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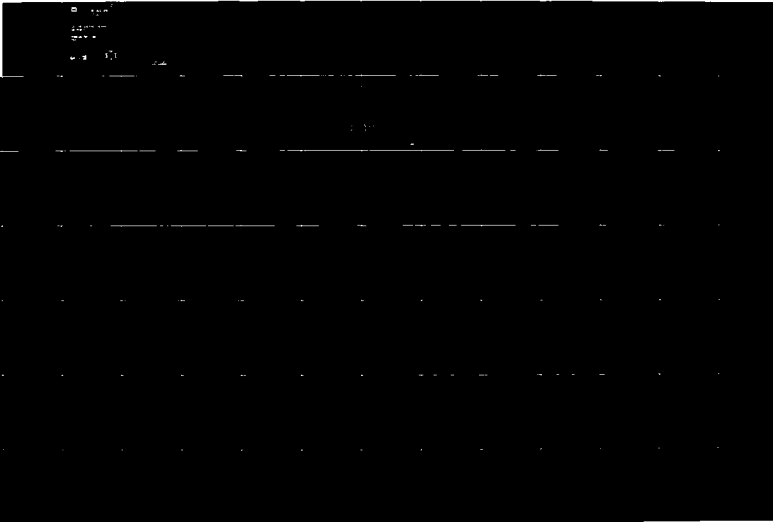
MITIGATION STUDY LAKE PONTCHARTRAIN LOUISIANA AND
VICINITY HURRYCANE PROTECTION PROJECT (U) ARMY ENGINEER
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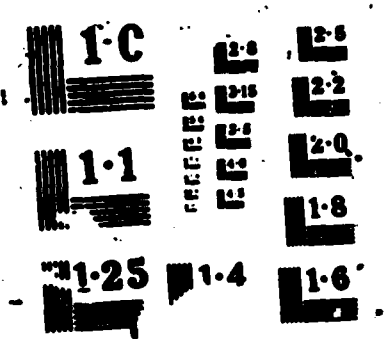
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United States Army Corps of Engineers
New Orleans District

MITIGATION STUDY

AD-A193 941

March 1988

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY

HURRICANE PROTECTION PROJECT



Environmental Impact Statement
Draft Supplement II to the
Environmental Impact Statement

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INTEGRATED DRAFT MAIN REPORT
AND
DRAFT SUPPLEMENT II TO THE
ENVIRONMENTAL IMPACT STATEMENT

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DRAFT MITIGATION REPORT/SUPPLEMENT II TO THE ENVIRONMENTAL IMPACT STATEMENT

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE
PROTECTION PROJECT, MITIGATION STUDY

ST. JOHN THE BAPTIST, ST. CHARLES, JEFFERSON, ORLEANS, AND
ST. BERNARD PARISHES, LOUISIANA

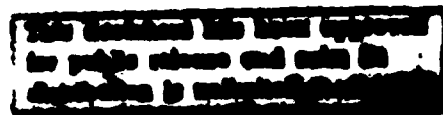
LEAD AGENCY: U.S. Army Engineer District, New Orleans

Abstract: Construction of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project caused habitat loss in the Pontchartrain Basin. There would be an annualized loss of 854 acres of brackish/saline marsh, 108 acres of fresh/intermediate marsh, 233 acres of marsh pond, and 134 acres of forested wetlands (a total of 1,329 acres). There would also be a loss of 2,610 Average Annual Habitat Units (AAHU's) for seven wildlife species. Sixteen mitigation plans were considered. Two plans were selected for detailed study. Both plans mitigated over 80 percent of the wildlife acreage loss and over 95 percent of the AAHU's lost. Plan M protects the 6.25-mile shoreline of the Manchac Wildlife Management Area (WMA) with a non-continuous two-foot high rock dike. The 20-foot per year loss of shoreline would be eliminated and 1,200 average annual acres of wetlands would be preserved, compared to the without-project condition. Plan O would protect approximately 5 miles of the Manchac WMA from shoreline erosion, thus preserving 1,100 average annual acres of wetlands. Plan O has been chosen as the Tentatively Selected Plan since it more nearly achieves the planning objective of 100% mitigation of total AAHU's lost; is responsive to all the project planning constraints; is effective, economically efficient, and implementable of all plans; is supported by State and Federal natural resource agencies; and is on public land so it can be implemented in a timely manner.

SEND YOUR COMMENTS TO
THE DISTRICT ENGINEER
BY May 18, 1988

For further information contact:

Mr. Larry Hartzog
U.S. Army Engineer District
P.O. Box 60267
New Orleans, LA 70160
Commercial telephone: (504)862-2524



S. SUMMARY

S.1. RATIONALE FOR TENTATIVELY SELECTED PLAN (TSP)

The Manchac South Foreshore Protection Plan, Plan O, is the TSP. A combination of rock dike and marsh grass plantings would provide protection to 5 miles of the shoreline of the Manchac Wildlife Management Area (WMA). This action would preserve wildlife and fisheries habitat: 300 average annual acres of marsh, 200 average annual acres of cypress, and 600 average annual acres of marsh ponds when compared to without-project conditions. Therefore this plan provides a balance between fishery and wildlife benefits. It mitigates the majority of significant adverse wildlife impacts of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project in terms of average annual habitat units (AAHU's). Plan O is a technically sound plan. It is the most efficient, cost effective, and acceptable plan. Each affected parish desires mitigation within its boundaries; however, a combination of small mitigation works is not cost effective. Thus, mitigation on public land, accessible to people of all affected parishes is the best solution. We are negotiating with the State of Louisiana concerning a letter of intent to cost share on Plan O. Plan O fulfills all planning constraints and has high monetary and non-monetary benefits.

