

Draft

Environmental Impact Statement

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

Proposed Plan for Flood Control, Recreation,
and Fish and Wildlife Enhancement in the
Sacramento-San Joaquin Delta, Contra Costa, Sacramento,
and San Joaquin Counties, California

The responsible lead agency is the U.S. Army Engineer District, Sacramento. The responsible cooperating agency is the California Department of Water Resources.

Abstract: The Sacramento-San Joaquin Delta is located in central California where the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras Rivers converge forming an 1,100-square-mile network of sloughs and islands. About 531,000 acres of prime farmland is protected from flooding by a series of levees with many in critical need of reconstruction. In addition, the Delta provides habitat for numerous fish and wildlife species. The resources and the extensive waterways make the Delta an important recreation area. Recognizing a need to protect the Delta, Congress authorized the Corps to determine the need for improved flood control measures and to specifically investigate means to preserve scenic values and enhance recreation and related opportunities. Currently there are five candidate plans under consideration: No Action; Incremental Flood Control Plan (Selected and National Economic Development Plans); System Flood Control Plan (Environmental Quality Plan); Modified System Flood Control Plan; and Polder Flood Control Plan. Each candidate plan would provide varying amounts of flood control, recreation and fish and wildlife habitat and would impact the following significant resources: esthetics, vegetation, agriculture, fish, wildlife, and cultural. The Incremental Flood Control Plan has been tentatively selected as the plan best meeting the National Economic Development goal and as an important contributor to the Environmental Quality goal (Figure 12 of main report). The purpose of this environmental impact statement (EIS) is to describe the environmental impacts of the proposed action. The draft EIS is being circulated to interested agencies, organizations, and individuals for review and comment. Comments received will assist in determining any additional impacts of the project and will be utilized in preparing the final EIS.

SEND YOUR COMMENTS TO THE
DISTRICT ENGINEER BY (date: 45 days from transmittal date)

If you would like further information on this EIS, please contact: Mr. Ray Williams at the above address or telephone (916) 440-3429 or FTS 448-3429.

NOTE: Information displays, maps, etc., discussed in the Sacramento-San Joaquin Delta main report and the plan formulation appendix are incorporated by reference into the EIS.

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ATTACHMENTS

Section 404 Evaluation
 FWS Coordination Act Report
 FWS Endangered Species Informal Consultation Response

1.0 Summary

1.1 Major Conclusions and Findings. - Five candidate plans for flood protection and associated recreation and fish and wildlife enhancement are described: The Incremental Flood Control Plan is the National Economic Development Plan (NED) and would provide 300-year flood protection to 15 islands which are economically feasible on an individual basis. This plan has been selected as the best solution for Delta flood control, recreation, and fish and wildlife problems. The System Flood Control Plan is the Environmental Quality (EQ) Plan and would provide 300-year protection to 54 major islands and tracts in the study area. The Modified System Flood Control Plan would improve 36 flood-prone islands (islands with less than 50-year flood protection) and provide 300-year flood protection. The Polder Plan would provide 300-year flood protection in 2 polders and 11 individual islands with a total of 15 islands protected. The No Action Plan provides no action by the Federal Government to resolve the flood, recreation, and fish and wildlife problems. The rationale for designation of these plans is described in the main report, Plan Formulation section.

The selected plan would provide flood protection to agriculture and limited urban areas; it would reduce the frequency of salinity intrusion attributable to a levee failure and provide improved public recreation and fish and wildlife habitats. Impacts associated with each of the four structural plans are comparable, but differ in intensity. The No Action Plan has temporary adverse impacts and potential long-term adverse impacts during periods of low Delta outflow. The significant resources adversely impacted with the structural alternatives are esthetics, vegetation, agriculture, fish, and wildlife. The adverse impacts to these resources result from the removal of riparian and emergent habitat due to levee rehabilitation. Also, agricultural land will be lost due to levee improvement; however, this would be offset by the overall flood protection received and by purchase of the land at fair market value. Possible impacts to cultural resources cannot be identified until a detailed field survey is completed. Mitigation of adverse impacts and enhancement would be provided as part of the selected plan. Sections 3 and 5 provide a more detailed description of the alternatives and their impacts.

1.2 Areas of Controversy. - Potential areas of controversy include impacts to esthetics, vegetation (riparian, upland, wetland), and fish and wildlife resources. Also, proposed recreation development at certain sites may create controversy due to landowners concerns over trespass, litter, vandalism, law enforcement, etc. There may be additional areas of concern identified upon coordination of this report.

1.3 Unresolved Issues. - There is one primary unresolved issue: adverse esthetic impact. Flood control levees, often with rock protection, conflict with scenic and natural values. Levees have been constructed at the water's edge, and this is the area where public concern over natural and scenic values is focused. The levees have been constructed and maintained over a period of about 100 years, but their foundations continue to consolidate. The peat soil provides inadequate levee building material, and expensive designs and maintenance are required. New project levees must be located upon the existing foundations to avoid expensive alternative engineering solutions. Riparian and emergent habitat provides valuable and desirable scenic and natural resources on the levees but cannot be permitted for safety of the levees unless expensive overbuilding of the levees is provided. Resolution of the esthetics conflict is difficult and may not be possible, although resolution of related problems for fish and wildlife habitat loss has been achieved. Even the no action alternative could result in a long-term loss of the very resources the public is concerned about as islands fail and are either permanently inundated or expensively repaired as in the past.

1.4 Relationship to Environmental Requirements. - The relationship of each alternative to Federal, State, and local environmental law, executive orders, and other policies is given in Table 1-1. Coordination will assist in further clarification of the relationship of the alternatives to the cited requirements. Following is a brief discussion of the requirements and their application. A more detailed discussion is presented in Sections 4 and 5 of the EIS (e.g., see cultural resources discussion in these sections for further data and requirements of the Archeological and Historic Preservation Act).

a. Archeological and Historic Preservation Act. - The alternatives are in partial compliance. Coordination with the National Park Service has been initiated and will be continued. If a project is authorized, further

TABLE 1-1

COMPLIANCE OF ALTERNATIVES WITH ENVIRONMENTAL REQUIREMENTS 1/ 2/

	No Action Alternative	Incremental Plan (NED, Selected Plan)	Modified Plan	System Plan (EQ Plan)	Polder Plan
(Refer to text following paragraph 1.4 for explanation of these compliance notes.)					
FEDERAL STATUTES					
Archeological and Historic Preservation Act, as amended, 16 USC 469 et seq		Partial	Partial	Partial	Partial
Clean Air Act, as amended, 42 USC 7401 et seq		Partial	Partial	Partial	Partial
Clean Water Act, as amended, 33 USC 1344		Partial	Partial	Partial	Partial
Coastal Zone Management Act, as amended, 16 USC 1451 et seq	N/A	N/A	N/A	N/A	N/A
Endangered Species Act, as amended, 16 USC 1531 et seq		Full	Full	Full	Full
Estuary Protection Act, 16 USC 1221 et seq	N/A	Full	Full	Full	Full
Federal Water Project Recreation Act, as amended, 16 USC 668aa-668ee		Full	Full	Full	Full
Fish & Wildlife Coordination Act, as amended, 16 USC 661 et seq		Partial	Partial	Partial	Partial
Land & Water Conservation Fund Act, as amended, 16 USC 4601-11 et seq		Full	Full	Full	Full
Marine Protection Research & Sanctuaries Act, 33 USC 1401 et seq	N/A	N/A	N/A	N/A	N/A
National Historic Preservation Act, as amended, 16 USC 470a et seq		Partial	Partial	Partial	Partial
National Environmental Policy Act (NEPA), as amended, 42 USC 4321 et seq		Full	Full	Full	Full
Rivers & Harbors Act, 33 USC 401 et seq		Full	Full	Full	Full
Watershed Protection & Flood Preservation Act, 16 USC 1001 et seq	N/A	N/A	N/A	N/A	N/A
Wild & Scenic Rivers Act, as amended, 16 USC 1271 et seq	N/A	N/A	N/A	N/A	N/A
EXECUTIVE ORDERS, MEMORANDA					
Flood Plain Management (E.O. 11988)		Full	Full	Full	Full
Protection of Wetlands (E.O. 11990)		Full	Full	Full	Full
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	N/A	N/A	N/A	N/A	N/A
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 11 Aug 80)		Partial	Partial	Partial	Partial
LOCAL POLICIES					
Sacramento County General Plan		Full	Full	Full	Full
San Joaquin County General Plan		Full	Full	Full	Full
Contra Costa County General Plan		Full	Full	Full	Full

1/ It is expected that, as planning proceeds, the selected plan will be in full compliance with all requirements.

2/ The compliance categories are assigned based on the following definitions:

- a. Full: all requirements of the statute, E.O., or other policy and related regulations have been met.
- b. Partial: some requirements of the statute, E.O., or other policy and related regulations remain to be met.
- c. Noncompliance: none of the requirements of the statute, E.O., or policy and related regulations have been met.
- d. N/A: statute, E.O., or policy not applicable.

reconnaissance and intensive surveys will be conducted and coordinated to achieve agreements among the responsible agencies. Post-authorization mitigation costs have not been estimated but are expected to be less than the 1 percent of project costs.

b. Clean Air Act. - The alternatives are in partial compliance. Federal, State, and local air requirements will be included in detailed design studies after project authorization and coordinated with the concerned agencies. No difficulty is anticipated for achieving compliance with the State Implementation Plan.

c. Clean Water Act. - The alternatives are in partial compliance. An evaluation in accordance with Section 404(b)(1) of the Clean Water Act is attached. Processing of this EIS and evaluation to the Congress in accordance with Section 404(r) of the Act will complete the process to obtain an exemption from further regulation under Sections 301(a), 402, and 404 of the Act and will bring the project into compliance.

d. Endangered Species Act. - The alternatives are in full compliance. FWS provided a listing of 8 endangered species and 14 candidate species occurring in the Delta. A biological assessment and an informal consultation with FWS on the peregrine falcon have been completed. These results indicate there will be no significant impacts on endangered species, and the proposed project is in full compliance.

e. Estuary Protection Act. - Delta waters are freshwater extensions of the San Francisco Bay estuary which is important to anadromous fish. The comments of FWS (for the Secretary of the Interior) have been requested concerning the effects of the selected plan on estuary resources. This information will be incorporated into the final EIS to bring the plan into full compliance.

f. Federal Water Project Recreation Act. - The alternatives are in full compliance. A recreation plan was developed and coordinated. The Resources Agency will be asked to furnish the letter of intent for non-Federal support of developing the plan as required by Public Law 89-72.

g. Fish and Wildlife Coordination Act. - The alternatives are in partial compliance. The FWS Draft Coordination Act Report is attached. Coordination is continuing with fish and wildlife agencies to refine mitigation and enhancement measures.

h. Land and Water Conservation Fund Act. - The alternatives are in compliance. No LWCF funds have or will be used or credited for non-Federal cost sharing included in the selected plan.

i. National Historic Preservation Act. - The alternatives are in partial compliance. The selected plan would be in full compliance upon completion of the intensive surveys and, if necessary, the execution of a Memorandum of Agreement with the President's Advisory Council on Historic Preservation and the State Historic Preservation Officer for any National Register eligible sites. These activities would be accomplished during advance planning if a project is authorized.

j. National Environmental Policy Act (NEPA). - The alternatives are in compliance. This DEIS has been prepared in accordance with NEPA regulations issued by the Council of Environmental Quality. Filing of the Final EIS and Record of Decision with the Environmental Protection Agency will complete the process.

k. Rivers and Harbors Act. - The three alternatives identified as in full compliance would not obstruct navigable waters. Although polders would obstruct some navigable waters, the Polder Plan would be in full compliance if chosen as the Selected Plan and authorized by the Congress.

l. Flood Plain Management (EO 11988). - The alternatives are in compliance. The project selected would assist in implementing the requirements of the Executive Order and, in addition, requirements of local cooperation will be specified as part of project authorization to allow only appropriate land use changes and development in the protected area.

m. Protection of Wetlands (EO 11990). - The alternatives are in compliance; although there will be a loss of wetland as a result of the project, there is no practicable alternative, and wetland losses will be

mitigated. Fish and wildlife enhancement included in the selected plan will include some wetland improvements resulting in an overall wetland increase.

n. Prime and Unique Farmlands. - The alternatives are in partial compliance. The Soil Conservation Service (SCS) has not completed surveys of the area to determine prime and unique values, but informal advice indicates all the farmlands are prime farmlands. Coordination of the EIS with SCS will bring the alternatives into full compliance.

o. Local Policies. - Local land use plans from Sacramento, San Joaquin, and Contra Costa Counties were reviewed to assist in the planning process. The alternative plans are consistent with local desires for the Delta.

