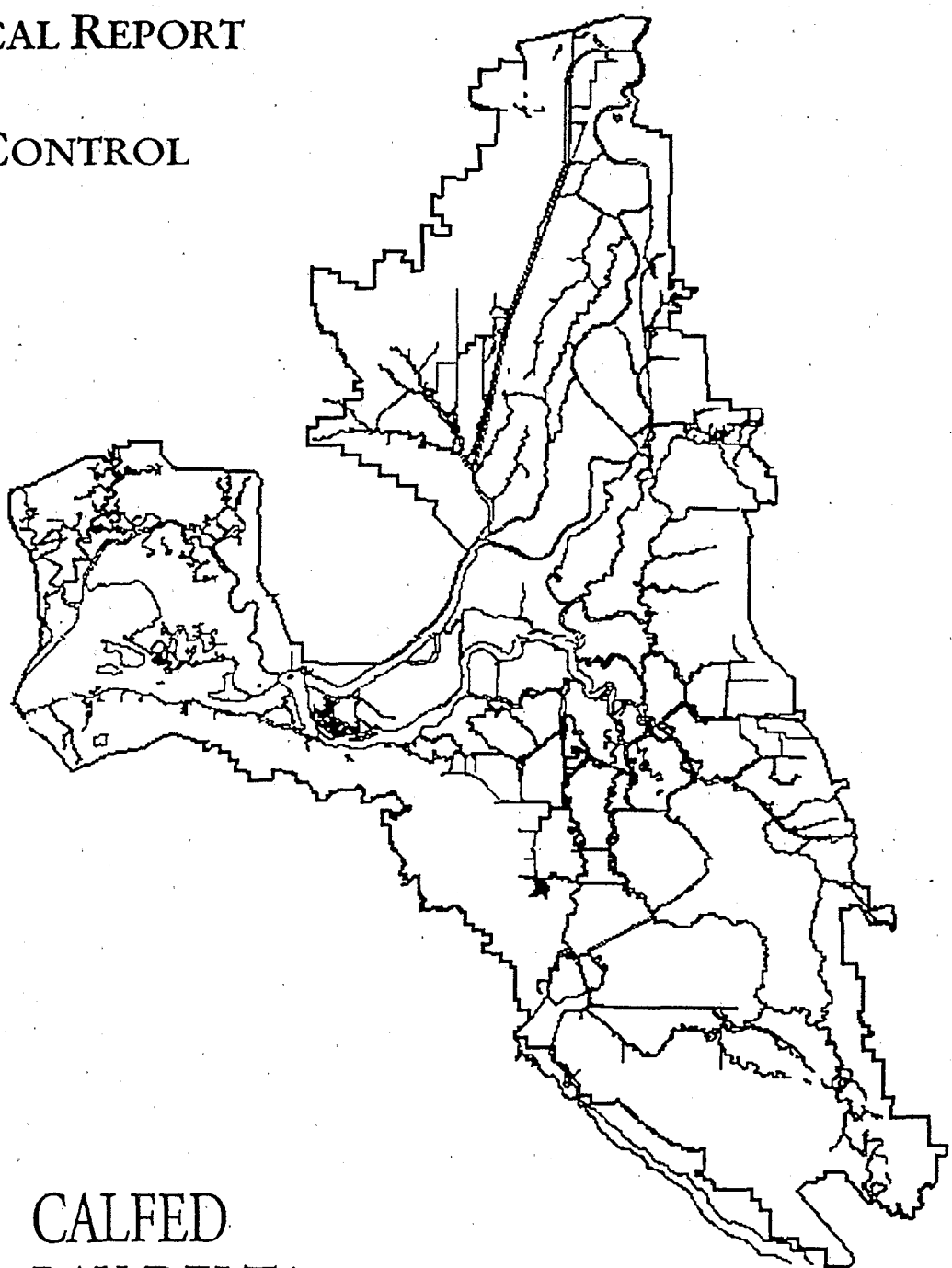
CALFED BAY-DELTA PROGRAM

DRAFT OUTLINE - TECHNICAL REPORT

FLOOD CONTROL SYSTEM



CALFED BAY-DELTA PROGRAM

MAY 30, 1997

Woodward-Clyde

CALFED/685

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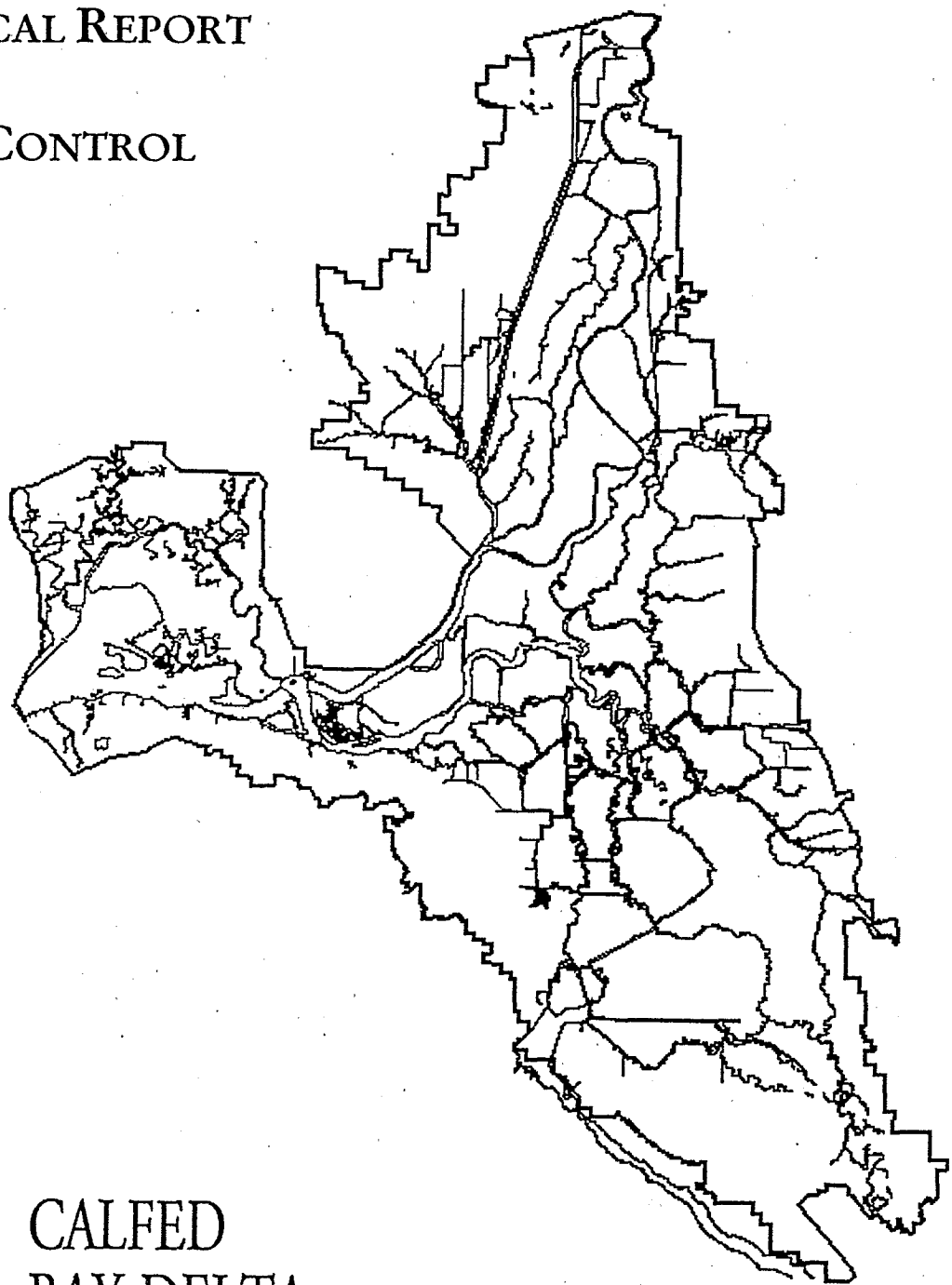
CALFED BAY-DELTA PROGRAM

DRAFT OUTLINE - TECHNICAL REPORT

FLOOD CONTROL SYSTEM



CALFED
BAY-DELTA
PROGRAM

MAY 30, 1997

Woodward-Clyde

C—070757

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DRAFT
TECHNICAL REPORT
FLOOD CONTROL SYSTEM

I. Introduction

II. Summary of Overall Affects
by Alt

2.1 Summary of Potential Significant Impacts

2.2 Summary of Mitigation Strategies

2.3 Summary of Significant Unavoidable Impacts

III. Assessment Method

IV. Significance

V. Environmental Impacts & Consequences

5.1 No Action Alternative (YR 2020)

The No-Action Alternative represents the condition of the flood control system most likely to exist in the year 2020 without any of the program actions. The No-Action alternative is used as a baseline to compare alternatives.

There are numerous projects in various stages of study, planning, and execution that could possible affect the No-Action alternative. The CALFED Bay-Delta Program has worked with agencies, stakeholders, and the public to develop an agreed upon set of projects to be included in the No-Action alternative. The screening criteria used for selection were:

- Has the action been approved?
- Does the action have funding?
- Does the action have final environmental permits and appovals
- Wil the action be excluded from the CALFED actions?
- Would the effects of the action be identifiable at the level of detail being considered for CALFED analysis?

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Based on answers to the foregoing questions, the list of projects shown at Table ___ represents the projects included in the analysis.

In addition to the project assumed to be implemented, the No-Action alternative must also include operational assumptions. For this analysis, it is considered that existing flood control policies will remain in effect through the year 2020. Likewise, the 1992 CVP operating criteria and current SWP operations remain in effect.