S.2. SUMMARY OF COASTAL ZONE CONSISTENCY DETERMINATION

Based on the conclusion of the Coastal Zone Management Consistency Determination, the New Orleans District, U.S. Army Corps of Engineers, has determined that construction of 5 miles of rock dike to preserve intermediate marsh on the Manchac WMA is consistent, to the maximum extent practicable, with the guidelines of the State of Louisiana's approved Coastal Zone Management Program.

S.3. SUMMARY OF SECTION 404 (b)(1) EVALUATION

1. No significant adaptations of the guidelines were made relative to this evaluation.
2. The dredged material would be temporarily deposited along the edge of the flotation channel until dike construction is complete in order to allow rock-carrying barges to enter and leave the site. The dredge would then backfill the channel as it exits following construction.
3. Construction of the flotation channel and canal would not be expected to result in significant long-term violations of the Louisiana State Water Quality Standards.
4. The 65 pollutants designated as toxic under Section 307 (a)(1) of the Clean Water Act, as revised under the EPA Water Quality Criteria Document FRL 1623-3, ("Federal Register", November 28, 1980), have not been adopted by the State of Louisiana and are not therefore regulatory as such, and are used in a comparative nature only.
5. Use of the proposed discharge sites would not harm any endangered or threatened species or their critical habitat. The Marine Protection, Research, and Sanctuaries Act of 1972 would not apply.
6. The proposed construction would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. Significant adverse effects upon aquatic ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values would not occur. Adverse effects that could occur as a result of the proposed dredged material discharge would not be significant.



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7. Appropriate steps to minimize potential adverse impacts include the use of dragline dredging in lieu of hydraulic dredging during flotation channel construction, backfilling of such channels, and incorporation of provisions for environmental protection in contracts for construction.

8. On the basis of the application of the guidelines (40 CFR 230), the sites designated for dredged material discharge are specified as complying with the requirements of these guidelines, with inclusion of practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

S.4. FINDINGS RELATING TO EXECUTIVE ORDER 11990

This E.O., Protection of Wetlands, was a guiding force in project planning. The TSP is designed to protect wetlands.

S.5. SUMMARY OF IMPACTS OF THE HURRICANE PROTECTION PROJECT

Construction of the hurricane protection project would cause the loss of the following average annual acres of valuable wildlife and fishery habitat: 854 of brackish/saline marsh, 108 of fresh/intermediate marsh, 134 of forested wetlands, and 233 of marsh pond - a total loss of 1,329 average annual acres. There would be an annual loss of 361,858 pounds of commercial fish and shellfish; 15,667 man-days of sport fishing; 1,078 man-days of hunting; and approximately 2,610 average annual habitat units (AAHU's) would be lost, based on an analysis of seven wildlife species.

S.6. SUMMARY OF BIOLOGICAL IMPACTS OF MITIGATION PLAN

The TSP would preserve 300 average annual acres of intermediate marsh, 600 average annual acres of marsh pond, and 200 average annual acres of cypress-tupelo. A net gain of 100,000 pounds of commercial fish would occur on an average annual basis.

In addition, unquantifiable benefits to Lake Pontchartrain fishery would result from the wetland preservation and dike construction. Temporary turbidity and a slight loss of benthic productivity would occur during construction of the dike and the necessary flotation channels. Waterfowl and other wildlife would be greatly benefited by the plan.

S.7. SUMMARY OF ENDANGERED SPECIES IMPACTS

There would be no impacts to endangered or threatened species or species proposed for such listing or to critical habitat.

S.8. SUMMARY OF RECREATIONAL IMPACTS

The TSP would show a net gain of 5,000 annual man-days of fishing and hunting.

S.9. SUMMARY OF CULTURAL RESOURCE IMPACTS

Consultation with the State Historic Preservation Officer will be pursued regarding possible impacts to the Manchac light. A remote sensing survey will be conducted to locate any significant shipwrecks in the vicinity of the barge flotation access channels.

S.10. SUMMARY OF SOCIO-ECONOMIC IMPACTS

The wetland preservation aspects of the plan would have beneficial impacts on recreational camps adjacent to the Manchac WMA and on the Illinois Central Railroad roadbed by preventing possible future erosion. Property values in the vicinity of the WMA would slightly increase. Esthetics would be retained by wetland preservation. Construction turbidity and noise would be temporary and only of minor importance. Business and industrial activity, tax revenues, and employment would be slightly benefited by the increased sale of fishing and hunting equipment

and licenses. Community growth and cohesion would be slightly benefitted by the reduction in wetland loss since the adjacent community is dependent on fishing and hunting to a great degree.

S.11. AREAS OF UNRESOLVED CONTROVERSY

Since mitigation was not a part of early project planning, local assuring agencies for the hurricane protection project object to cost sharing in the mitigation plan. In August of 1985, Jefferson, St. Bernard, Orleans, and St. Charles Parishes all passed resolutions requesting mitigation within each affected parish, with benefits roughly corresponding to damages within each parish. The resolutions encouraged 100 percent Federal funding for mitigation and requested that the mitigation plan be approved by all affected parishes. The parish resolutions were considered and evaluated; however, the TSP fulfills the planning objective and complies with all planning constraints and, more importantly, is implementable since the Louisiana Department of Wildlife and Fisheries has offered a letter of intent to participate in funding for Plan M (which would protect the entire WMA shoreline). We are negotiating with them concerning a letter of intent on Plan O.