1.5 Other Informative EIS's. - The following Corps EIS's also provide data useful to understanding Delta conditions, resources, and impacts of additional work such as described in the selected plan:

a. San Francisco Bay to Stockton, California (John F. Baldwin and Stockton Ship channels), September 1980. (accompanies the general design memorandum)

b. Operation of the Delta pumping plant, 12 September 1980. (concerning Corps 404 permit to State of California)

c. Sacramento River Deep Water Ship Channel, California, Final Feasibility report, July 1980.

2.0 Need for Project

2.1 Study Authority. - Congress authorized the Corps of Engineers to determine the need for improved flood control measures in the Delta and to specifically investigate means to preserve scenic values and preserve and enhance recreation and related opportunities. The Corps of Engineers has undertaken this study as a joint effort with the California Department of Water Resources (DWR). The California State Legislature authorized DWR to develop a plan to improve flood protection in the Delta. DWR published Bulletin No. 192 in 1975, "Plan for Improvement of the Delta Levees," which presented possible courses of action for improvement of levees, recreation, and fish and wildlife habitat. DWR plans to report to the legislature in 1982. The feasibility report of the Corps, along with the EIS, will be presented to the Congress for Federal authorization of a joint project.

2.2 Public Concerns. - There is a considerable amount of interest in preserving present uses in the Delta and concern about the need for levee rehabilitation and improved flood protection. Public concerns have been voiced widely in the news media and at public meetings and workshops held for this investigation. The primary concern expressed has been to preserve the Delta essentially as it is. Also, there is a desire to protect the scenic quality of the Delta, particularly the riparian and wildlife habitat along the levees. The public desires to continue to expand recreation and fish and wildlife uses of the Delta. Additional items that have been of particular concern to reclamation districts, landowners, and farming interests include the high cost of a project, equitable cost sharing for construction and maintenance, and potential conflicts between public and private use. Environmental and conservation agencies and local environmental interests want environmental protection incorporated into any plan for rehabilitation of Delta levees, particularly protection from potential adverse impacts on fish and wildlife resources. They also generally endorse the need for additional recreation and fish and wildlife enhancement opportunities. The State of California has indicated interest in sponsoring an acceptable Federal flood control plan and has expressed a preference for at least 100-year flood protection for urban islands and 50-year flood protection for agricultural islands. The State is also willing to sponsor desirable recreation and fish and wildlife enhancement developments.

2.3 Planning Objectives. - This study has been conducted as a joint effort by the Corps and DWR to determine Federal and State interest in providing flood protection, recreation facilities, and fish and wildlife enhancement. Protection of agriculture and existing land uses, preservation of scenic values, and control of tidal intrusion have also been important factors studied.

3.0 Alternatives

This chapter presents the various alternatives and discussion of comparative impacts. A detailed description of impacts and potential means of minimizing these impacts is provided in Section 5 of this report. Table 3-1 provides a listing of islands to be protected under the four structural plans. Table 3-2 lists the proposed environmental quality measures. Table 3-3 presents a comparison of each alternative and summarizes the impacts to the significant resources.

3.1 No Action Plan. - With this alternative, no action would be taken by the Federal Government to participate in resolving the flood, recreation, and fish and wildlife problems. The Delta developed from a prehistoric tule marsh underlain by up to 60 feet of peat soil resulting from decayed emergent vegetation. The marsh began to be converted to a leveed agricultural area in the 1860's. Since the conversion began, the interior of the islands has subsided up to 25 feet below sea level primarily because of oxidation and erosion, thus making flood protection increasingly difficult. During the past 50 years, 1930-80, about 40 failures have resulted in flood damage. Estimated failure rates for individual islands are shown on Figure 7 of the main report. Islands that have been flooded have had significant agricultural or urban improvements and practically all have had the levees repaired and the water pumped out. Further increases in open water would not provide as valuable a habitat for fish and wildlife as the present leveed islands provide. Open water areas on Donlon and Venice Cut islands (about 370 acres) will be filled with dredge materials as part of the San Francisco Bay to Stockton project, to bring these areas up to about mean sea level and reestablish a tule marsh. About \$50 million of public funds for emergency restoration of flood control structures and for emergency restoration pursuant to Presidential declaration of disaster (Public Law 93-288) were utilized in 1980 for restoration of Webb, Holland, Dead Horse, and Jones Tracts and for flood fighting on other islands.

Without a Federal project for the general improvement of the Delta, it was assumed that existing levees would be maintained at about their current condition. Island interiors are expected to continue to lower, with a resultant increase in the probability of levee failure. It was also assumed

TABLE 3-1
LIST OF ISLANDS FOR EACH ALTERNATIVE

INCREMENTAL FLOOD CONTROL PLAN

1. Andrus	6. Hotchkiss	11. Rindge
2. Bacon	7. Jones, Lower	12. Roberts, Lower
3. Brack	8. Jones, Upper	13. Terminous
4. Brannan	9. Mandeville	14. Tyler
5. Empire	10. McDonald	15. Webb

MODIFIED SYSTEM FLOOD CONTROL PLAN

1. Andrus	13. Holland	25. Rio Blanco
2. Bacon	14. Hotchkiss	26. Roberts, Lower
3. Bishop	15. Jones, Lower	27. Shima
4. Bouldin	16. Jones, Upper	28. Shin Kee
5. Brack	17. King	29. Staten
6. Bradford	18. Mandeville	30. Terminous
7. Brannan	19. McCormack-Williamson	31. Tyler
8. Byron	20. McDonald	32. Veale
9. Canal Branch	21. New Hope	33. Victoria
10. Coney	22. Orwood, Upper	34. Webb
11. Dead Horse	23. Palm	35. Woodward
12. Empire	24. Rindge	36. Wright-Elmwood

SYSTEM FLOOD CONTROL PLAN

1. Andrus	20. Jones, Lower	39. Roberts, Middle
2. Atlas	21. Jones, Upper	40. Roberts, Upper
3. Bacon	22. King	41. Sargent-Barnhart
4. Bethel	23. Mandeville	42. Sherman
5. Bishop	24. McCormack-Williamson	43. Shin Kee
6. Bouldin	25. McDonald	44. Shima
7. Brack	26. Medford ^{2/}	45. Stewart ^{1/}
8. Bradford	27. Mildred ^{2/}	46. Staten
9. Brannan	28. Mournian ^{1/}	47. Terminous
10. Byron	29. New Hope	48. Twitchell
11. Canal Ranch	30. Orwood	49. Tyler
12. Coney	31. Orwood, Upper	50. Union ^{1/}
13. Dead Horse	32. Palm	51. Veale
14. Drexler	33. Pescadero ^{1/}	52. Venice
15. Empire	34. Pico-Nagle ^{1/}	53. Victoria
16. Fabian ^{1/}	35. Quimby ^{2/}	54. Walnut Grove ^{1/}
17. Holland	36. Rindge	55. Webb
18. Hotchkiss	37. Rio Blanco	56. Woodward
19. Jersey	38. Roberts, Lower	57. Wright-Elmwood

^{1/} Levee improvements would only consist of levee shaping, erosion protection, and patrol roads. Maintenance would be required in accordance with standards prescribed by the Secretary of the Army and Section 221 of the 1970 Flood Control Act.

^{2/} Medford, Mildred, and Quimby Islands included in Wildlife Management Area.

POLDER FLOOD CONTROL PLAN

- | | | |
|------------------------|-------------------------------|-------------------------|
| 1. Andrus | 6. Hotchkiss | 11. Rindge |
| 2. Bacon ^{1/} | 7. Jones, Lower ^{2/} | 12. Roberts, Lower West |
| 3. Brack | 8. Jones, Upper | 13. Terminous |
| 4. Brannan | 9. Mandeville ^{1/} | 14. Tyler |
| 5. Empire | 10. McDonald ^{2/} | 15. Webb |

Note: Island marked ^{1/} or ^{2/} will be joined into respective polders.

that failed levees would be repaired and that flooded islands would be restored as they have been historically. It should be noted, however, that as the frequency of levee failure increases and as levee repair and island restoration costs increase, flooded islands may eventually not be restored to pre-flood conditions. The future availability of public funds may dictate whether flooded islands will be restored. Events following the 1980 Delta floods suggest that only limited Federal funds may be provided in the future (refer to Candidate Plans section in the main report).

A comparison of the following action plans with this No Action Plan indicates that there would be little or no project-caused impact to land based natural resources if the islands were not restored in the future. A larger benefit to water quality would result. Also, economic benefits would be increased for such a project evaluation. Therefore, under this "without restoration" scenario, significant adverse changes would be expected if no Federal action is taken to protect Delta islands from flooding.

3.2 Incremental Flood Control Plan. (NED and Selected Plan) - Levee improvements would be made on 15 islands which are economically feasible on an incremental basis. Figure 10 (main report) shows the islands to be protected. The levee improvements would provide 300-year protection (i.e., protection from a flood of a size expected to occur once in 300 years on the average). Most of these levees would be provided with erosion protection (e.g., rock riprap) on the waterside to within 1 foot of the crown. Some of the levees would have a 1 vertical to 15 horizontal landward slope on the lower portion to provide for stability and seepage control. This would be required on levees generally located in deep peat areas. Most of the levees would be constructed in stages. Initial levee enlargement would be followed by additional raising of the levee, where required and when necessary over a period of up to 80 years, to accommodate subsidence and to maintain design section. No trees or large shrubs would be allowed on the levees and landward slopes in the interest of levee safety. Grasses and ground covers would be permitted. Maintenance of the levees in accordance with standards prescribed by the Secretary of the Army would be required to insure safety and protection of the Federal investment. A requirement of local cooperation would include appropriate land use control to prohibit unwise future development on

agricultural lands within the Delta. For a more detailed description of the selected plan, refer to the Plan Formulation Appendix.

The selected plan includes 45 recreation sites and considerable recreation facilities (Figure 12 in main report). These are of four types: general recreation activities (picnicking, boat launching, fishing, camping, boat docks, support facilities); fishing access sites (parking and waterfront access); boater destination sites; and trails. These would be located on levees, on adjacent agricultural lands, and on already disturbed sites (for example, sites already cleared of vegetation for other purposes, etc.) and portions of many of them will be managed for wildlife resources. The selected plan includes 17 fish and wildlife enhancement developments (Figure 12 in main report). These developments were devised from the environmental quality planning process and from plans previously developed by others. One of these developments was identified as a potential National Wildlife Refuge on five islands (Quimby, Little Mandeville, Rhode, Mildred, and Medford); however, FWS has reservations about support of the wildlife refuge due to concern over high operation and maintenance costs for the levees, so it is now proposed as a Wildlife Management Area to be operated and maintained by non-Federal interests. A detailed description of the recreation and fish and wildlife enhancement plans can be found in the Plan Formulation Appendix. The selected plan also includes the mitigation and enhancement measures described in Section 5.

3.3 System Flood Control Plan. (EQ Plan) - Approximately 54 Islands and tracts would be provided with 300-year flood protection (Figure 8 in main report). This alternative plan consists of rehabilitating all nonproject levees on all islands in the study area regardless of the economic feasibility of individual islands. The levee design would be similiar to that described for the Incremental Flood Control Plan (Section 3.2). This plan includes the same recreation plan as the Selected Plan. All of the proposed fish and wildlife enhancement developments described in Table 3-2 would be provided. Fish and wildlife enhancement was developed during the EQ planning process. The EQ measures are discussed in more detail in the Plan Formulation Appendix.

