol Mall
Sacramento, California 95814-4794
Attn: SPEKD-D

Subject: Comments on August 1985 Supplemental Environmental Impact Statement to the 1980 Sacramento deep water ship channel general design memorandum.

Gentlemen:

I have solicited comments on the above EIR from our Sacramento Commissioned Pilot members. All of the replies were generally favorable therefore the San Francisco Bar Pilots support this project as described with the following comments:

1. We urge the bends in the reaches from mile 18.6 to the port be expanded to accepted design specifications consistent with the economies involved.

2. We appreciate the Port's position with respect to funding and support a two phased construction schedule. For safety we also endorse their consideration of special operating restrictions or measures in the interim period after deepening and prior to widening.

I am available at this office to answer any further questions you may have.

Yours truly,

W W Meyer

Captain W.W. Meyer
Port Agent