S.12. COMPLIANCE WITH APPLICABLE ENVIRONMENTAL REQUIREMENTS

Table 1 shows the stage of compliance for Plan M, Manchac Foreshore Protection (Entire) and Plan O, The TSP, Manchac South Foreshore Protection.

TABLE 1

RELATIONSHIP OF THE PLAN TO APPLICABLE ENVIRONMENTAL REQUIREMENTS

POLICIES OR STATUTES	COMPLIANCE STATUS	
	Plan M	Plan O
FEDERAL - Public Laws		
Archeological and Historic Preservation Act	Partial ^a / ₁	Partial ^a / ₁
Bald Eagle Act	Full	Full
Clean Air Act	Partial ^b / ₁	Partial ^b / ₁
Clean Water Act	Partial ^b / ₁	Partial ^b / ₁
Coastal Zone Management Act of 1972	Partial ^b / ₁	Partial ^b / ₁
Endangered Species Act of 1973	Full	Full
Estuary Protection Act	Partial ^b / ₁	Partial ^b / ₁
Farmland Protection Policy Act	N/A	N/A
Federal Water Project Recreation Act	Partial ^b / ₁	Partial ^b / ₁
Fish and Wildlife Coordination Act of 1958	Full	Full
Marine Protection, Research, and Sanctuaries Act	N/A	N/A
National Environmental Policy Act	Partial ^c / ₁	Partial ^c / ₁
National Historic Preservation Act	Partial ^a / ₁	Partial ^a / ₁
River and Harbor Act	N/A	N/A
Watershed Protection and Flood Prevention Act	N/A	N/A
Water Resources Development Act of 1986	Full	Full
Wild and Scenic Rivers Act	Full	Full
FEDERAL - Executive Orders		
Flood Plain Management (E.O. 11988)	Partial ^b / ₁	Partial ^b / ₁
Protection and Enhancement of Environmental Quality (E.O. 11991)	Partial ^b / ₁	Partial ^b / ₁
Protection of Wetlands (E.O. 11990)	Partial ^b / ₁	Partial ^b / ₁
FEDERAL - Other Policies		
Analysis of Impacts of Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act	N/A	N/A
Environmental Quality and Water Resources Management	N/A	N/A
STATE OF LOUISIANA		
Air Control Act	Partial ^b / ₁	Partial ^b / ₁
Louisiana Coastal Zone Management Plan	Partial ^b / ₁	Partial ^b / ₁
Protection of Cypress Trees	Full	Full
Water Control Act	Partial ^b / ₁	Partial ^b / ₁

^a/₁ Full compliance will be achieved when archeological and historical coordination is completed.

^b/₁ Full compliance will be achieved when coordination of the EIS and accompanying documents is completed.

^c/₁ Full compliance will be achieved by coordination of the EIS and signing the Record of Decision.

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1. PURPOSE AND SCOPE OF STUDY

The purpose of this mitigation report is to examine fish and wildlife losses occurring as a result of the Lake Pontchartrain, Louisiana, Hurricane Protection project and to evaluate means to compensate for these losses. It also establishes to what extent the authorized project should be modified to include justifiable mitigation measures for fish and wildlife to obtain maximum overall project benefits. The Draft Supplemental Environmental Impact Statement (EIS) integrated into this report evaluates the impacts of the mitigation alternatives.

2. STUDY AUTHORITY

2.1. The evaluation of mitigation is required by the Fish and Wildlife Coordination Act of 1958 (FWCA); and the Council of Environmental Quality Regulations for implementing the National Environmental Policy Act (NEPA); and is guided by U.S. Army Corps of Engineers' Engineering Regulation (ER) 200-2-2 and ER 1105-2-50.

2.2. ER 1105-2-10, Chapter 2, Section 2-5 (a)(5) delegates approval authority to the Division Commander for the addition of fish and wildlife mitigation measures to authorized projects, provided no land acquisition is required, or where the required lands will be acquired voluntarily by local interests.