3.4 Modified System Flood Control Plan. - This alternative plan provides protection to the seriously flood prone areas of the Delta; i.e.,

Table 3-2
EQ MEASURES

	<u>Acreage</u>
1. Bonetti Island	33
2. Coney Island	50
3. Disappointment Slough Channel Island	300
4. Eucalyptus and Widdows Island	120
5. Grand Island	100
6. Headreach, Fern, Lost Lake, Tule Islands	300
7. Middle River (Union Island)	45
8. Middle River and Latham Slough Channel	290
9. Old River Islands	220
10. Potato Slough Channel Islands	200
11. Sevenmile Slough	20
12. Spud and Hog Islands	295
13. South Fork Mokelumne River	10
14. Quimby, Little Mandeville, Rhode, Medford, Mildred Islands	3454
15. Webb Tract	230
16. Shin Kee Tract	50
17. Beaver Slough	50
18. Hog Slough	100
19. Mokelumne River	125
20. Trapper Slough	100

approximately 36 islands or tracts (Figure 9 in main report) that presently have less than 50-year flood protection -- a flood expectation of 2 percent or more in any 1 year. The islands would receive 300-year flood protection. The levee design and maintenance requirements would be similar to that described for the Incremental Flood Control Plan (Section 3.2). The Modified System Flood Control Plan includes the same recreation and fish and wildlife enhancement measures as described for the System Flood Control Plan.

3.5 Polder Flood Control Plan. - The polder plan provides for the construction of 2 polders and the rehabilitation of 11 individual island/tract levees not included in a polder (Figure 11 in main report). The two polders would be constructed by permanently closing Connection Slough between Mandeville and Bacon Islands and Empire Cut between McDonald and Jones Tracts. The sloughs and cuts would be closed by rockfill structures with no water circulation across the polder. The exterior levees of each pair of joined islands would be rehabilitated as described under the selected plan,

and interior levees along the closed waterways would be abandoned. Rehabilitation of levees on the other 11 islands would be as described under the selected plan. Further data on the channel closures is described in the basis for design section of the Plan Formulation Appendix. This plan includes the same recreation plan and fish and wildlife enhancement plans as the Selected Plan.

3.6 Plans Eliminated From Further Study. - Three structural alternatives were considered for alleviating the Delta's flood problem: levee rehabilitation, construction of downstream barriers, and construction of upstream dams. Although barriers could be used to control salinity intrusion, they would not improve flood protection in the Delta and would adversely affect fish and wildlife, navigation, and recreation. This alternative was therefore eliminated. The upstream dams alternative would provide limited flood protection to the Delta as well as limited economic and environmental justifications; this alternative was also dropped.

3.7 Comparative Impacts of Alternatives. - Table 3-3 provides the comparison of impacts on significant resources. A detailed description of the impacts is in Section 5.

TABLE 3-3
Comparative Impacts of Alternatives

Base condition and alternative plans	Soils	Water Quality	Esthetics	VEGETATION (acres impacted)					
				Riparian					Agricultural land (acres) Now available:
				Forested Now available: 2,730	Shrub-Scrub Now available: 4,340	Wetland (emergent) Now available: <u>2/</u> 11,960	Upland Now available: 44,450	Now available: 531,160	
Base condition ^{1/} and no action alternative	Continued impacts due to flooding and soil subsidence	Continued impacts from flooding	Continued loss due to levee failure and maintenance practices.	0	0	0	0	0	
Incremental Flood Control Plan	Reduced impacts due to flooding; continued subsidence	Water quality degradation following levee failures during periods of low Delta outflow would be reduced. Beneficial impacts increase as more islands are protected.	All structural alternatives will impact the esthetic quality of the Delta by removal of the riparian and wetland habitat along new levee section.	45	343	160 ^{1/}	1,257	1,126	
System Flood Control Plan	same as above			260	1,630	720	2,823	2,821	
Modified System Flood Control Plan	same as above			180	975	365	2,113	1,845	
Polder Flood Control Plan	same as above			45	343	152	997	981	

^{1/} Acreages taken from the Sacramento-San Joaquin Environmental Atlas for the legal Delta

^{2/} 60 percent will regrow by year 30.

TABLE 3-3 (Continued)
Comparative Impacts of Alternatives

	Aquatic ^{3/}	Wildlife ^{4/}		Cultural Resources	Recreation
	(miles of streamside land) Now Available: 700	To be given over to upland vegetation	Net gain after project		(millions of recreation-days gained) Present figure: 12.3 ^{5/}
Base condition and no action alternatives	0	0	0	Unknown for all alternatives	0
Incremental Flood Control Plan	165	2,771	1,514	Unknown for all alternatives	2.43
System Flood Control Plan	608	7,534	4,711	Unknown for all alternatives	2.43
Modified System Flood Control Plan	483	5,113	3,000	Unknown for all alternatives	2.43
Polder Flood Control Plan	157	2,366	1,369	Unknown for all alternatives	2.43

^{3/} The major impact to aquatic resources will result from loss of riparian/wetland habitat. The mile figures shown are the miles of levee work called for by each alternative.

^{4/} Wildlife impacts will result from loss of riparian/wetland habitat. Riparian and agricultural land lost will be converted into upland habitat. Unimpacted emergent habitat will remain emergent. The net gain in upland habitat is shown in the table.

^{5/} Actual use survey and projection Geidel and Moore, 1981. Approximately 45 recreation sites are included with all alternatives. These sites will increase visitation to the Delta, resulting in increased impacts to wildlife resources.

4.0 Affected Environment

4.1 Environmental Conditions. - This section briefly describes the major characteristics of the study area's natural and human resources. In order to prepare a concise EIS, only the most significant resources of the Delta are discussed here and in the environmental effects section. For a more complete description, refer to the main report. Resources considered significant include soil, water quality, esthetics, vegetation, agriculture, fish, wildlife, endangered species, cultural elements, and recreation which are described in detail in Section 4.2. The following environmental considerations are not known to be significant in consideration of this project and are not discussed in the environmental effects section.

Geology and Seismicity. - The Delta area lies on a foundation of schists, quartzite, crystalline limestone, and marble, all of which are intruded by igneous rock. Although traversed by several minor faults, the area shows little evidence of extreme crustal movements.

Climate. - The Delta climate is predominantly Mediterranean, influenced by moist marine air mass and a warmer inland air mass.

Air Quality. - In general, the air quality is good in the Delta and is affected by imported sources from the San Francisco Bay area and indigenous sources. The indigenous sources include automobiles, industrial emissions, agricultural burning, and peat storms. Oxidant levels at Stockton frequently exceed California standards; the main oxidant source is automobile exhaust. Sulfur dioxide levels usually fall within acceptable standards in San Joaquin County. The biggest problem in the Delta is the particulate material from agricultural burning and wind erosion of peat soils.

Hydrology. - Inflow to the Delta originates from three main sources: the Sacramento River; the San Joaquin River; and eastside rivers (Mokelumne, Cosumnes, and Calaveras). The islands in the study area currently have an estimated frequency of levee failure of up to 18 times per 100 years. Before upstream water storage projects were constructed, natural flows into the Delta were estimated at 29 million acre-feet annually. Most runoff occurred in winter and spring, when rain and snowmelt swelled the stream. Flows in late

summer and fall were very low, and saltwater penetrated far into the Delta, even as far as Sacramento and Stockton in extremely dry years. Currently about half of this annual inflow is stored and diverted upstream for agricultural and municipal and industrial use. In order to control salinity intrusion and maintain State water quality standards for the Delta during summer and fall, releases are made from upstream storage reservoirs.

Socioeconomics. The population in the study area has increased an average of only 0.5 percent per annum between 1960-1980 due to the rural character, while the total population of the three counties, which includes the study area, grew at a rate of 2 percent. The slow growth rate in the study area is expected to continue at about the same level in the future. The main sources of employment in the study area are provided by agriculture and service jobs related to summer recreation. Access to the Delta is limited. State Highways 4 and 12 bisect the Delta east and west. North and south, State Highway 160 follows the Sacramento River through the western portion of the Delta and Interstate 5 is near the eastern border. The State highways are two-lane roads with uncontrolled access. Local county and private roads are narrow and are often on top of the levees; many are not paved or continuous, and most private roads are not open for public travel. Little or no safe public parking areas are available along most of the waterways.

Land Uses. - The Delta is one of the richest agricultural areas in the United States. Agriculture in the Delta began with subsistence gardening during the Gold Rush, but because of the problems of drainage and flood protection, extensive crop cultivation was slow to develop. Prior to 1910, the reclaimed areas encompassed large areas of native marshlands considered usable only for seasonal grazing of livestock. Winter and spring flooding periodically covered approximately 70 percent of the Delta lands (1/2 million acres) making grazing during these times hazardous to livestock. This flooding promoted vigorous growth of native tules and marsh grasses with a nutritional value. Considering the vast area of California lands available for grazing at that time, the Delta was not of great economic importance. Mechanization; contract day labor; use of fertilizers; and the development of new crops, such as sugar beets, in the early 1900's are largely responsible for the transformation from grazing to field agriculture. Agriculture now represents the largest single use (76.6 percent) of Delta lands. Native areas

which include waterways represent 18.7 percent, with urban and recreational uses 4.7 percent.

4.2 Significant Resources. - Many of these resources are described in more detail in the Corps' "Sacramento-San Joaquin Delta, California Environmental Atlas" published by the Sacramento District in July 1979.

Soils. - Soils within the Delta are primarily organic and are generally comprised of peats, organic silts, and clays. The organic material ranges in depth from about 2 feet along the eastern edge of the Delta to a maximum thickness of 56 feet under Sherman Island, in the western Delta. The average depth is about 10 feet. With few exceptions, the mineral soils in the Delta are found along the eastern and southern perimeter, but even here the mineral soils are rich in organic matter or contain layers of organic material. As part of their Delta subsidence study, DWR mapped the thickness of Delta soils containing greater than 25 percent organics (Figure 4 of Plan Formulation Appendix). In general, organic soils are associated with the Delta freshwater marshes and river channels. Runoff from these soils is slow; also, the soils have a high permeability rate. Because of the high organic content, the soils are excellent for agriculture, but their productivity can be limited by the high ground water table. In addition to the purely organic soils, there are the mixed mineral-organic soils and accumulated mineral sediments and organic matter found in elevated and better drained areas. These soils are also excellent agricultural soils, but drainage problems and a natural high water table can reduce their productivity.

Delta soils have a high to very high shrink/swell potential and low strength for supporting the load of embankments, dikes, and levees. The soil volume is decreased substantially under load, and seepage through the soil is rapid. These factors cause a subsidence problem for levees. Another widespread subsidence problem is the general lowering of the islands' interior elevations, which may be as much as 3 inches per year in some locations. Ten islands in the central and western Delta have subsided between 12 and 21 feet since the time of their development. An additional 11 Delta islands have experienced 10 feet of subsidence. Many complex and interrelated factors contribute to the general soil subsidence in the Delta; some of the major factors include oxidation of organic soil, shrinkage (dewatering), and wind

erosion. Other less important causes of subsidence are compaction, withdrawal of natural gas and ground water, agricultural cultivation and burning practices, anaerobic decomposition, and possibly tectonic movement. Possible methods of slowing Delta subsidence have been discussed and evaluated by the California Department of Water Resources (DWR). The DWR has determined that the present rate of approximately 3 inches per year of Delta subsidence might be reduced by an average of 30 percent if preventive measures are implemented. However, subsidence of Delta soils probably could not be reduced more than 30 percent as long as present agricultural uses of the islands continue (DWR, 1980). Figure 5 of the Plan Formulation Appendix and Table 4-1 identify the location and degree of subsidence in the Delta (the figures show approximate depths below msl).