5.1.1 Summary of No-Action Affects/Comparison to Existing Conditions

Delta Region (Figure___, Map of Delta) (Use figure 1, Draft Affected Env Rpt Flood Control System 23 Sept 96)

The most pressing problem in the Delta is repeated, extensive flooding. Under the No-Action alternative, continued deterioration of the levees is expected and, hence, the ability to handle flood flows at the required stages. Levees serve many purposes in addition to maintaining a floodway. Maintaining an adequate floodway within the delta is critical to the protection of land and homes, serves as a water supply conveyance, provides balance in salt water intrusion and other water quality benefits, and protects other valuable infrastructure.

Some 65% of the levees are non-project levees. Standards of initial construction were weak and many of the non-project levees were constructed piecemneal without the benefit of modern engineering and scientific methods. While many of the levees look "standard" from the outside, they are often founded on earlier levees of questionable construction. These levees can fail at any time.

[Expand discussion of the types of levees - Bulletin 192-82, PL 99, Hazard Mitigation Plan, FEMA]

A special challenge in the Delta that gets worse with time is the continued subsidence of the levees. In many areas [need map] the levees are founded on peat soils. Subsidence ranges from 1-3 inches per year in peat areas. As the levee crown drops in relation to the water surface, freeboard is lost and the ability of the floodway to handle necessary flows is jeopardized. Loss of freeboard exacerbates the danger of overtopping from combinations of high tide and wind that occur during the normal flood season. Forty per cent (40%) of the delta levee failures have occurred due to overtopping. As subsidence continues under the No-Action alternative and without a comprehensive fix, the ability of the system to handle peak flows is increasingly jeopardized.