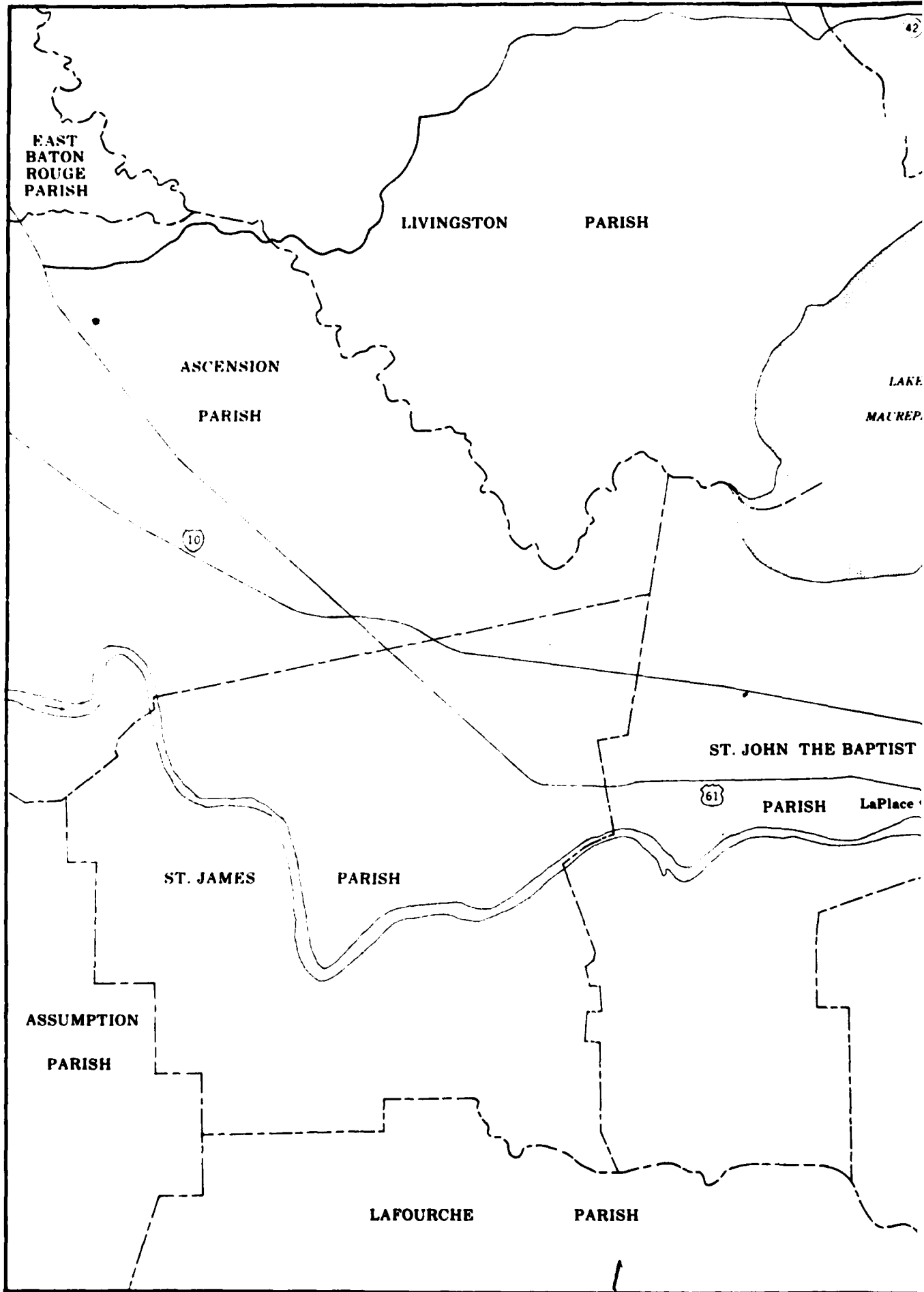
2.3. Additional guidance concerning the implementation of mitigation was provided through the Office of the Chief of Engineers' (OCE) second endorsement (7 February 1985) to the Record of Decision for the hurricane protection project. This guidance provided that "development and finalization of a specific mitigation plan should proceed expeditiously."

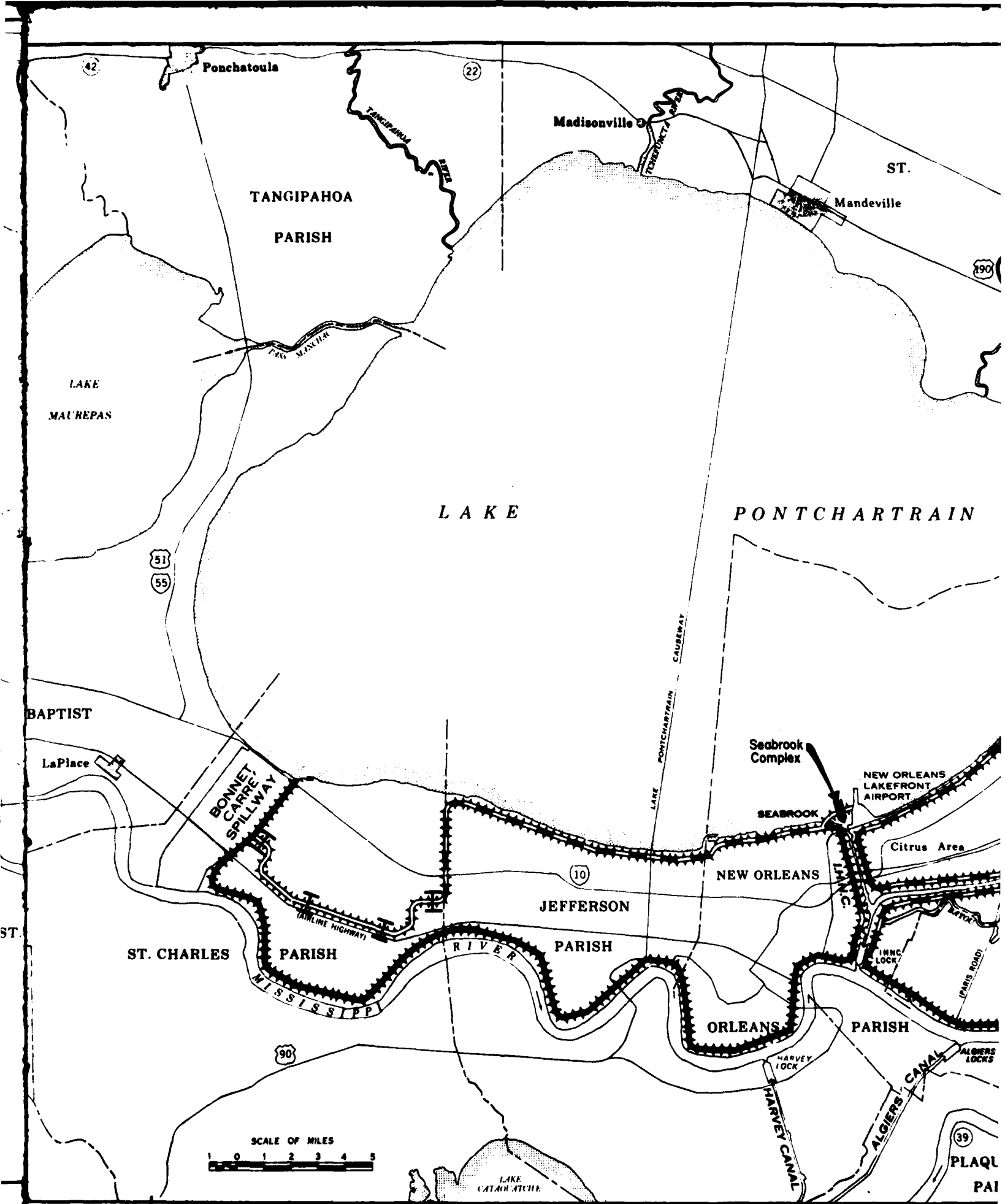
3. BACKGROUND OF MITIGATION STUDY AND PRIOR REPORTS