TABLE 4-1

LOCATION OF GREATEST AMOUNTS OF DELTA SUBSIDENCE
(Since Reclamation of the Particular Island or Tract)

<u>Location</u>	<u>Amount</u>		<u>Location</u>	<u>Amount</u>	
	<u>Metres</u>	<u>(feet)</u>		<u>Metres</u>	<u>(feet)</u>
Tyler Island	6.4	(21)	Holland Tract	3.0	(10)
Brannan Island	5.2	(17)	Jersey Island	3.0	(10)
Webb Tract	5.2	(17)	Lower Jones Tract	3.0	(10)
Mandeville Island	4.6	(15)	Medford Island	3.0	(10)
Sherman Island	4.6	(15)	Mildred Island	3.0	(10)
Venice Island	4.6	(15)	McDonald Island	3.0	(10)
Bacon Island	4.3	(14)	Orwood Tract	3.0	(10)
Bouldin Island	4.3	(14)	Palm Tract	3.0	(10)
Upper Jones Tract	4.0	(13)	Twitchell Island	3.0	(10)
Lower Roberts Island	3.7	(12)	Victoria Island	3.0	(10)
			Woodward Island	3.0	(10)

Source: California Department of Water Resources, August 1980.

Water Quality. - The quality of the water-related environment of the Bay-Delta estuarine system is dependent on many interrelated factors, including but not limited to adequate freshwater flows; positive downstream net flows; a long and gradual salinity gradient; prevention of significant increases in agricultural wastewater inflows; adequate collection,

treatment, and disposal of wastes; and retention of levees in the Delta to maintain the tidal prism and avoid added evaporation. During high tides, saltwater moves through the bay and into the Delta, although the general "mixing zone" is in the Carquinez Straits. The higher the tide and the lower the freshwater flow, the greater the amount of saltwater that moves into the Delta. The Sacramento River, with about 85 percent of the net flow to the Delta, is controlled by Shasta, Oroville, and other dams for flood control and to maintain the concentration of salts at a level that would not be harmful to crops in the vicinity of Antioch and Pittsburg. Due to timely and substantial releases from the upstream dams, saltwater intrusion has not caused any major problems in the eastern Delta since 1944. Saltwater intrusion accompanies levee failures that occur during periods of low Delta outflow. For example, in June 1972, the Andrus-Brannan Island levee failed, and saltwater was drawn upstream from the Bay as about 164,000 acre-feet of water inundated the island. Approximately 294,000 acre-feet of water was required to combat the salinity. At current costs (the cost of storage estimated for the Cottonwood Creek project), this release from storage would be valued at \$84 million. Freshwater is also lost due to evaporation from the increased surface area of the flooded island.

Crops have been damaged due to the high levels of salts which result from extensive reuse of river water for agricultural purposes; each time crops are irrigated, water is consumed, but little if any of the salt content is removed. Tributary streams which empty into the Delta carry an estimated 1.8 million tons of salts per year with Delta irrigation return flows contributing an additional 300,000 tons per year. Irrigation return flows and municipal effluents contain high concentrations of nutrients which produce an important food source and high concentrations of phytoplankton. When this mass of living algae is carried downstream, particularly from the relatively shallow, well-lit waters of the San Joaquin River system upstream of Stockton to the deeper, slow-moving waters of the Delta and the excavated ship channel, a large percentage of the algae do not receive enough sunlight for photosynthesis and die. These dead algae plus the oxygen demanding materials released from the Stockton area sewage treatment plants and canneries result in very low levels of dissolved oxygen for several miles downstream. At times the dissolved oxygen drops below the adopted standard of 5 parts per million and even gets so low that there are fish kills. The

low dissolved oxygen content is also believed to be a barrier to the upstream migration of salmon into the San Joaquin River system.

Agricultural return flows carry with them large concentrations of various agricultural biocides. These biocides are adsorbed by sediments and accumulate on the channel bottom. Though biocide levels in the Delta are not considered high enough to cause direct harm to man, there is concern over bioaccumulation in aquatic organisms inhabiting the Delta. Heavy metal concentrations are also high in the sediments. Zinc is particularly high in the Delta and, in several water samples collected by the Corps, was found to be three times higher than the objective levels developed by the Environmental Protection Agency. The source of this zinc appears to be from natural erosion in the Delta and watershed. Zinc is firmly attached to the surface of the sediment particles, and is not known to be harmful to aquatic organisms in this form.

Presently, bacterial concentrations are relatively high in the southern Delta, and in some locations coliform counts exceed standards for water contact sports. However, in other locations such as Brannan Island State Park, water quality is satisfactory for water contact sports. Bacteriological aspects of water quality are expected to improve in the future as a result of improved waste treatment measures being taken by State and local agencies.

Average annual water temperatures in the Delta are approximately 63°F (17°C), with maximum temperatures approaching 79°F (26°C) in the eastern and southern portions of the Delta. This maximum is close to the tolerance limits of many anadromous fish and is near the extreme high end of the range of tolerance of Neomysis shrimp, but well within the limits of most warmwater fishes.

There are deposits of subterranean freshwater in the Delta, but whether the deposits are isolated pockets or extensive aquifers is not known. In some parts of the Delta, such as at Pittsburg, excessive overdrafts for municipal and industrial water supply have induced infiltration of lesser quality water from the adjacent river. However, at Stockton a barrier formed by contact between alluvial sediment from the east and Delta deposits from

the west has effectively prohibited the movement of poor quality water from the river into the excellent quality ground water.

Esthetics. - The esthetic, or visual, resources of the Sacramento-San Joaquin Delta are varied, representing a complex setting of leveed islands, streamside vegetation, and open and confined waterways. By nature, visual resources are inherently intangible and qualitative, but there are a number of indicator conditions that are helpful in describing the visual quality of an area: Variety or diversity in the landscape; conditions of contrast; and the presence of water. The Delta waterways and adjacent levees afford varying degrees of variety and diversity. Viewed from a distance, the topography of the Delta lacks any significant features or changing patterns and appears as a flat, rather homogeneous landscape. However, near views of the Delta waterways and leveed islands, either from a terrestrial or water level vantage point, offer a significant amount of variety or diversity in the Delta-scape. This is especially evident in waterways and sloughs containing numerous small islands. Many of these areas are bordered by levees containing significant or substantial riparian vegetation which enhances the esthetic value of the waterway. Areas of high visual quality include the island-filled reaches of Middle and Old Rivers and Disappointment, White, and Fourteenmile Sloughs. The interiors of leveed islands offer broad, expansive views of agricultural lands with isolated small stands of natural vegetation and trees. Contrasts in the Delta are more evident when viewed from a water level vantage point. As an example, the water surface and riparian vegetation along the Mokelumne River and Snodgrass Slough contrast for abundant high visual quality. Quality is generally regarded as greatly diminished and poor where rock revetment has replaced significant vegetation and where effective levee maintenance allows little or no significant growth.

Vegetation. - The Sacramento-San Joaquin Delta is a large interconnected water zone that supports a varied amount of vegetative cover types, such as freshwater marsh, riparian vegetation, valley grassland, and cultivated agriculture. Much of the native vegetation found within the Delta region has been eliminated by man in the development of agricultural, urban, and industrial areas. A few areas still exist, mainly within the freshwater marshland cover types which represent a fragment of the historic marshland.

Estimates of tidal and nontidal freshwater marsh in the Delta vary from 9,000 to 11,000 acres (USFWS, CDFG, 1980). Much of the tidal marshes consist of narrow bands of tules along the margins of islands and in sediment accumulation along the base of levees. Other sediment deposits associated with channel meanders have formed nonleveed channel islands. These nonleveed channel islands are a habitat complex with usually a mixture of riparian species in less frequently inundated zones and marsh vegetation in lower elevation areas. The most significant marshland areas are nonleveed tidal islands within the channels of Old and Middle Rivers and Disappointment Slough and the western tip of Sherman Island and Franks Tract. These islands contain primarily dense growths of tules, sedges (Carex spp.) and common reeds (Phragmites communis). Nontidal marshes are associated with lakes, irrigation canals, or other standing water behind levees. The freshwater marsh in the Delta is dominated by the presence of common tules (Scirpus acutus), cattails (Typha latifolia), and soft rushes (Juncus effusus). A number of spikerushes (Lisocharis spp.) and additional species of tules (Scirpus spp.) are present within this vegetative cover type.

Riparian habitat is of two types in the Delta: riparian woodland and riparian shrub-scrub. It has been estimated that riparian woodland which consists of large trees encompasses 2,700 acres and riparian shrub which consists of small willows and herbaceous vegetation, approximately 4,300 acres (COE, 1978). The vegetation normally associated with these areas includes willows (Salix spp.), cottonwoods (Populus fremontii), red alder (Alnus rubra), and dogwoods (Cornus spp.). Shrubs include California blackberry (Rubus vitifolius), wild rose (Rosa californica), and blue elderberry (Sambucus mexicana). Herbaceous riparian vegetation includes creek nettle (Urtica holosericea), California mugwort (Artemisia douglasiana), and slender aster (Aster exilis). Riparian vegetation is found along many levees and banks of the Delta.

The valley grassland vegetation cover type found within the Delta is dominated by a number of annual forbs and grasses. These include wild oat (Avena fatua), common foxtail (Hordeum glaucium), cheeseweed (Malva parviflora), and Italian rye grass (Lolium multiflorum). This habitat type is common on many levees and uncultivated fields. A number of valley oaks (Quercus lobata) and eucalyptus (Eucalyptus spp.) are also found. This cover

type is generally limited in area and is found only on the few undeveloped portions of islands (such as on Jersey Island and Bethel Tract) and are usually substantially influenced by grazing. At least one unnamed unleveed island in Old River near Fabian Tract exhibits the valley grassland habitat and contains numerous valley oaks.

Agriculture. - For 1976, the gross value of agricultural production was estimated at \$899 million. The agricultural vegetative cover type found throughout the leveed islands includes a number of economically important crops. This includes corn, milo, barley, asparagus, sugar beets, and orchard crops. According to informal advice from SCS (detailed surveys have not been completed), the Delta is predominantly prime farmland. But there are problems with soil subsidence, threat of flooding from levee failure, and water quality, and there are a number of uncultivated areas within the Delta. One substantial fallow area exists within Webb Tract north of the submerged Franks Tract. Many of the valley grassland species, including milk thistle, common yellow mustard, and yellow star thistle (Centaurea solstitialis) inhabit this and many waste and border areas within the agricultural vegetative cover type.

Fish. - The Delta contains 91 species of fish, with 17 found only in this system, and 11 species of native and introduced anadromous fish which are directly affected by Delta conditions (Moyle, 1976).

Both native and introduced fishes use marshes for spawning, nursery grounds, cover, and food sources. The vast reduction of tule marshes has contributed to the gradual reduction of many native fish, such as the Sacramento perch (Archoplites interruptus), Sacramento hitch (Lavinia exilicauda), Sacramento blackfish (Orthodon microlepidotus), hardhead (Mylopharodon conocephalus), Sacramento splittail (Pogonichthys macrolepidotus), Delta smelt (Hypomesus transpacificus), tule perch (Hysterocarpus traski), and the extinct thicketail chub (Gila crassicauda).

The dead-end sloughs provide the principal habitat for most of the resident species, such as white catfish (Ictalurus catus), brown bullhead (Ictalurus nebulosus), largemouth bass (Micropterus salmoides), and threadfin shad (Dorosoma petenense). The most important resident fish in the Delta, in

terms of numbers caught, are catfish. Catfish angling in California ranks second only to trout fishing, and one-third of the catfish caught in the state are caught in the Delta (Association of State Water Projects Agencies, 1976). Black crappie, bluegill, and warmouth are the most abundant species of the sunfish family caught in the Delta. The juvenile white catfish feed primarily on neomysis shrimp, Corophium sp. and tendipedid insect larvae, whereas the adults feed on neomysis, amphipods, and tendipods. Neomysis shrimp and Corophium sp. are important food items for sunfish.