Project levees maintained under the federal program are in better shape and have a more reliable maintenance posture. However, these levees can become merely islands in a flooded landscape if the often interconnected non-project levees fail.

Maintenance of the flood control system remains an ever-present challenge. As with other public infrastructure, funding is inadequate to eliminate the maintenance backlog. As the lack of a comprehensive solution to the delta persists, maintenance organizations and organizations charged with protecting environmental resources are often at loggerheads trying to balance the frequently conflicting goals of flood protection and environmental protection.

Finally, as population growth continues in and around the delta and its contributing streams and rivers, runoff is expected to increase. Increasing runoff leads to increasing stage in the delta. Increasing stage coupled with continued subsidence is a recipe for continued and ever more serious impacts on the flood control system.

Bay Region

Sacramento River Region

San Joaquin River Region

SWP and CVP Service Areas Outside the Central Valley

5.2 Delta Region

5.2.1 Summary of Delta Regional Affects by Alternative

Brief Text
Tables

Summary	Significant Impacts
Summary	Mitigation Strategies
Summary	Potential Significant Unavoidable Impacts

5.2.2 Comparison of Program Actions to No Action Alternative

The three major alternatives (Alternative 1,2 and 3) can be divided into two components; one consisting of the "Common Programs" and the other consisting of the "Alternative Specific Storage and Conveyance Programs". Furthermore, the overall Common Program is composed of four programmatic actions:

1. Ecosystem Restoration
2. Water Quality
3. Water Use Efficiency
4. Levee System Integrity

Within each of these four component programs are several specific action items. The impacts of the specific action items that relate to flood management as compared to the No Action Alternative are described below.

The three alternatives differ from each other primarily in regard to the actions taken to modify conveyance and water storage facilities. Potential impacts resulting from each of these actions are also discussed following the common program items.

5.2.2.1 Alternative 1 - Common Programs Compared to No Action

Ecosystem Restoration Program

Within the Delta Region the Ecosystem Restoration plan consists of 22 resources elements each of which consist of from 1 to 5 specific action items. The programmatic resource elements and actions are listed in Table 5.X from the Phase II alternative descriptions report. The resource elements were screened to identify those elements whose actions would significantly impact flood management operations and capabilities. These are described below. Elements were considered to have minimal impacts on flood management if they did not significantly change the flows or water levels in the affected channels.

RESOURCE 1: DELTA CHANNEL HYDRAULICS

GENERAL DESCRIPTION OF ACTIONS THAT COULD INDUCE IMPACTS ON FLOOD MANAGEMENT

Flows in selected Delta channels may be altered by constricting flows into or out of the channels, or increasing the cross-sectional area of the channels which will reduce flow stages. Also, a network of channels would be constructed within the Yolo Bypass that connects the Putah and Cache Creek sinks, and potentially the Colusa Drain to the Delta. These channels would drain all flooded lands in the Bypass after flood flows cease entering from the Fremont and Sacramento Weirs. Flow constrictions in the Yolo Bypass, such as the openings in the railway causeway, will be enlarged to reduce the impedance of flows.

Approximately 20,000 to 25,000 acres of tidally influenced freshwater wetlands will be restored by flooding portions of islands. One possible restoration method for these wetlands will be to construct setback levees and then breach the existing levees.

CONSTRUCTION RELATED IMPACTS

It is assumed that all construction will take place during the dry season and therefore will not adversely affect flood flows. However, even if the setback levees are constructed during the wet season they would not impact the ability of channels to convey flood flows since they would be

constructed on land that is presently behind levees and therefore does not provide any flood conveyance.

Channel widening or construction of a constriction in a channel to reduce flow rates is assumed to occur during the dry season and therefore would not impact flood flows during construction.

OPERATIONAL IMPACTS

The actions in each of the resource areas shown in Table 5-X are designed to either increase the capacity of channels to convey flood waters or restrict the flow through selected channels to reduce flow rates (and therefore stages). Most Delta lands are below sea level and are protected from flooding by levees. Presently there is no consistent design standard for all levees in the Delta. A smaller percentage of the levees (approximately 35%) (DWR, 1991) protecting lowlands in the Delta are part of the Federal Flood Control Program. These levees are designated as Project levees. They are maintained by the Army Corps of Engineers and generally provide a relatively high level of protection. However, most of the levees in the Delta are classified as nonproject levees. These levees are maintained by local reclamation or levee maintenance districts. They provide varying levels of flood protection and are in various stages of disrepair. Some levees in the Delta are certified to meet the minimum requirements for providing 100-year flood protection. This certification is provided by the National Flood Insurance Program run by the Federal Emergency Management Agency (FEMA). These levees probably provide the greatest level of protection.

If no actions are taken (No Action Alternative) (**I assume that section 5.1.2 will discuss the no action alternative compared to existing conditions)** the frequency of flooding is likely to increase as unmaintained or poorly maintained levees fail more frequently. Also, for the nonproject levees that are built on poor foundations, subsidence will lower the level of protection that presently exists. For some levees this could amount to several feet. Urbanization of tributary watersheds to the Delta will increase flows to the Delta thereby increasing the frequency of levee overtopping and further decrease the level of protection provided by the existing levees. The comparison to existing conditions was described in Section 5.1.2.