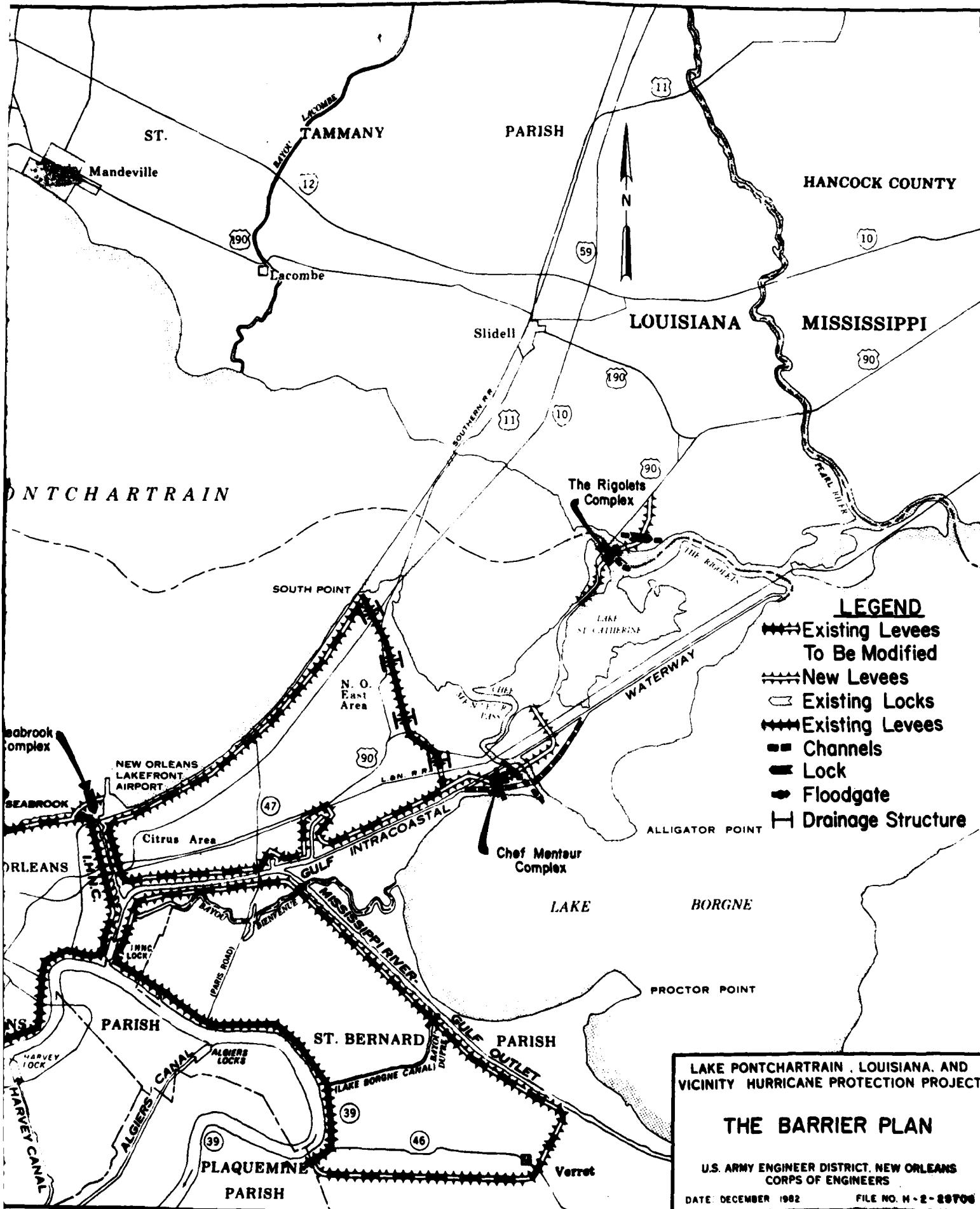
3.1 Construction on the Lake Pontchartrain Hurricane Protection Project started in 1966, and will not be completed until 2000. The originally authorized protection plan consisted of features designed to prevent an increase in water levels in Lake Pontchartrain as the hurricane approached. This was to be accomplished by placing barrier structures in the Rigolets and Chef Menteur tidal passes, and the Inner Harbor Navigation Canal (see Figure 1). In addition, levees were to be built along the entire lakefront from Bonnet Carre' Spillway to South Point with a connection to the Mississippi River levee along the Inner Harbor Navigation Canal.