Anadromous fish which spawn in or upstream from the Delta include chinook salmon (Oncorhynchus tshawytscha), striped bass (Morone saxatilis), sturgeon (Acipenser spp.), steelhead (Salmo gairdneri gairdneri), and American shad (Alosa sapidissima). There are three runs of chinook salmon, fall, winter, and spring. The fall run is the largest beginning in August, reaching a peak in late September and declining through late January. The winter migration commences in December and lasts through May, with the salmon spawning in May or June. Spring run salmon enter freshwater about April, and spawn in the upper rivers from September through November. The winter run salmon pass through the Delta in the winter but do not spawn until the following May or June. Salmon fingerlings on their seaward migration are most abundant in the estuary between February and July. They apparently remain in brackish water until they become acclimated to saline conditions. Copepods, neomysis, isopods, and polychaete worms are considered to be the dominant food organisms for the fingerlings. The adults do not feed while in freshwater. Natural production of fall run salmon in the Sacramento River system is supplemented by the production of three hatcheries - Coleman on Battle Creek, Feather on the Feather River, and Nimbus on the American River. The two most important factors affecting upstream chinook salmon migration are dissolved oxygen concentrations and temperature. Dissolved oxygen (DO) levels below 6 milligrams per liter (mg/l) are considered unsuitable for salmonid migration. A similar DO requirement exists for the downstream migrating juveniles, which migrate downstream between February and April (Bureau of Reclamation, January 1978). Chinook salmon are reluctant to ascend the rivers whenever water temperatures exceed 69°F (21°C) (California Department of Fish and Game, June 1972).

Steelhead are present in the Sacramento River at all times considering both upstream and downstream migrants, but the bulk of the spawning fish move upstream in the fall and winter. After hatching, young steelhead remain in freshwater for 2 or more years. Young steelhead migrate downstream through the Delta primarily during the spring. Unlike salmon, steelhead may spawn more than once. They migrate to sea at various cycles throughout a long seasonal period. Adult steelhead probably do not feed in the Delta.

Striped bass, first introduced into the Sacramento-San Joaquin River system in 1879, are a popular game fish of the Delta. In the fall, some adults move upstream into the Delta, but most winter below the Carquinez Strait. In the spring, most adults move upstream to spawn. Striped bass spawning location is primarily a function of flows which determine temperature and salinity. Spawning usually begins when water temperatures reach 59°F (15°C) and peaks when temperatures are in the 59° to 67°F (15° to 20°C) range. Such temperatures are usually encountered in the Delta between April 25 and May 25 and from 2 to 3 weeks later in the Sacramento River. Studies indicate that substantial striped bass spawning occurs at salinities no higher than 600 mg/l TDS (CDFG, 1966). Ideal salinities for spawning have been estimated at 180 mg/l (USBR, January 1969). Neomysis is the dominant food of young striped bass, but other food items such as copepods, cladocerans, Corophium, and tendipedid or midge larvae are also important. Subadult and adult striped bass prefer small bass and threadfin shad, although neomysis are still consumed. Most bass spend their first summer within a few miles of the confluence of the Sacramento and San Joaquin Rivers. Survival of young-of-the-year striped bass is positively correlated with flows into the estuary (Department of Water Resources, 1974).

Another important anadromous sport fish is the introduced American shad. Most shad spawn in the upstream tributaries with some believed to spawn in the Delta. Young shad are abundant in the Delta from July through November but migrate out of the Delta to the bay and ocean in the fall. Adults feed mainly on neomysis, copepods, cladocerans, and aquatic worms.

White sturgeon and green sturgeon are native to the Delta with white sturgeon being the more abundant and the most frequently caught by anglers. Sturgeon are anadromous with some individuals reaching several hundred

pounds. The Delta is an important summer nursery area during years when spring runoff is high; also, the Delta and Suisun and San Pablo Bays are known to be areas of great importance to the older juveniles.

The Delta is rich in planktonic organisms which provide the base for the aquatic food chain. Phytoplankton, the microscopic, drifting, often unicellular plants, have been reported with concentrations on the San Joaquin River at Mossdale as high as 70 million cells per liter. Zooplankton are small, free-swimming or drifting animals that feed primarily on phytoplankton and detritus with their distribution controlled largely by tides, currents, and wind. Zooplankton are consumed by shrimp and small fish with two groups, the cladocerans and copepods, roughly equal in abundance throughout the freshwater part of the Delta. Neomysis, an abundant and extremely important zooplankton species in the Delta, is the principal food of young fish, notably striped bass. Distribution of the neomysis appears to respond directly to salinity and velocity of flow, although it may also be related to food supply. Their abundance is dependent upon temperature and dissolved oxygen concentrations. Their populations are high from June through August with greatest abundance occurring from Suisun Bay to Antioch. The zoobenthos are sedentary and mobile species which live on or within the bottom substrate; these are important food items for fish and waterfowl. In fact, 138 species have been identified in the Bay-Delta system.

Wildlife. - Diverse and abundant species of reptiles, amphibians, birds, and mammals inhabit the complex habitat in the Delta created by the combination of open waters, tidal marshlands, riparian vegetation, valley grasslands, and agricultural lands. The marshland habitat provides cover, food, and nesting sites.

The Sacramento-San Joaquin Delta is valuable habitat for a number of reptile and amphibious species. Although the marshland areas support number of different species, the majority of species are associated with valley grasslands and adjacent wet areas. Reptile species such as the western fence lizard (Sceloporus occidentalis) and the common kingsnake (Lampropeltis getulus) are found in grassland habitat, while the western turtle (Clemmys marmorata) is associated with wetland or riparian habitat. Many of the common amphibians located in the study area are found in

freshwater habitats. They include such species as the common bullfrog (Rana catesbeiana) and the western toad (Bufo boreas halophilus). In habitats adjacent to these freshwater habitats, the northern rough-skinned newt (Tarhicha granulosa granulosa) and the yellow-eyed salamander (Ensatina eschscholtzi xanthoptica) may be found.

There are over 225 species of birds occurring in the Delta. Waterfowl and shorebird species are found throughout the waterways and wetlands, which are associated with agricultural lands; and a majority of these species are migratory. Species of waterfowl include whistling swan (Olor columbianus), snow goose (Chen caerulescens), various subspecies of Canada geese (Branta canadensis), pintail (Anas acuta), mallard (A. platyrhynchos), and American coot (Fulica americana). The shorebird and associated species include great blue heron (Ardea herodias), sandhill crane (Grus canadensis), spotted sandpiper (Actitis macularia), Forsters tern (Sterna forsteri), and great egret (Casmerodius albus). Within the waterways and marshland environments, these species utilize small mollusks, fish and crustaceans, as well as submerged or emergent aquatic vegetation. Waterfowl primarily utilize the thousands of acres of Delta grain crops that are flood irrigated to leach salts out of soils on a seasonal basis. These areas of corn, milo, and barley provide high quality feed and resting areas for migrating waterfowl. Passerine or songbird species are found in great numbers. Most of these species are associated with the riparian vegetative cover type because it provides excellent habitat conditions for these birds. Passerine species such as northern oriole (Icterus galbula), white-crowned sparrows (Zonotrichia leucophrys), American goldfinch (Carduelis tristis), and rufous-sided towhees (Pipilo erythrophthalmus) utilize the tree, shrub, and herbaceous plant species of this habitat. Other passerine species are associated with grassland and agricultural areas, including western meadowlarks (Sturnella neglecta) and American robins (Turdus migratorius).

species such as hawks and owls nest within the larger trees of the riparian and grassland habitats and feed on small mammals that inhabit the riparian areas of the Delta. Marsh hawks (Circus cyaneus), red-tailed hawk (Buteo jamaicensis), American kestrels (Falco sparverius), burrowing owl (Chene cucularia), and turkey vultures (Carthartes aura) are the most commonly observed raptors found in the Delta. Upland game species found in the Delta are associated with valley grassland, riparian, and

agricultural habitats. Their abundance and species composition vary seasonally and depend, to a large extent, upon the type of agricultural crops cultivated. The upland game species commonly found in the Delta include ringed-necked pheasants (Phasianus colchicus), California quail (Lophortyz californicus), and mourning dove (Zenaida macroura). Food, water, and cover available in areas adjacent to waterways provide excellent habitat for quail and dove. The extensive agricultural areas of the Delta bordered by riparian and hedgerow vegetation provide suitable habitat for pheasant.

Semiaquatic and terrestrial mammals are abundant in the Delta, due to the large areas of farmlands, the isolation from large urban areas, and the presence of riparian and grassland vegetation. Adequate food and habitat are present for most species. Common semiaquatic mammals inhabiting the area are beaver (Castor canadensis), muskrat (Ondatra zibethica), and river otter (Enhydra lutris), while the terrestrial mammals include jackrabbit (Lepus californicus), ground squirrel (Otospermophilus beecheyi), and raccoon (Procyon lotor). Additional common mammals found in the Delta include striped shunk (Mephitis mephitis) and opossum (Didelphis marsupialis).

Threatened and Endangered Species. - Fish and Wildlife Service has advised there are 8 listed endangered species and 14 candidate species which may be present in the study area. Table 4-2 provides the Federal and State designations.

Recreation. - Problems associated with recreation use of the Delta include: inadequate access for land-based users, inadequate number of public recreation facilities, public waterways surrounded by private levees and farmlands, and landownership controversies regarding the unleveed channel islands.

Overland routes are extremely limited for auto access to the interior of the Delta. Of the few existing public roads, many are located on narrow levee crowns which offer very few places for cars to stop and park alongside the roadway. Parking along the narrow roadways often creates traffic safety problems. Additionally, the public roads and waterways are often separated by privately owned land, and recreationists attempting to gain access to the waterway are trespassing.

Table 4-2 Species Potentially Occurring in the Sacramento-San Joaquin Delta

<u>S P E C I E S</u>		<u>S T A T U S</u>			
COMMON NAME	SCIENTIFIC NAME	FEDERAL	STATE	HABITAT	GENERAL DISTRIBUTION
Lange's metatmark butterfly	<i>Apodemia mormo langei</i>	Listed		Riverine dunes	Antioch Dunes
American peregrine falcon	<i>Falco peregrinus anatum</i>	Listed	E	Many communities	Statewide
Aleutian Canada goose	<i>Branta canadensis leucopareia</i>	Listed		Ponded wetlands	Suisun Bay; Central Valley
San Joaquin kit fox	<i>Vulpes macrotis mutica</i>	Listed	R	Grasslands	San Joaquin Valley
Salt marsh harvest mouse	<i>Reithrodontomys raviventris</i>	Listed	E	Brackish marsh	West Delta, Suisun & San Francisco Bays
Contra Costa wallflower	<i>Erysimum capitatum</i> var. <i>augustatum</i>	Listed	E	Riverine dunes	Antioch Dunes
Antioch Dunes evening primrose	<i>Oenothera deltoides</i> ssp. <i>howellii</i>	Listed	E	Riverine dunes	Antioch Dunes
Solano grass	<i>Orcuttia mucronata</i>	Listed	E	Alkaline vernal pool	Dozier
Sacramento anthicid beetle	<i>Anthicus sacramento</i>	Candidate		Sand dunes	West Delta
California yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	Candidate		Riparian woodland	Sacramento Valley
Giant garter snake	<i>Thamnophis couchi gigas</i>	Candidate		Sluggish backwaters	Lower Sacramento & Upper San Joaquin Valleys
Suisun aster	<i>Aster chilensis</i> var. <i>lentus</i>	Candidate		Brackish marsh	Suisun Bay region
Slough thistle	<i>Cirsium crassicaule</i>	Candidate		Steambanks	Central Valley
Soft bird's beak	<i>Cordylanthus mollis</i> ssp. <i>mollis</i>	Candidate		Brackish marsh	Suisun & San Pablo Bays
Delta coyote thistle	<i>Eryngium racemosum</i>	Candidate		Vernal pools	Central Valley
California hibiscus	<i>Hibiscus californicus</i>	Candidate		Streambanks	South Delta & Sacramento River Corridor
Contra Costa baeria	<i>Lesthenia conjugens</i>	Candidate		Vernal pools	Central Valley
Hispids bird's beak	<i>Cordylanthus smollis</i> ssp. <i>hispidus</i>	Candidate		Marsh areas	Central Valley
Delta tule pea	<i>Lathyrus jepsonii</i> ssp. <i>jepsonii</i>	Candidate		Tidal shorelines	Lower Delta
Legenere	<i>Legenere limosa</i>	Candidate		Vernal pools, marsh	Central Coast Range & Central Valley
Mason's lilaeopsis	<i>Lilaeopsis masonii</i>	Candidate		Tidal shorelines	Suisun Bay; west Delta
Colusa grass	<i>Neostapfla colusana</i>	Candidate		Vernal pools	Dozier; lower San Joaquin Valley

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Nearly all recreation facilities in the Delta are provided by private enterprise, and these are devoted almost exclusively to providing services for the boater. There is a significant lack of publicly provided picnic sites; swimming beaches; campgrounds for land based users; equestrian, hiking, and bicycle trails; boater destination areas; bank fishing areas; and public hunting areas.