The construction of new setback levees under Alternative 1A to increase the conveyance of selected Delta channels would have several positive affects relative to the No Action Alternative. These would be primarily related to the replacement of nonproject nonengineered levees with engineered levees built to a higher design standard. Qualitatively the impacts would include:

- Less frequent levee failures as nonengineered levees would be replaced by engineered levees.
- A higher level of protection since new levees would be built on a more solid foundation thereby decreasing the amount of annual subsidence.
- A higher level of protection because the new levees would be built using the latest estimates of flood flows which would include flows due to urbanized areas

- Under the no action alternative some failed levees would not be repaired. This could create new areas of open water exposing the remaining levees to increased wind and wave action further increasing the rate of levee failure.

A more quantitative estimate of the impacts of Alternative 1A compared to the No Action Alternative was made by comparing predicted 100-year flood stages for selected locations with and with out the setback levees. Since the exact locations of the setback levees and the exact amounts of setback to be provided have not been determined for this programmatic EIR/EIS a typical section was chosen and a 100-year flood stage estimated. Figure 5-X **(to be provided later)** shows a typical Delta channel cross-section with and without a setback levee. For the No Action Alternative it was assumed that the existing levee had subsided two feet. The new levee was assumed to be at an elevation greater than the 100 flood elevation. The Corps of Engineers HEC-2 model was run to determine the flood stage for each case. One-hundred year flows were obtained from the North Delta Program EIR/EIS (DWR, 1990). Table 5-XX **(to be provided later)** shows the decrease in 100-year flood stage at selected locations in the Delta. As shown in the Table the flood stage decreases by ..... to ..... feet.

(section of Yolo Bypass improvements to be added)

RESOURCE 2 FLOODPLAIN INUNDATION AND SEDIMENT RETENTION

GENERAL DESCRIPTION OF ACTIONS

The goal of this resource unit is to expand the floodplain areas in the Delta by incorporating approximately 10% of the leveed lands into the active floodplain. This will be accomplished by converting leveed lands into tidal marches and slough complexes (e.g., Little Holland, Liberty and Prospect islands) and constructing set back levees along selected rivers and sloughs (e.g., South Mokelumne and San Joaquin River and Beaver, Hog and Sycamore sloughs). In some locations deeper subsided islands will be converted to overflow basins (e.g., East Delta, San Joaquin River). Lastly, set back levees will be constructed at selected locations.

CONSTRUCTION RELATED IMPACTS

Set back levees will be constructed behind existing levees so their construction would not impact flood management. One method for converting leveed lands to tidal wetland/slough complexes is by breaching the existing levees in several locations and allow the remaining levees to erode. The breaching of these levees would not impact flood management. The conversion of deeper islands to overflow basins was assumed to occur during the dry season.

OPERATIONAL IMPACTS

The construction of overflow basins and conversion of leveed lands to wetlands will have the effect of reducing peak flood flows to areas downstream of the overflow basins. Some of the islands proposed to be converted under Alternative 1A (e.g., Prospect Island, tracts along Snograss Slough, Beaver, Hog and Sycamore Sloughs) are presently protected by nonproject levees. Under the No Action Alternative it is possible that some of these levees will fail and not be repaired or subside to the extent that they are overtopped during a large storm event. In either of these cases the affect would be to reduce peak flood flows downstream similar to Alternative 1A.

However, if the existing levees are maintained or retain their integrity Alternative 1A actions will increase the level of flood protection relative to the No Action Alternative. To estimate the amount of protection provided, estimated 100-year flood flows were obtained from the North Delta Program EIR/EIS (DWR, 1990) for the Mokelumne River. Figure 5.X shows the 100-year flood hydrograph. A typical river cross-section with and without a set back levee is shown in Figure 5.XX. HEC-2 was used to estimate flood stages with and without setback levees.