3.2. Ring levees were to be built around the New Orleans East and Chalmette areas. In response to the National Environmental Policy Act, a final EIS was prepared and filed with the Council on Environmental Quality in January 1975. The adequacy of the document, in terms of impacts of the proposed barrier structures, was challenged, and the court ruled in favor of the plaintiffs to stop construction. In 1978, the court allowed construction to continue on all portions except the barrier complexes.

3.3. As a result of the injunction, alternatives were reanalyzed and in December 1984, the Reevaluation Study/Final Supplement I to the EIS was filed with EPA. The Reevaluation Study/EIS recommended abandonment of the barrier plan and construction of a high level plan in which no barriers would be built, but levees would be raised to provide hurricane protection







LEGEND

- Existing Levees To Be Modified
- New Levees
- Existing Locks
- Existing Levees
- Channels
- Lock
- Floodgate
- Drainage Structure

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT

THE BARRIER PLAN

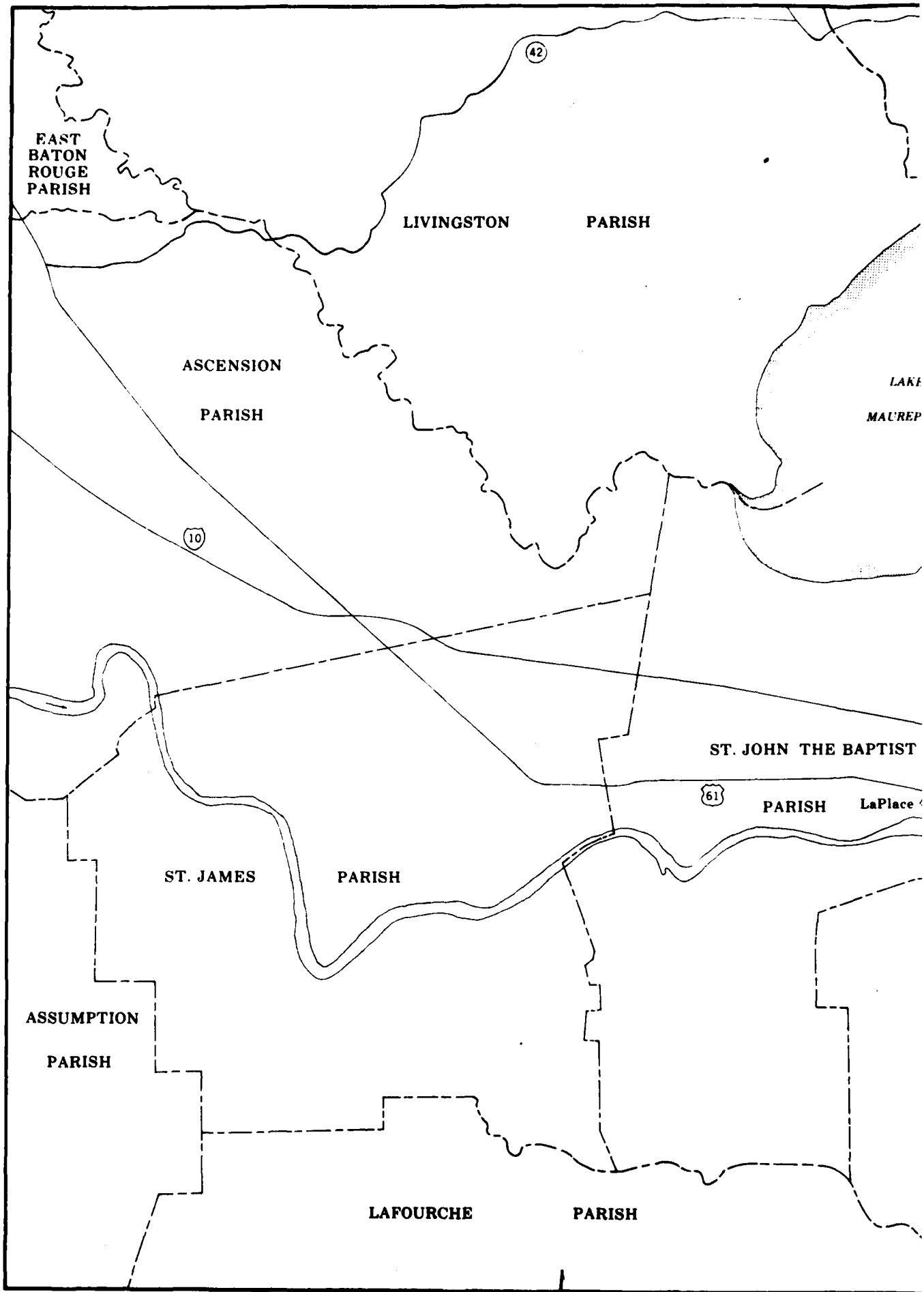
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CORPS OF ENGINEERS