The public demand for access to Delta waterways and levees is steadily increasing. Although the waterways are publicly owned, most of the Delta levees, islands, and tracts are privately owned. Recreationists using such levees are generally trespassing. San Joaquin County has reported that the unauthorized use of such levees has resulted in damage to the levee, destruction of existing vegetation, pollution of the waterways, littering, and vandalism to private property. Wildfires on dry peatlands of the Delta are known to occur. The thoughtless acts of a small number of individuals increase the resistance of landowners to public use of the levees. If provision is made for increased public recreation uses, accompanying provisions will be needed to maintain control of the public to avoid or reduce hazards to private owners. In addition to needs for public lands and facilities, there is a need for adequate operation and maintenance to provide a pleasant, safe, and sanitary recreation experience and a need for sufficient law enforcement to police recreationists and control trespass, littering, and vandalism.

Many of the Delta's waterways contain unleveed islands which provide scenic enhancement, valuable fish and wildlife habitat, and places which are attractive to boaters to moor or beach for picnicking and other activities. Most of the unleveed islands with land lying above tidal influence were originally part of the initial reclamation works and were later cut off to reduce maintenance costs. Because of the modifications of the Delta waterways, it is often difficult to determine the boundaries between publicly owned (the State's Constitution provides that river lands are publicly owned) and privately owned land. The State Lands Commission reports that many of the higher nonleveed islands have been taken over by squatters, thus preventing public use. To date, the State Lands Commission has not firmly established the State's claim to many of these nonleveed islands, berms, and waterways in the Delta.

The Delta Recreation Concept Plan (Geidel and Moore, 1981) includes an inventory of existing commercial recreation facilities in the Delta. There are 116 commercial recreation facilities in the Delta: 107 commercial marinas, 3 commercial restaurants with guest docks, 1 retail store with guest docks, 1 commercial community development, 1 commercial boatyard, 1 trailer court with berths, 1 recreation vehicle park, and 1 community dock.

Recreation use of the Delta has increased steadily since the mid-1940's. The major recreation season occurs from June through August, with peak use occurring on weekends and holidays. Camping facilities are typically used to capacity on weekends, and a substantial number of persons are turned away. Potential use is considerably greater than current use because use is constrained by poor access and few facilities. The extent to which existing and future recreation demand exceeds actual use and capacity of facilities is termed "latent demand." This recreation demand, as reported in the Delta Master Recreation Plan (Delta Master Recreation Plan Task Force, 1976) represents recreation use which could occur in the Delta if sufficient facilities were provided. However, the amount of actual recreation use was estimated based on increasing population and planned future facilities. The difference between these two figures represents the latent recreation demand.

Table 4-3
Recreation Demand (Millions of Recreation Days)^{1/}

<u>Year</u>	<u>Existing and Estimated Future Recreation Use</u>		<u>Latent Demand</u>
	<u>With Sufficient Facilities</u>	<u>With Existing Facilities</u>	
1980	21.7 ^{2/}	12.3 ^{3/}	9.4
1990	28.8	13.6	15.2
2000	39.8	14.1	25.7

^{1/} Recreation days = participation in any activity for any portion of a 24-hour period.

^{2/} Delta Master Recreation Plan Task Force, 1976. Delta Master Recreation Plan.

^{3/} Actual use survey and projection from Geidel and Moore, 1981.

Cultural Resources. - The Delta was inhabited by the Plains Miwok Indians which had one of the largest native American populations of any tribe in California. Settlements were generally concentrated around water sources

because of abundant food resources and water supply. Pedro Fages is credited with the discovery of the Delta by European man in 1772, and considered it an extension of San Francisco Bay. During the early 1850's unsuccessful gold seekers settled in the Delta as subsistence farmers. After the completion of the Central Pacific Railroad, unemployed Chinese laborers were hired to reclaim the Delta, and they built the first system of levees around selected islands using only hand tools and wheelbarrows. Between 1860 and 1866, private reclamation districts were formed with the assistance of a State Bureau of Reclamation Commissioner. Reclamation works have evolved from the early hand constructed, mounded levees to the present day levees, which can be 100 feet wide and 25 to 30 feet high. Reclamation was essentially complete by 1930.

5.0 Environmental Effects

The environmental effects of the selected plan, the three alternative plans, and the no action plan are presented below. Unless otherwise noted, the beneficial and adverse impacts of the alternative plans are similar or identical to those identified for the selected plan. An impact that is not mentioned below, but which is common to all except the no action plan, is the impact to the borrow sites. Potential borrow site locations are noted in Figure 7 in the Plan Formulation Appendix. When final borrow sites are chosen and the impacts to those sites determined, a discussion of pertinent impacts will be appended to this report. The other structural alternatives have beneficial and adverse impacts similar to those of the selected plan, but differing in extent. The polder plan has, in addition, impacts to waterways which the other plans do not.

5.1 No Action. - (Refer to the discussion in paragraph 3.1.) The foreseeable impacts of a no-action plan differ depending upon whether or not island reclamation continues in the Delta. If reclamation continues at or near its present rate, periodic impacts to the resources would also continue. Due to an expected increase in levee failures in the future, these impacts would also increase. This EIS was prepared assuming that reclamation would continue. However, if due to lack of financial resources island reclamation cannot continue, existing islands would be successively inundated; no action would, in this case, result in more severe impacts than would any other plan.

5.2 Incremental Flood Control Plan. - The incremental plan (selected plan) consists of levee improvement for 15 islands chosen on the basis of economic feasibility. A description of the alternative appears in Section 3.2. The incremental plan would include approximately 6,092 acres of enhancement as well as 650 acres for mitigation, as described in Section 5.6.

Soils. - The selected plan would not adversely impact the soils in the Delta. Although the soils in the Delta would still be subsiding with this alternative, additional subsidence would not contribute to levee failure, and agricultural production would not be interrupted due to levee failure. The beneficial impacts are the same for all the structural plans; however, their magnitude would increase as more islands are protected.

Water Quality. - Water quality degradation results from levee failures during periods of low Delta outflow. The projects would have beneficial impacts resulting from the saving of freshwater required to restore water quality following levee breaks during periods of low Delta outflow. All the plans would improve water quality with differing magnitudes: The Modified System Plan, 15 percent less protection than the System Plan; and the Incremental and Polder Plans, 40 percent less than the System Plan. However, with the Polder Plan, 4 miles of waterways (Empire Cut and Connection Slough) would be isolated. This could result in increased turbidity, salinity, higher temperature, and lower dissolved oxygen content with further lowering water quality beneficial impact. The closed channels would be converted to wetlands to effect a trade-off of aquatic resource loss to wetland/wildlife gain.

Esthetics. - The project will result in removal of substantial vegetation from the levees to be improved and replacement with rock riprap. This will adversely impact the esthetic quality of the Delta. Although loss of the vegetation would be mitigated and enhancement provided, these measures often would occur in the interior of the island. Therefore, the mitigation and enhancement would generally not be visible from boats. Since much of the recreation in the Delta involves boating, there will be a significant loss of esthetics to a large number of visitors. This trade-off is necessary if flood protection is to be provided to the Delta.

Vegetation. - The flood protection provided would reduce the impacts due to levee failure and the resulting periodic loss of wildlife habitat in the interior of the islands. The magnitude of these losses would depend upon the season, duration, and the types of vegetation on the particular island being flooded, and are therefore difficult to accurately assess. Also, during emergency repairs of the levees under existing conditions, impacts which are not mitigated occur to the vegetation. There are three vegetative types which would be adversely impacted with the project: riparian, wetland, and upland. An estimated 388 acres of riparian habitat would be lost: 343 acres consisting of shrub-scrub and 45 acres of riparian forest. In addition, 325 acres of wetland or emergent vegetation in close proximity to the waterside of the levee could potentially be impacted. This figure represents a worst-case analysis which assumes all emergent vegetation would be removed. It is anticipated, however, that 50 percent of the emergent vegetation may remain or

become reestablished shortly after construction, thus only about 160 acres would be impacted. Of this amount, about 60 percent would reestablish naturally in 30 years and the remaining 40 percent, 65 acres, would be permanently lost. Also, 1,257 acres of upland habitat would be impacted by levee construction. Due to levee maintenance practices, existing levees support primarily annual forbs and grasses rather than a more typical form of upland vegetation (woodland or forests). With the project there would be some 2,771 acres of similar upland habitat established on the levees and landside berms for a net gain of 1,514 acres of upland habitat; this would partly offset the loss of wetland and riparian habitat.

Agriculture. - An estimated 1,126 acres of agricultural land would be removed from production to allow for the construction of levee enlargements. On the islands which would be affected by the selected plan, the probability of levee failure under existing conditions is once every 25 years or greater, on the average. Therefore, although there is a permanent loss, this should be offset by the overall flood protection provided to these islands.

Three of the islands proposed for levee rehabilitation have significant urban improvements, and the others are primarily agricultural. There is a potential for significant losses due to land use changes which the high degree of flood protection would encourage. A requirement for local cooperation in the proposed project, however, would be the development of an appropriate local land use plan prior to construction and adherence to the plan after construction. Plans must require zoning or include other measures to strictly control land use and to prevent added flood protection from leading to undesirable land use changes. This will insure compatibility with Executive Order 11988 on Floodplain Management.

Fish. - Currently, when levee failures occur during periods of low Delta outflow (summer), saline water intrudes and can impact the fisheries. Maintenance of Delta water quality will serve to protect the phytoplankton and zooplankton populations on which neomysis and, ultimately, striped bass and many other fish species depend. The loss of wetland and riparian vegetation with the project would have an equally deleterious impact on the aquatic resources. During construction, 165 miles of land in a strip 10-20 feet wide along the waterside would be cleared. A significant proportion of that land

now supports riparian and wetland vegetation. This vegetation plays an important role in the land-water linear relationship: it is the source of detritus, food (terrestrial insects), spawning habitat, and a shade canopy.

Wildlife. - As previously stated, flood protection would reduce temporary impacts to wildlife due to levee failure. Some islands are important waterfowl areas, and flooding would reduce available food sources and habitat. Refer to Section 5.6 for mitigation and enhancement measures. Wildlife resources would be impacted by the removal of riparian, emergent, and agricultural habitat and their replacement by upland habitat. The riparian and wetland habitat in the Delta which would be impacted by the project is found mostly in a narrow band along the waterside of the existing levees. Most of the riparian vegetation is relatively young, consisting predominantly of willows, blackberries, and forbs. This narrow band, extensive in terms of total acreage, provides an important edge effect or interface between the water and agricultural lands. Also, many birds and mammals utilize the agricultural lands for seasonal feeding and depend on riparian/wetland habitat for cover, reproductive needs, and food. The net gain of 1,514 acres of upland habitat would support a more diverse wildlife fauna than the agricultural habitat which is seasonally disturbed by farming practices.

The agricultural lands have seasonal value to wildlife. When the fields are under active cultivation, they have only limited value, but, during the fall and winter, flooded and unflooded cover and grain crops and ruderal fields have significant value. In fact, the Delta is an important wintering habitat for 60 percent of the waterfowl that use the Pacific Flyway, and 91 percent of all waterfowl that winter in California (FWS, 1977). There is a total of 531,160 acres of agricultural land available in the Delta; therefore, a loss of 1,126 acres of agricultural land will not seriously affect the waterfowl. The Delta is currently valuable to many birds and aquatic mammals mainly because of the numerous 'tule' channel islands found there. Sediment deposits or old dredger cuts from larger islands formed these 'tule' islands, and, on some of the higher islands, willows and other riparian species have become prevalent. These islands will not be impacted by the project; it is uncertain, however, how much development pressure the area is under.