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the Delta

Storage Facilities

Conveyance Facilities

Alternative 1b in the Delta

Storage Facilities

Conveyance Facilities

Alternative 1c in the Delta

Storage Facilities

Conveyance Facilities

Alternative 2a in the Delta

Storage Facilities

Conveyance Facilities

Alternative 2b in the Delta

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Conveyance Facilities

Alternative 2c in the Delta

Storage Facilities

Conveyance Facilities

Alternative 2d in the Delta

Storage Facilities

Conveyance Facilities

Alternative 2e in the Delta

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Conveyance Facilities

Alternative 3a in the Delta

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Alternative 3b in the Delta

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Conveyance Facilities

Alternative 3c in the Delta

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Conveyance Facilities

Alternative 3d in the Delta

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Conveyance Facilities

Alternative 3e in the Delta

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Alternative 3f in the Delta

Storage Facilities

Conveyance Facilities

Alternative 3g in the Delta

Storage Facilities

Conveyance Facilities

Alternative 3h in the Delta

Storage Facilities

Conveyance Facilities

Alternative 3i in the Delta

Storage Facilities

Conveyance Facilities

5.2.3 Comparison of Delta Program Actions to Existing Condition

The Common Program in the Delta

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the Delta

Storage Facilities

Conveyance Facilities

Alternative 1b in the Delta

Storage Facilities

Conveyance Facilities

Alternative 1c in the Delta

Storage Facilities

Conveyance Facilities

Alternative 2a in the Delta

Storage Facilities

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Alternative 2b in the Delta

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Alternative 2c in the Delta

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Alternative 2d in the Delta

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Alternative 2e in the Delta

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Alternative 3a in the Delta

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Alternative 3b in the Delta

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Alternative 3c in the Delta

Storage Facilities

Conveyance Facilities

Alternative 3d in the Delta

Storage Facilities

Conveyance Facilities

5.3 Bay Region

5.3.1 Summary of Bay Regional Affects by Alternative

Brief Text
Tables

Summary Significant Impacts
Summary Mitigation Strategies

5.3.2 Comparison of Bay Program Actions to No Action Alternative

The Common Program in the Bay

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the Bay

Storage Facilities

Conveyance Facilities

Alternative 1b in the Bay

Storage Facilities

Conveyance Facilities

Alternative 1c in the Bay

Storage Facilities

Conveyance Facilities

Alternative 2a in the Bay

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Conveyance Facilities

Alternative 2b in the Bay

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Alternative 2c in the Bay

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Alternative 2d in the Bay

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Alternative 2e in the Bay

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Alternative 3a in the Bay

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Alternative 3b in the Bay

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Alternative 3c in the Bay

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Alternative 3d in the Bay

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Alternative 3e in the Bay

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Alternative 3f in the Bay

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Alternative 3g in the Bay

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Conveyance Facilities

Alternative 3h in the Bay

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Conveyance Facilities

Alternative 3i in the Bay

Storage Facilities

Conveyance Facilities

5.3.3 Comparison of Bay Program Actions to Existing Condition

The Common Program in the Bay

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the Bay

Storage Facilities

Conveyance Facilities

Alternative 1b in the Bay

Storage Facilities

Conveyance Facilities

Alternative 1c in the Bay

Storage Facilities

Conveyance Facilities

Alternative 2a in the Bay

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Alternative 2b in the Bay

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Alternative 2c in the Bay

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Alternative 2d in the Bay

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Alternative 2e in the Bay

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Alternative 3a in the Bay

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Alternative 3b in the Bay

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Alternative 3c in the Bay

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Alternative 3g in the Bay

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Alternative 3h in the Bay

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Alternative 3i in the Bay

Storage Facilities

Conveyance Facilities

5.4 Sacramento River Region

5.4.1 Summary of Sacramento River Regional Affects by Alternative

Brief Text
Tables

Summary	Significant Impacts
Summary	Mitigation Strategies
Summary	Potential Significant Unavoidable Impacts

5.4.2 Comparison of Sacramento River Program Actions to No Action Alternative

The Common Program in the Sacramento River

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the Sacramento River

Storage Facilities

Conveyance Facilities

Alternative 1b in the Sacramento River

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Conveyance Facilities

Alternative 1c in the Sacramento River

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Conveyance Facilities

Alternative 2a in the Sacramento River

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Alternative 2b in the Sacramento River

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Alternative 2d in the Sacramento River

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Alternative 2e in the Sacramento River

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Alternative 3a in the Sacramento River

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Alternative 3c in the Sacramento River

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Alternative 3d in the Sacramento River

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Alternative 3e in the Sacramento River

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Alternative 3f in the Sacramento River

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Alternative 3g in the Sacramento River

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Alternative 3h in the Sacramento River

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Conveyance Facilities

Alternative 3i in the Sacramento River

Storage Facilities

Conveyance Facilities

5.4.3 Comparison of Sacramento River Program Actions to Existing Condition

The Common Program in the Sacramento River

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the Sacramento River

Storage Facilities

Conveyance Facilities

Alternative 1b in the Sacramento River

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Conveyance Facilities

Alternative 1c in the Sacramento River

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Alternative 2a in the Sacramento River

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Alternative 2b in the Sacramento River

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Conveyance Facilities

Alternative 2c in the Sacramento River

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Alternative 3a in the Sacramento River

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Alternative 3d in the Sacramento River

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Alternative 3e in the Sacramento River

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Alternative 3f in the Sacramento River

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Alternative 3g in the Sacramento River

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Alternative 3h in the Sacramento River

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Conveyance Facilities

Alternative 3i in the Sacramento River

Storage Facilities

Conveyance Facilities

5.5 San Joaquin River Region

5.5.1 Summary of San Joaquin River Regional Affects by Alternative

Brief Text
Tables

Summary	Significant Impacts
Summary	Mitigation Strategies
Summary	Potential Significant Unavoidable Impacts

5.5.2 Comparison of San Joaquin River Program Actions to No Action Alternative

The Common Program in the San Joaquin River

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the San Joaquin River

Storage Facilities

Conveyance Facilities

Alternative 1b in the San Joaquin River

Storage Facilities

Conveyance Facilities

Alternative 1c in the San Joaquin River

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Conveyance Facilities

Alternative 2a in the San Joaquin River

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Alternative 2b in the San Joaquin River

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Alternative 2c in the San Joaquin River

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Conveyance Facilities

Alternative 2d in the San Joaquin River

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Alternative 2e in the San Joaquin River

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Alternative 3a in the San Joaquin River

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Alternative 3b in the San Joaquin River

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Alternative 3c in the San Joaquin River

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Alternative 3f in the San Joaquin River

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Alternative 3g in the San Joaquin River

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Conveyance Facilities

Alternative 3h in the San Joaquin River

Storage Facilities

Conveyance Facilities

Alternative 3i in the San Joaquin River

Storage Facilities

Conveyance Facilities

5.5.3 Comparison of San Joaquin River Program Actions to Existing Condition

The Common Program in the San Joaquin River

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the San Joaquin River

Storage Facilities

Conveyance Facilities

Alternative 1b in the San Joaquin River

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Alternative 1c in the San Joaquin River

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Alternative 2a in the San Joaquin River

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Alternative 3g in the San Joaquin River

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Alternative 3h in the San Joaquin River

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Conveyance Facilities

Alternative 3i in the San Joaquin River

Storage Facilities

Conveyance Facilities

5.6 SWP and CVP Service Areas Outside Central Valley Regional Affects by Alternative

5.6.1 Summary of SWP and CVP Service Areas Outside Central Valley Regional Affects by Alternative

Brief Text
Tables

Summary	Significant Impacts
Summary	Mitigation Strategies
Summary	Potential Significant Unavoidable Impacts