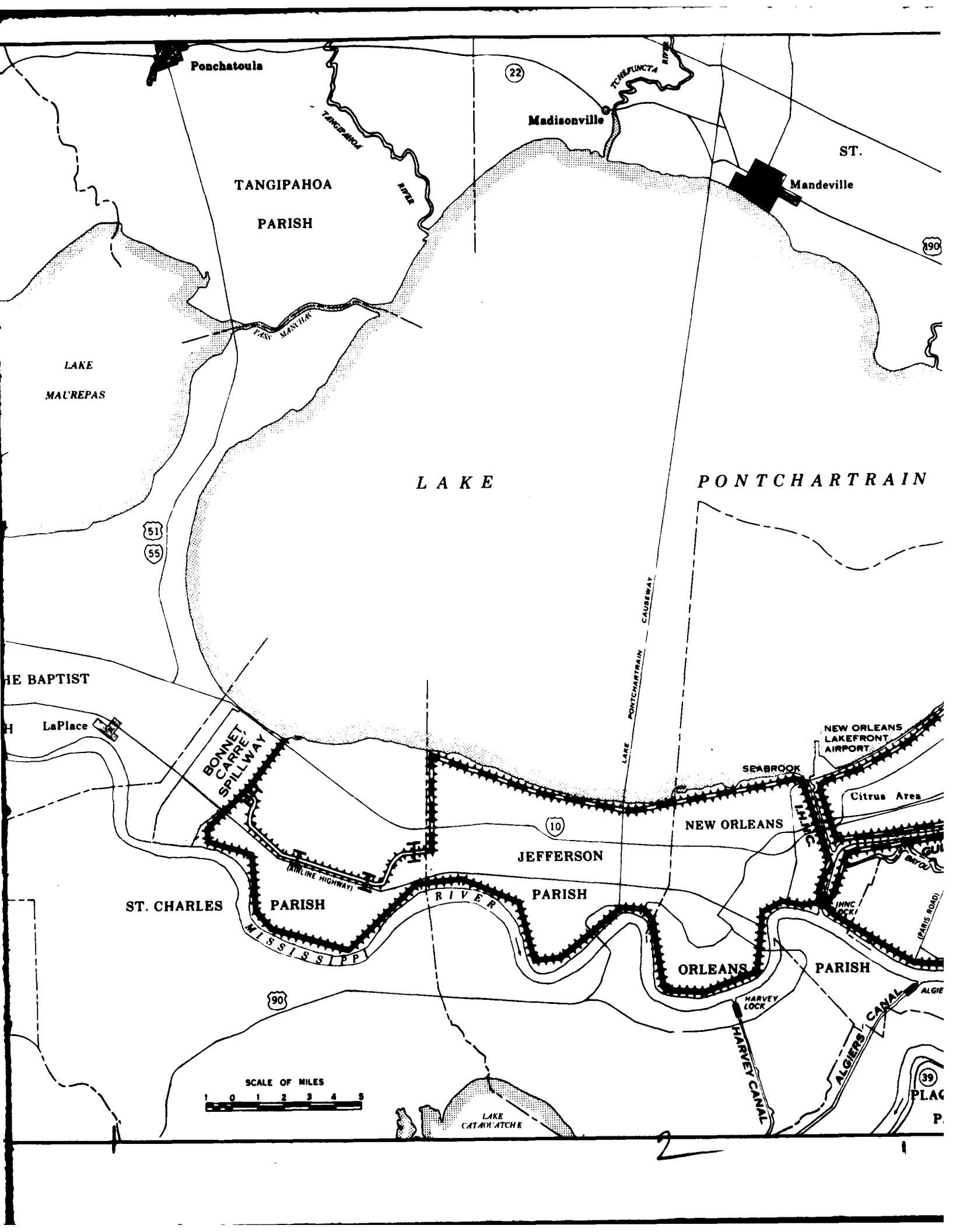
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FIGURE 1

(See Figure 2). The levee alignment in St. Charles Parish was moved from the lakefront to just north of Airline Highway (US 61). The high level plan was approved and completion of hurricane protection by that method was started in 1985.

3.4. There have been numerous prior reports concerned with navigation and flood control in the area. A summary of pertinent reports is contained in the 1984 Reevaluation Study/EIS. All the above mentioned reports are incorporated by reference.





Ponchatoula

22

Madisonville

ST.

Mandeville

TANGIPAHOA
PARISH

190

LAKE
MAUREPAS

LAKE

PONTCHARTRAIN

51
55

THE BAPTIST

LaPlace

BONNET
CARRE
SPILLWAY

NEW ORLEANS
LAKEFRONT
AIRPORT

SEABROOK

Citrus Area

NEW ORLEANS

10

JEFFERSON

ST. CHARLES

PARISH

MISSISSIPPI
RIVER

PARISH

ORLEANS

PARISH

90

HARVEY LOCK

HARVEY CANAL

ALGERS CANAL

39

PLAC
P.