Threatened and Endangered Species. - A biological assessment has been completed and coordinated with FWS as required by Section 7(c) of the Endangered Species Act. The eight Federally listed species present are not likely to be affected by the selected plan. Informal consultation with FWS confirmed that possible effects on the peregrine falcon (loss of some of its perch sites) were not likely. In addition, five species are candidates for a Federal threatened and endangered designation and are listed as rare or endangered by the State: yellow-billed cuckoo, Mason's lilaepsis, Colusa grass, soft birds-beak, and giant garter snake. These are considered significant resources. The Biological Assessment concludes that only the State listed species Mason's lilaepsis may be impacted by this project. The FWS indicated that two other plant species, the Suisun aster and the delta tule pea are found in association with Mason's lilaepsis. Because all three plants are known to be in the project area, they may be impacted by the project.

Recreation. - Construction of the 45 recreation sites will occupy about 1,075 acres of land and cause beneficial increases in recreation use and some resulting adverse impacts. The increase of 2.43 million recreation days will satisfy about 10 percent of the latent or unsatisfied demand for recreation projected by the State for the Delta. The recreation sites would be regulated and patrolled, and suitable sanitary facilities provided. This should reduce problems of trespassing on private lands and resulting litter, vandalism, and peat fires that landowners complain of. The increased public use would result in greater consumptive and nonconsumptive use of the renewable fish and wildlife resources of the Delta. The recreation developments will permanently displace some fish and wildlife habitat and cause a temporary impact while construction is in progress. The following measures are planned to offset the fish and wildlife impacts. Plantings of native or other compatible plant species would be established and maintained in the project recreation areas. These would provide shade, shelter from wind, and an esthetically pleasing setting for recreation activities. The waterward portions of the recreation areas would be graded with appropriate slopes and contours and planted with selected vegetation, providing a natural riparian setting and enhanced esthetic conditions for recreation users as well as suitable habitat for fish and wildlife. The landward periphery of the recreation sites would be planted with a vegetative cover to serve as a windscreen and esthetic buffer for

recreation users as well as food and shelter for indigenous wildlife. All recreation areas and facilities would be designed to be compatible with the Delta's natural environment. Restroom buildings and other structures would receive appropriate architectural treatment, be sited away from shorelines, and be appropriately landscaped. The increased recreation use is expected to cause an insignificant increase in air pollution emissions in the three-county area of 0.4 percent nitrogen oxides, 0.3 percent carbon monoxide, and 0.3 percent hydrocarbons compared to 1980 levels.

Cultural Resources. - A cultural resources literature review of the Sacramento-San Joaquin Delta was prepared in 1977 by Greenway and Soule. The impacts to the cultural resources are unknown for all the structural alternatives at this time. Refer to Section 4.2 for a detailed description of coordination. If the selected plan of improvement is authorized, a reconnaissance level survey will be conducted of sufficient magnitude to provide a predictive model for the numbers, types, and quantities of sites in the area. The reconnaissance report will also discuss, in general terms, recommendations for further study and testing. The reconnaissance report and any additional studies will be coordinated with the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and the National Park Service. Cultural sites within the project area will be evaluated for eligibility to the National Register of Historic Places and possible impacts to the sites identified. If the project receives construction authorization, a mitigation plan will be undertaken in accordance with 36 CFR 800 and 33 CFR 305 procedures. The mitigation plan, developed in coordination with the Advisory Council on Historic Preservation and the State Historic Preservation Officer, will attempt to preserve, protect, and/or mitigate for unavoidable loss to National Register eligible cultural resources.

5.3 System Flood Control Plan. - This alternative provides flood protection to 54 major islands and tracts (see Section 3.3 for a detailed description). This alternative would include approximately 3,165 acres of mitigation; however, this mitigation would have to be coordinated at a later date.

Esthetics. - This alternative would entail the loss of vegetation along levees; it would therefore result in a negative impact upon the esthetic value of the project area. Mitigation and enhancement measures would be carried

out, but these measures do not involve replanting the levee slopes. Thus, the esthetic improvements that would result from these measures would not be visible to the most frequent recreational user in the area - the boater.

Vegetation. - The vegetative types which would be adversely impacted are the same types as for the selected plan, except that the acreages would be greater; 1,890 acres of riparian habitat would be lost. Included in the lost acreage would be 1,630 acres of shrub-scrub and 260 acres of forested riparian habitat. In addition, 720 acres of emergent habitat would be impacted during construction, and 2,823 acres of upland habitat would be lost. All levee structures would return to an upland habitat type, resulting in a gain of 4,711 acres of upland habitat.

Agriculture. - An estimated 2,821 acres of agricultural habitat would be lost if this alternative were carried out with the beneficial impacts of a greater magnitude as described for the selected plan.

Fish. - The types of impacts to aquatic resources that would result from this plan are similar to those described for the selected plan. The aquatic interface would be impacted by 608 miles of levee work.

Wildlife. - The major impacts to wildlife resources would result from the replacement of riparian and emergent habitat with an upland habitat type. The types of impacts would be the same as those described for the selected plan, but would be greater in magnitude.

Threatened and Endangered Species. - No impacts to endangered species are likely.

Recreation. - The recreation plan is the same as that for the selected plan. The fish and wildlife mitigation and enhancement measures would be similar to those described for the selected plan.

5.4 Modified System Flood Control Plan. - This alternative calls for levee improvement on 36 major islands and tracts (see Section 3.4 for a detailed description). This alternative would include approximately 1,935 acres of mitigation; however, this mitigation would have to be coordinated at a later date.

Esthetics. - Same type of impacts described for the selected plan but with a greater magnitude.

Vegetation. - The impacts to the vegetation that would ensue from this plan are similar to those that would result from the selected plan. The plant species that would be adversely impacted are also the same; the acreages affected differ, however. An estimated 1,155 acres of riparian habitat, consisting of 975 acres of shrub-scrub and 180 acres of forested riparian habitat would be lost. An additional 365 acres of emergent habitat, would be impacted during construction. A loss of 2,113 acres of existing upland habitat would be replaced with 5,113 acres resulting in a net gain of 3,000 acres.

Agriculture. - Approximately 1,845 acres of agricultural land would be removed from production by this project, but the beneficial impacts would be of a greater magnitude than described for the selected plan. The impacts on wildlife from the loss of agricultural land are the same as described for the selected plan.

Fish. - The impacts to aquatic resources are similiar to those described for the selected plan except that the extent of the impact is greater. An estimated 483 miles of levee work would occur with this plan, with riparian/wetland vegetation removed adjacent to the waterside.

Wildlife. - The major impacts to wildlife resources would result from the replacement of riparian and emergent habitat with an upland habitat consisting of grasses and forbs. This upland habitat would provide a lower interspersion value to wildlife, as previously described. The net gain of upland habitat would be 3,000 acres.

Threatened and Endangered Species. - No impacts to endangered species are likely.

Recreation. - The recreation plan is the same as that for the selected plan and therefore has the same potential impacts. The mitigation and enhancement measures would also be similiar to those described for the selected plan.

5.5 Polder Flood Control Plan. - The Polder Plan calls for levee improvement on 11 individual islands and construction of 2 polders (see Section 3.5 for a detailed description). This alternative would include approximately 850 acres of mitigation; however, this mitigation would have to be coordinated at a later date.

Esthetics. - The esthetic impacts of the Polder Plan would be similar to those of the selected plan: approximately the same amount of vegetation would be removed from the levees. Since the construction of the polders would close off Empire Cut and Connection Slough and cut off boating access, the Polder Plan would result in a greater negative impact on the esthetic qualities of the area than would the other plans.

Vegetation. - The vegetation of the area would be impacted by levee rehabilitation on for the polder plan in essentially the same ways it would be for the selected plan. About 343 acres of shrub-scrub, 45 acres of forested riparian, and 152 acres of emergent vegetation would be lost. Also, 997 acres of upland habitat would be lost and replaced with 2,366 acres of upland habitat, a net gain of 1,369 acres.

Agriculture. - The Polder Flood Control Plan calls for the conversion of approximately 981 acres of agricultural land to levee structures. Converting Empire Cut and Connection Slough into polders might also affect existing irrigation practices along those waterways and requires relocating pumping facilities.

Fish. - In terms of the impact it would have on the aquatic life in the project area, the Polder Plan is the least desirable alternative discussed in this report. Because it calls for closing off Empire Cut and Connection Slough from the replenishing and flushing effects of a continuous flow of water, this plan could result in significant adverse impacts on the water quality and, therefore, the aquatic life in those waterways. The following undesirable changes would occur once the flow was cut off: (1) oxygen levels would decrease, creating a potentially eutrophic environment; (2) irrigation return flows and runoff from the surrounding fields would lead to an accumulation of silt, fertilizers, and other agricultural chemicals (as fertilizer levels increased, the potential for eutrophism would also

increase); (3) the water temperature in the polders would no longer be consistent with the temperature in the surrounding waterways (wider fluctuations would be likely once the moderating effects of a constant flow were absent). Accordingly, to avoid these impacts the areas would be converted to wetlands causing a trade-off of aquatic resource loss to wetland/wildlife gain. The wetlands would be created by filling the closed channels to near mean sea level with dredged materials.

Wildlife. - Wildlife would be affected by the Polder Flood Control Plan in much the same way it would be by the Selected Plan. Impacts would result primarily from the conversion of riparian and emergent to upland vegetation types. Wildlife would gain from the wetland conversion of the sloughs.

Threatened and Endangered Species. - No effects on endangered species are likely.

Recreation. - The recreation plan that accompanies the polder alternative is the same as that accompanying the selected plan. The same fish and wildlife mitigation and enhancement measures would also be incorporated into the recreation plan.

5.6 Mitigation. - The Fish and Wildlife Service in its draft Detailed Report recommended compensation (full mitigation) for project impacts on fish and wildlife. FWS has determined through the use of its Habitat Evaluation Procedure that conversion of 650 acres of land from agriculture to riparian vegetation would be necessary. Fire, use of herbicides, and intrusions by off-road vehicles would be prohibited. Natural establishment would result in a succession of plant species from fallow agriculture to intermediate stages of annual grassland, to scrub-shrub riparian, and finally to mature riparian forest. The maximum habitat values would be attained by year 40. The attainment of the mitigation goal can occur only if these lands are of appropriate size and shape and are distributed throughout the construction area. FWS recommends these sites should be no smaller than 15 acres and circular where practicable to provide maximum utilization by wildlife. Also, the sites should be distributed evenly and generally be adjacent to rehabilitated levees throughout the project area to spread their benefits. This would also not put an unequal burden of loss of agricultural areas onto any

one landowner. Where feasible, these sites could be located on already fallow fields, small peninsulas, or other similar geographical irregularities in order to minimize impacts to farming operations. These sites should be located away from private or commercial developments. Approximately 30 potential management sites have been identified, two sites per island or tract which are part of the project (Figure 12 in the main report). Site selection would include input from landowners, and future coordination between the Corps, the Service, and landowners will be necessary to determine the actual location of these sites. These lands would generally be acquired in easement with stipulations that the habitat be preserved in perpetuity, although fee acquisition would be obtained if mutually agreeable.