5.6.2 Comparison of SWP and CVP Service Areas Outside Central Valley Program Actions to No Action Alternative

The Common Program in the SWP and CVP Service Areas Outside Central Valley

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 1b in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 1c in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 2a in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2b in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2d in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2e in the SWP and CVP Service Areas Outside Central Valley

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Alternative 3a in the SWP and CVP Service Areas Outside Central Valley

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Alternative 3g in the SWP and CVP Service Areas Outside Central Valley

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Alternative 3h in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3i in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

5.6.3 Comparison of SWP and CVP Service Areas Outside Central Valley Program Actions to Existing Condition

The Common Program in the SWP and CVP Service Areas Outside Central Valley

EERP Program

Water Quality Program

Water Efficiency Program

Levee System Integrity Program

Alternative 1a in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 1b in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 1c in the SWP and CVP Service Areas Outside Central Valley

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Conveyance Facilities

Alternative 2a in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2b in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2c in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2d in the SWP and CVP Service Areas Outside Central Valley

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Alternative 2e in the SWP and CVP Service Areas Outside Central Valley

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Alternative 3a in the SWP and CVP Service Areas Outside Central Valley

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Alternative 3b in the SWP and CVP Service Areas Outside Central Valley

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Conveyance Facilities

Alternative 3c in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3d in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3e in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3f in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3g in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3h in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

Alternative 3i in the SWP and CVP Service Areas Outside Central Valley

Storage Facilities

Conveyance Facilities

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[alphabetize later]

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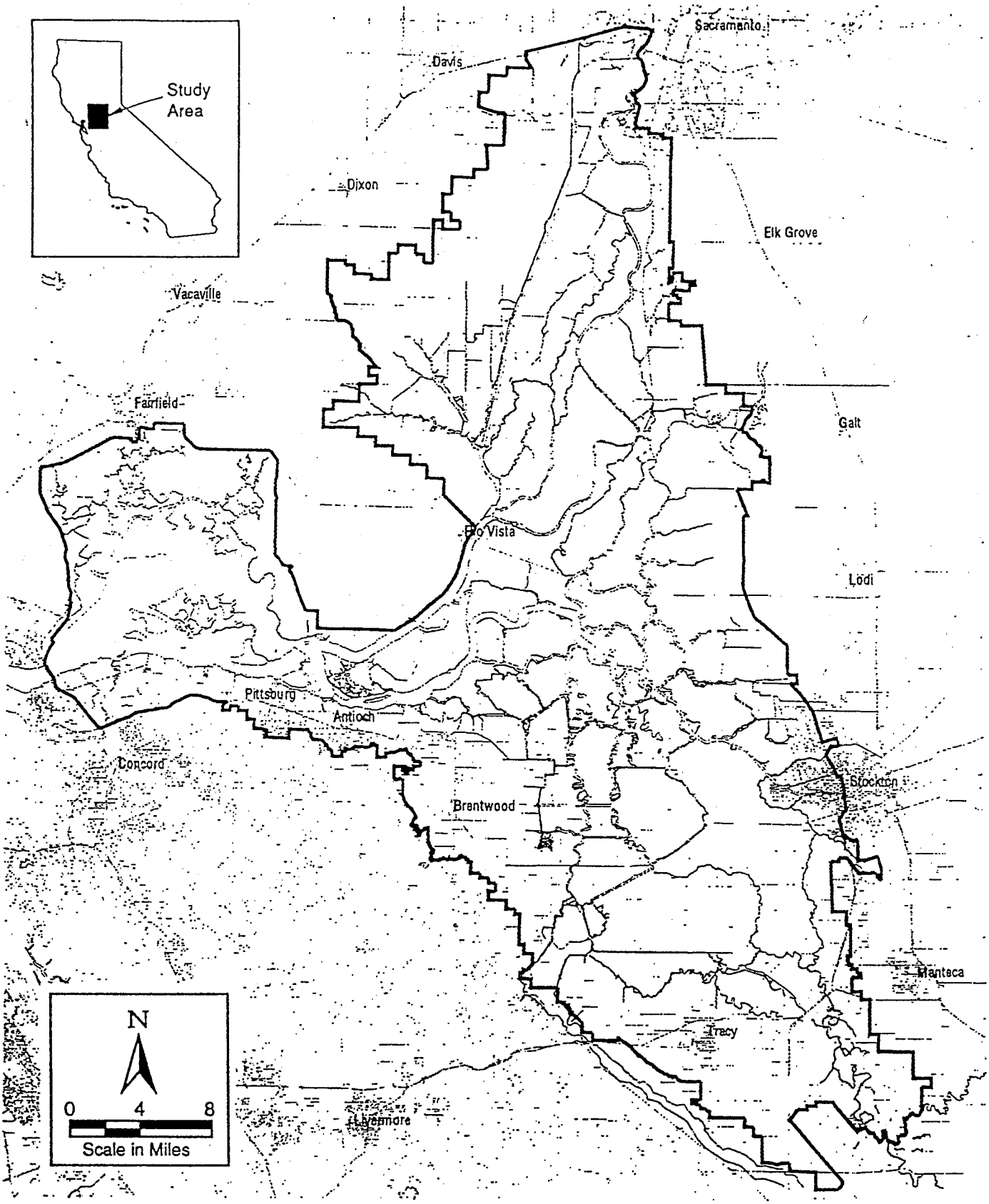
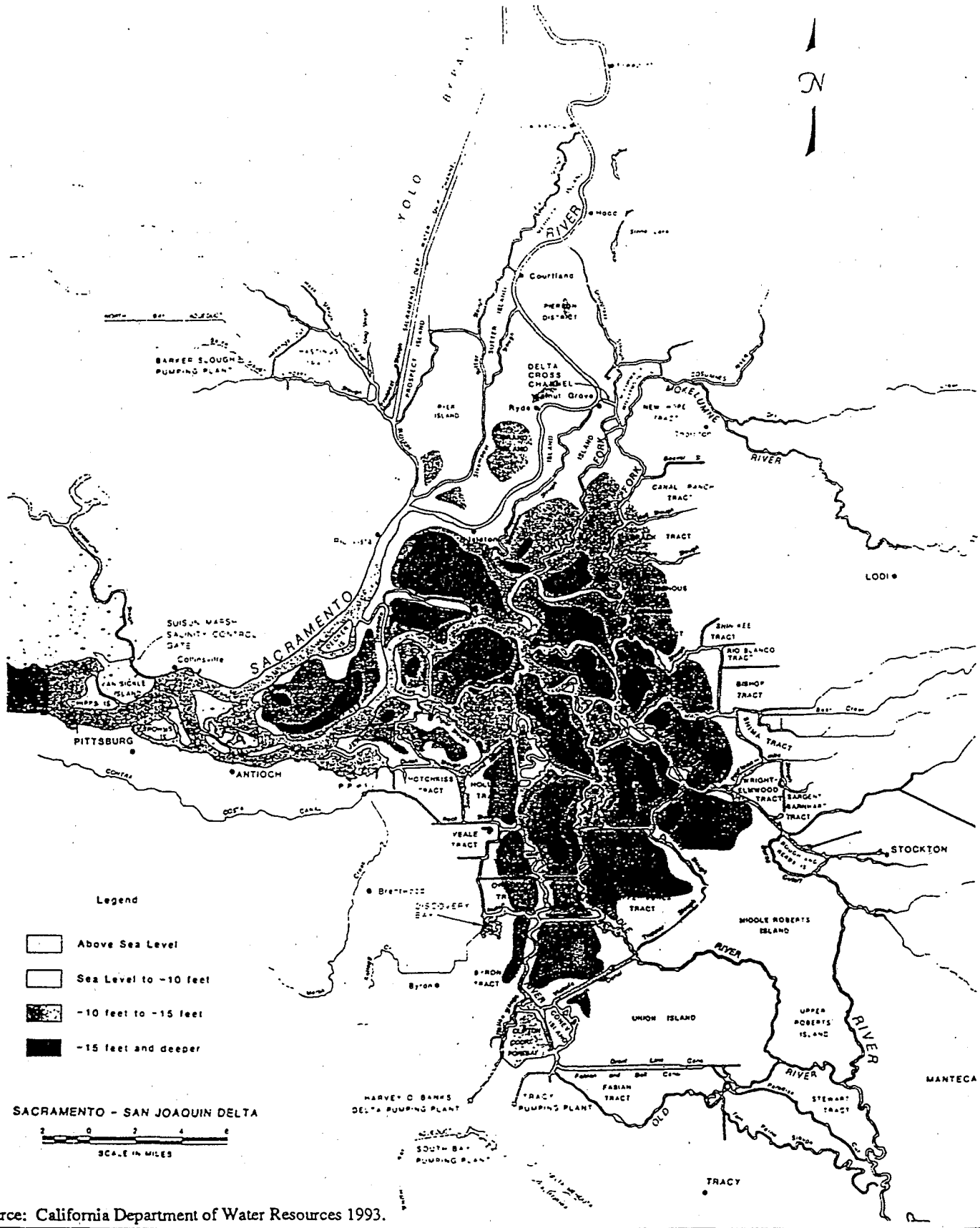