FWS provided the mitigation alternatives listed in Table 5-1 (See Figure 10 of main report) which would reduce conversion of agricultural lands with the following criteria: At least one-half of all mitigation occurs on the islands receiving levee improvements, and at least two-thirds of all benefits attributed to mitigation should be from the increase of riparian habitat. Assessment of habitat value for wildlife indicated that it would take 4 acres of oak-woodland, or 2 acres of emergent habitat, to provide the same mitigative value as 1 acre of riparian mitigation. Riparian habitat for mitigation therefore results in the least acreage requirements. These areas, if managed as indicated, would provide 283 acres towards the mitigation goal, and only 367 acres of agricultural lands would then be required. These measures, combined with acquisition of the agricultural parcels, meet the two criteria of FWS. The mitigation measures for the other structural alternatives would be similar, as described for the selected plan. Based on mitigation requirements developed by FWS for the selected plan, it is estimated about 3,165 acres would be required for the System Flood Control Plan, 1,935 acres for the Modified System Flood Control Plan, and 850 acres for the Polder Flood Control Plan. However, these estimates are extrapolations of the HEP finding for the selected plan and are very preliminary. If any of the other structural alternatives are chosen, the mitigation would need to be coordinated at a later date. The Polder Flood Control Plan impacts approximately the same amount of vegetation as the selected plan, but there would be 4 miles of aquatic habitat additionally impacted. There is no feasible way to mitigate for impacted navigation, recreation, water quality, and aquatic resources. Therefore, to mitigate for

the closure of the two channels, the following three items would be included: (1) acquisition of sufficient easements along the channels for preserving and enhancing riparian vegetation, (2) conversion of the closed waterway (approximately 200 acres) to wetland by adding sufficient fill to bring them to msl, and (3) incorporation of these two areas into the overall fish and wildlife management areas to be provided by the project. For a complete description of how these acreage determinations were made, see the FWS draft Detailed Report which is attached.

TABLE 5-1
POTENTIAL MITIGATION LANDS

<u>EQ Item No.</u>	<u>Area</u>	<u>Management Measure</u>	<u>Actual Acres</u>	<u>Equivalent Riparian Mitigation Acres</u>
1	Bonetti	Remove grazing, establish oak woodland	33	8
4	Widdows	Breach levee, establish wetland habitat.	60	Included in Item 14
5	Grand Island	No spoil, riparian revegetate naturally.	100	100
7	Middle River (Union)	Manage existing vegetation, establish riparian.	45	45
9	Old River Island	91 acres of upland, rest in agricultural.	220	55
14	Quimby, Little Mandeville, Rhode, Mildred, Medford	Establish oak woodland Establish wetland habitat.	100 <u>1/</u>	50
16	Shin Kee	Manage existing habitat and extend wetland habitat.	<u>50</u>	<u>25</u>
TOTAL:			608	283

1/ Although there are about 3,450 acres available, only about 100 acres of emergent habitat could be established on these islands to equal 50 acres of riparian habitat mitigation.

5.7 Enhancement. - The project provides the unique possibility to enhance wildlife values by preserving and improving habitat which is subject to

inappropriate development or flooding. All the EQ items shown in Table 3-2 would be acquired for enhancement.

One of the enhancement features consists of acquisition in fee title or environmental easement of many project area channel islands, approximately 1,525 acres. FWS believes that, although existing State and Federal policies and regulations protect these valuable resource areas, future economic and political changes could greatly reduce their protection. Many of these areas represent the last vestiges of historic Delta conditions; for these two reasons they would provide effective enhancement.

Another enhancement feature includes acquiring public interest on 1,113 acres of significant riparian and upland habitat, including important habitat for the State designated rare giant garter snake and California black rail. These areas are also subject to development, and some of these areas are fallow fields which could potentially be farmed.

The third enhancement feature includes acquisition and management of some of the smaller leveed channel islands, 3,454 acres (Quimby, Little Mandeville, Rhode, Medford, and Mildred Islands). FWS believes that these islands would be inundated as a result of levee failure early in the life of the project and would not be reclaimed. The loss of a diverse and valuable wildlife habitat could be avoided by rebuilding the levees to provide a minimum 50-year protection as part of the projects. These islands provide the necessary mix of upland, agricultural, riparian and marsh habitat for a productive wildlife area. The agricultural area could be kept in production, however, and a portion of the crops grown would be left in the field to provide important food items to waterfowl with only a certain percentage harvested as is currently done in many wildlife refuges. Currently, no Federal National Wildlife Refuge (NWR) or Wildlife Management Areas (WMA) intensively managed by the State exist in the Delta. The Delta received from FWS second ranking and Suisun Marsh third ranking for biological importance and potential acquisition and management in the entire State of California (USEFWS, 1978). The Delta also received high desirability/potential value and high feasibility for waterfowl refuge development by FWS. The FWS Regional Director has indicated that the enhancement areas could be included in the NWR system, contingent upon prior completion of all necessary habitat improvements and

negligible annual operation and maintenance costs. FWS indicated final approval by the Service's Director would be necessary, and additional planning efforts would be needed. Also, the State has generally endorsed this concept and could manage these lands as part of their Wildlife Management Area. Further coordination is necessary to determine the most desirable management strategy for these lands.

6.0 Public Involvement

6.1 Public Involvement Program. - A public involvement program was implemented early in the planning study to insure that the study is responsive to public views and preferences. The program actively involved other Federal, State, regional, and local governmental entities and officials; public and private organizations; and individuals. A detailed description of the public involvement program is provided in the main report.

The Sacramento-San Joaquin Delta Investigation began in 1962, and a draft survey report was prepared in 1965. In May 1966, a public meeting was held to present the alternative solutions for flood control and recreation proposed in the report. The meeting resulted in an indication of opposition to the recreation proposals from landowners and a lack of State response to the proposed flood control alternatives. Consequently, the draft report was not submitted to higher authority, and the study was discontinued.

In 1973, the California State Legislature adopted Senate Bill No. 541 which delineated the State's policy concerning the Delta and the State's interest in the Delta levees. As a result of that bill, the Secretary of the State Resources Agency requested that the Corps resume the Delta investigation, and on 28 August 1975 a public meeting was held in Stockton to inform the public that the investigation had been resumed and to invite comments and input. Various agencies, organizations, and individuals supported resumption of the Corps investigation and endorsed the preservation, restoration, and maintenance of Delta levees; therefore, the study was continued. The Environmental Working Paper was circulated for informal agency review in June 1978. The working paper described the alternatives being considered and the existing resources and generally discussed the types of impacts that might be expected with each alternative. The comments received were reviewed and used in determining the areas of concern and for further plan formulation.

In August 1979 a scoping notice was published in the Federal Register inviting all interested parties to participate in a public meeting on 30 August 1979 to identify significant environmental concerns.

DWR sponsored the public meeting held in Stockton, at which Corps representatives presented alternative solutions for flood control, recreation, and related problems of the Delta. The Corps subsequently held informal workshops at Rio Vista and Antioch in December 1979 to insure that all interests in the Delta had been given an opportunity to provide input to the study.

In March 1981, a conference was held in Sacramento on "The Future of the Delta." The conference was co-sponsored by the State Resources Agency; California Department of Water Resources; and the University of California, Davis Extension. About 250 representatives from agriculture, environmental groups, water agencies, recreation interests, academia, all levels of Government, and the general public participated in the seminar. The Corps was actively involved in workshops on Delta Levees and the Future of the Delta.

Beginning on 27 May 1981, a series of meetings sponsored by the Central District Office of DWR were held with local interests to discuss State and local cost sharing for levee and recreation improvements.

In addition, DWR provided data on recreation, economics, water quality, land values, and levee profile and cross-section surveys. DWR also contributed extensively to this investigation by conducting studies of land subsidence, seismicity hazards, the use of vegetation for erosion control, and by reviewing levee maintenance standards and practices. The U.S. Fish and Wildlife Service (FWS) and the California Department of Fish and Game (DFG) provided evaluations of the fish and wildlife aspects of the investigation. In addition to these major contributors, Federal, State, and local agencies having primary responsibilities in specific problem areas provided information, advice, and comments.

A Notice of Intent to prepare an EIS was published in the Federal Register on 8 April 1982.

6.2 Required Coordination. - The draft EIS will be circulated for a 45-day public and agency comment period. Additional comments on the draft will be requested at a public meeting in the fall of 1982 when the proposed project will be presented to the public. After the public review period and the

public meeting, the Feasibility Report and EIS will be completed and will include comments received and appropriate responses.

The Feasibility Report and EIS will be forwarded to the Division Engineer, the Board of Engineers for Rivers and Harbors (BERH), and the Chief of Engineers and the Secretary of the Army who will transmit them to Congress.

A considerable amount of review will occur prior to submittal to Congress. The Division Engineer will review the District Engineer's report. Comments will be solicited from the public. The BERH will review the report and the comments received. BERH will approve it and forward it to the Chief of Engineers with recommendations. The Chief of Engineers will file the EIS with EPA, coordinate the report and EIS with the Secretaries of the interested cabinet level Departments and Governor(s), and forward them to the Secretary of the Army with his recommendations. The Secretary of the Army will review the report and EIS, prepare a Record of Decision (ROD), and transmit the report and EIS to Congress. Changes or additional studies could occur during this process. The ROD will be filed with EPA and a copy sent to concerned agencies, organizations, and members of the public known to have an interest in the project. The ROD will describe the recommendation to Congress and the alternatives which were considered environmentally preferable and discuss whether all practicable means were taken to avoid or minimize environmental impacts. In addition, the ROD will discuss the major factors which led to the decision, including public comments.

6.3 Statement Recipients. - Copies of this EIS are being sent to the U.S. Departments of Agriculture (Forest Service and Soil Conservation Service); Commerce; Energy; Health and Human Services; Housing and Urban Development; Interior (Fish and Wildlife Service, National Park Service, Bureau of Land Management, and Bureau of Reclamation); Labor; Transportation; and the Environmental Protection Agency. Coordination with the State and regional agencies will be undertaken through the A-95 Clearinghouse System. Sacramento, San Joaquin, and Contra Costa Counties, organizations, and members of the public at large known to be interested will also receive this EIS.

6.4 Public Views. - Coordination to date has indicated that there is a considerable amount of interest in preserving the Delta and concern about the

need for levee rehabilitation and improved flood protection. The State of California has indicated its interest in sponsoring a recreation and fish and wildlife enhancement plan in conjunction with an acceptable Corps flood control plan, and has expressed a preference for 100-year flood protection for urban islands and 50-year flood protection for agricultural islands. Additional items that have been of particular concern to reclamation districts, landowners, and farming interests include the cost of a project, equitable cost sharing for construction and maintenance, and potential conflicts between recreationists and property owners. Environmental and conservation agencies and local environmental interests want to see that environmental factors are incorporated into any plan for rehabilitation of Delta levees, particularly any potential adverse impact on esthetics, fish and wildlife resources, and other areas of concern. They also endorse provision for public recreation opportunities and fish and wildlife enhancement.

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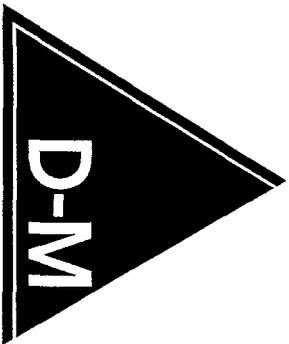
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NOTED

LIST OF PREPARERS

The following people were primarily responsible for preparing this EIS:

<u>Name</u>	<u>Expertise</u>	<u>Experience</u>	<u>Role in Preparing EIS</u>
Pat Frost	Environmental Studies	4 years, EIS studies, Sacramento District Corps of Engineers; 4 years, Environmental Engineering, U.S. Navy	Affected environment.
Cay Collette Goude	Aquatic Biologist	3 years, EIS studies, Sacramento District, 1 year Park Ranger; 2 years, biological studies California Department Fish and Game and US Fish and Wildlife Service	EIS coordinator, affected environment, environmental effects.
Wesley Ingram	Plant Ecologist	4 months EIS studies, Sacramento District; 4 years, Scientific/ Technical writing and writing instruction	Affected environment.
Patti Johnson	Cultural Resources	7 years, cultural resources management; 13 years, cultural resources experience, private and state	Cultural resources review.
Sannie Kenton	Cultural Resources	3 years, cultural resources management, Sacramento District; 9 years, cultural management, Federal & private	Cultural resources review.
Fred Kindel	Wildlife Management	18 years, EIS studies, Sacramento District Corps of Engineers; 7 years, Wildlife Management, State and Private	Report review.
George Redpath	Aquatic Biologist	6 years, EIS studies, Sacramento District Corps of Engineers; 4 years, EIS studies, private consultant	Affected environment, report review.
Raymond E. Williams	Civil Engineering	4 years water resources planning studies; 6 years design disciplines, Sacramento District	Planning engineer, study manager, formulation of alternatives.

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