Figure
Study Area

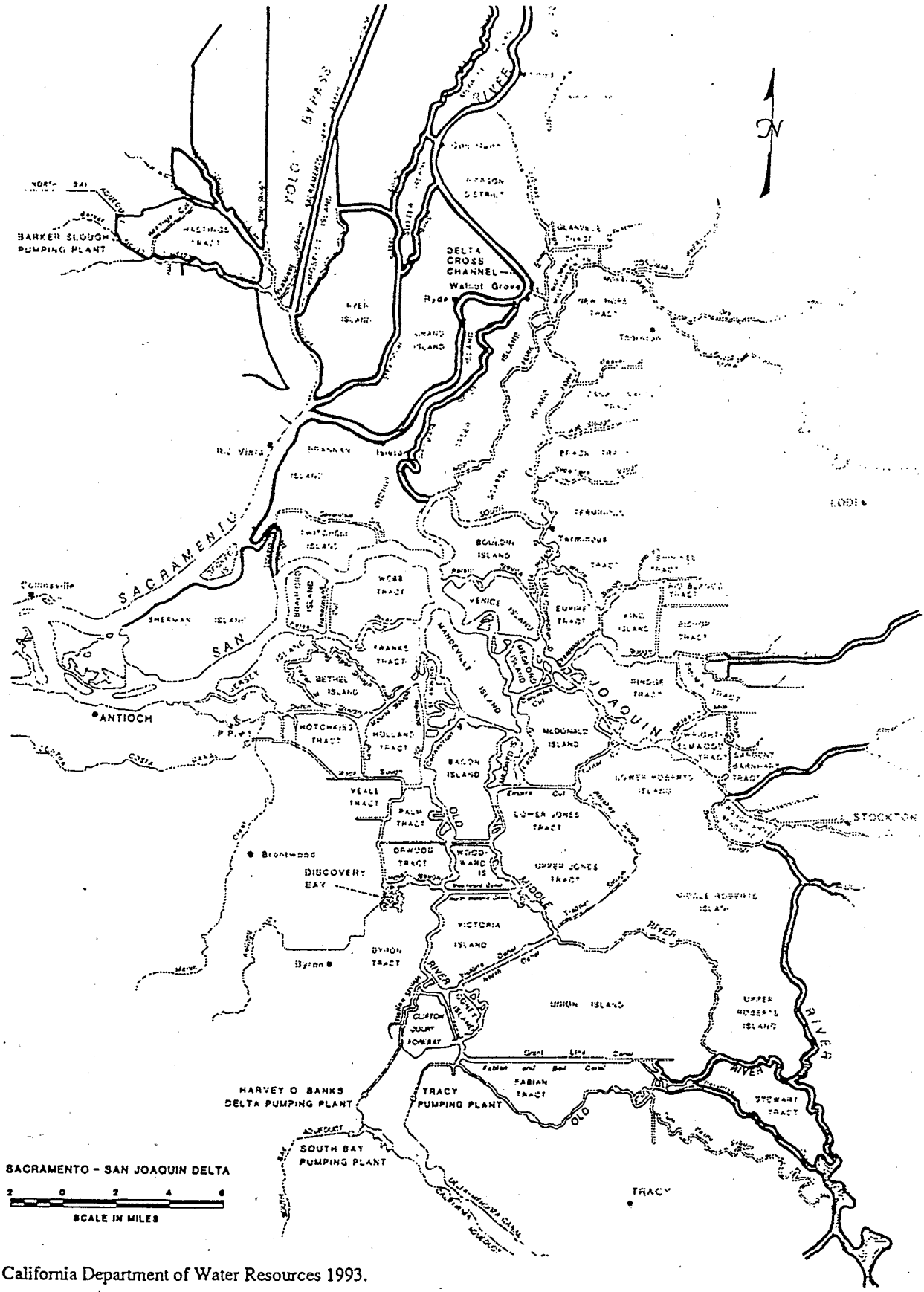
For each region, a general map will be provided.



Source: California Department of Water Resources 1993.

Figure
Land Surface below Sea Level

C-070794



Source: California Department of Water Resources 1993.

Figure
Project and Nonproject Levees in the Delta

C-070795

Table Flood Stages in the Delta

Gaging Station	50-Year	100-Year
Sacramento River		
Collinsville	6.3	6.4
Three-Mile Slough	7.7	7.9
Rio Vista	8.3	8.7
Walnut Grove	14.4	15.0
Snodgrass Slough	20.1	20.6
I-Street	30.4	31.4
San Joaquin River		
Antioch	6.3	6.5
Three Mile Slough	6.3	6.4
San Andreas Landing	6.8	7.0
Venice Island	7.1	7.4
Rindge Pump	7.2	7.4
Burns Cutoff	7.4	7.6
Brandt Bridge	14.9	17.0
Mossdale	22.4	25.0
Old River		
Rock Slough	6.8	7.2
Byron Tract	7.3	7.6
Clifton Court	7.5	7.8
Tracy Bridge	8.8	9.2
Middle River		
Bacon Island	6.9	7.2
Borden Highway	7.3	7.6
Mowry Bridge	12.8	13.4
Other Stations		
Grant Line Canal at Tracy Bridge	8.8	9.2
Mokelumne River at New Hope Landing	13.4	14.0
Georgiana Slough at Mokelumne River	7.5	7.8

Source: U.S. Army Corps of Engineers. 1993b

For each region, typical flood stages will be provided.

Table 5-X
DELTA REGION RESOURCE ELEMENTS AND IMPACTS OF ACTIONS ON FLOOD MANAGEMENT

Resource Element	Flood Related Actions	Total Acreage or miles Affected	Significant Impact on Flood Management
Stream Flows	Provide pulse flows in spring and early winter, provide minimum flow of 13,000 cfs into Delta from Sacramento in May,	NR	no
Delta Channel Hydraulics	Reduce flows in selected channels by increasing cross-sectional area of channels via set-back levees or constructing constrictions, Construct network of channels within the Yolo Bypass and connect Putah and Cache Creek sinks, and potentially the Colusa Drain to the Delta; Reduce constrictions in the Yolo Bypass such as openings in railways causeway that parallels Interstate 80.	Unknown 50 to 100 miles of tidal channels in southern Yolo Bypass. 900 - 2,300 acres	yes yes
Water Temperature	none		no
Floodplain Inundation and Sediment Retention	Convert selected leveed lands to tidal marsh/slough complexes, construct set-back levees, connect dead end sloughs, construct overflow basins.		yes
Food Web			no
Levees and Bank Protection	Modify levee and berm vegetation management practices on water side of levee. This may reduce mannings n values and erosion potential.		no
Dredging	may reduce stage		no
Exotic Species			no
Predators			no
Unscreened and Poorly Screened Diversions			no
Contaminants			no

Boat Wake Erosions	may reduce erosion along levees		no
Illegal and Legal Harvest of Fish and Wildlife			no
Shallow Water Habitat		7,000 acres	no
Non-tidal Perennial Aquatic Habitat		2,000-2,500	no
Tidal Slough Habitat			no
Seasonal Wetland Habitat		34,000	no
Riparian Scrub Habitat	Obtain conservation easements or purchase from willing sellers land needed to restore habitat along newly created sloughs and sloughs with new levee setbacks, and along new or upgraded Delta Levees...	15 to 25 linear miles along Delta island levees throughout the delta Ecological Unit to create corridors of riparian vegetation of which 60 percent is greater than 75 ft wide with 10 percent no less than 300 feet width and one mile in length.	no
Riparian Woodlands			no

Tidal Emergent Wetland Habitat	applies to areas discussed in Floodplain Inundation and Sediment Retention		yes
Non-tidal Emergent Wetland Habitat		15,000	no
Mid-channel Islands		<1000	no

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