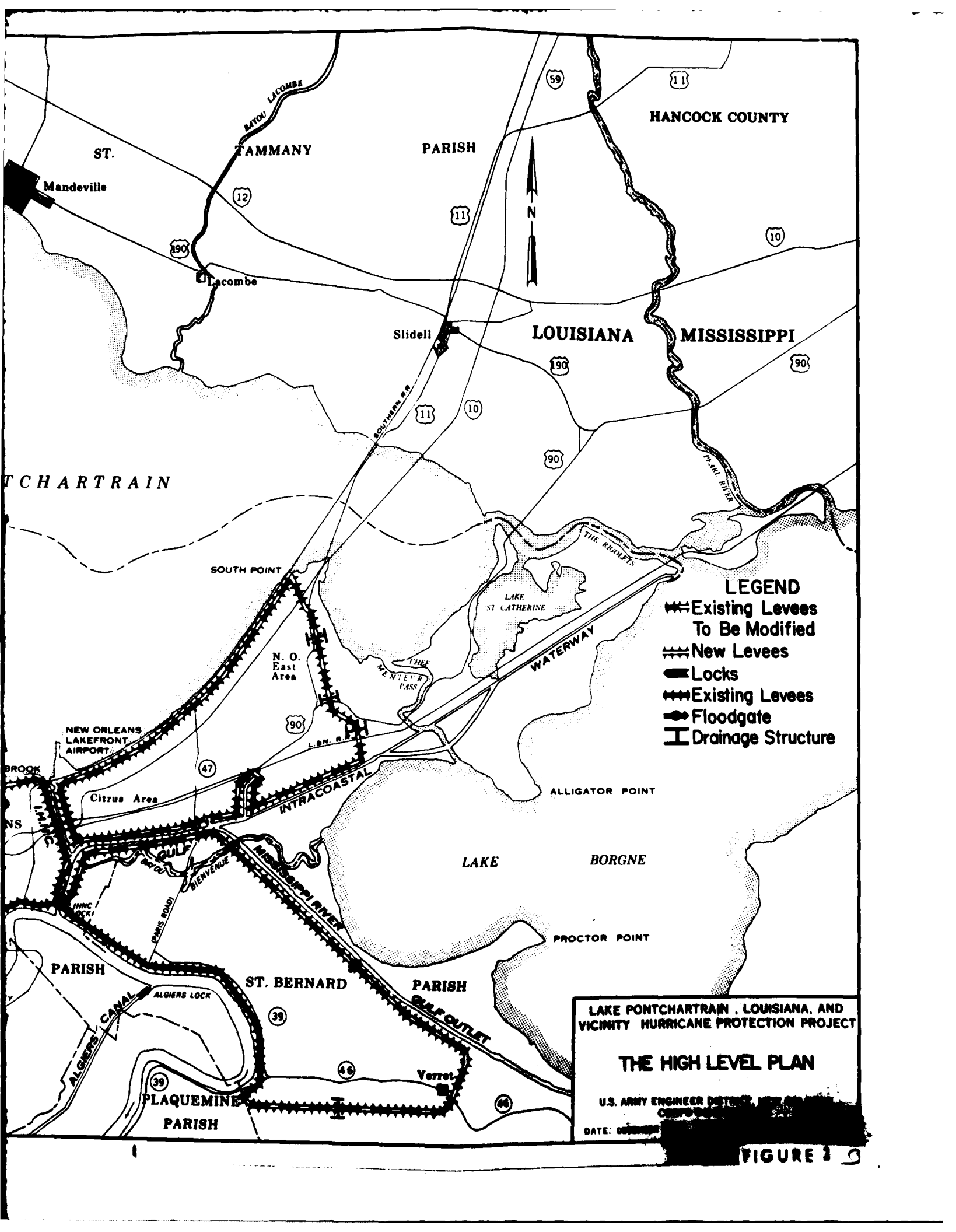
SCALE OF MILES



LAKE
CATAOUCHE

2

1



HANCOCK COUNTY

ST.

TAMMANY

PARISH

Mandeville

Lacombe

Slidell

LOUISIANA

MISSISSIPPI

PONTCHARTRAIN

SOUTH POINT

N. O. East Area

NEW ORLEANS LAKEFRONT AIRPORT

LEGEND

- Existing Levees To Be Modified
- New Levees
- Locks
- Existing Levees
- Floodgate
- Drainage Structure

WATERWAY

ALLIGATOR POINT

LAKE BORGNE

PROCTOR POINT

PARISH

ST. BERNARD

PARISH

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT

THE HIGH LEVEL PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LOUISIANA

DATE: [REDACTED]

PLAQUEMINE

PARISH

Verret

FIGURE 3

4. IMPACTS OF HURRICANE PROTECTION PROJECT

4.1 INTRODUCTION

The Reevaluation Study contained only a preliminary conceptual mitigation plan. Since that time, mitigation planning has been refined. This mitigation study analyzes impacts associated with the pre-1984 barrier plan construction as well as those associated with past and future high level plan construction. Since the hurricane protection plan is extensive, impacts occurred in four parishes: Jefferson, Orleans, St. Bernard, and St. Charles.

4.2 ACREAGE IMPACTS IN 1984 FINAL EIS

4.2.1. The total acreage of wildlife habitat lost as a result of the hurricane protection project is averaged over the 100-year project life and is expressed as an annualized value defined as the average annual acre. The following average annual acres of valuable wildlife and fishery habitats were lost due to barrier plan construction between 1967 and 1984: marsh, 922; marsh pond, 222; and forested wetlands, 20.

4.2.2. Activities from 1984 through the end of the project life in 2095 would cause the loss of the following average annual acres: marsh, 40; marsh pond, 11; and wooded wetlands, 114. The losses occur over a 128-year period however, they have been adjusted in order that they may be compared to the same 100-year period used for economic analysis. An explanation of

how the conversions were made is explained on page A-6 of the Fish and Wildlife Coordination Act Report, Appendix A. The 1984 Final EIS discussed the use of 477 acres of lake bottoms in Jefferson Parish as borrow. In May 1987, a Supplemental Information Report (SIR) deleted these borrow areas, since hauled fill or a recurved I-wall will be used along the Jefferson Parish lakefront. No borrow will be taken from the lake. Table 2 shows wildlife habitat losses due to the hurricane protection project.

4.3. IMPACTS SINCE 1984 FINAL EIS

Additional impacts resulting from refinements in levee alignment and need for additional borrow areas since publication of the 1984 Final Supplemental EIS have been evaluated in several SIR's which have been referenced in the Literature Cited section of the EIS. For further discussion of these impacts, see Appendix E.

4.4. RECREATIONAL AND COMMERCIAL WILDLIFE AND FISHERY IMPACTS

Data for this analysis are from the U.S. Fish and Wildlife Service (USFWS) Coordination Act Report (Appendix A). Average annual man-days of hunting and sportfishing attributable to various habitat types were computed and multiplied by the average annual acres impacted by the hurricane protection project. Total man-day losses were calculated and are shown in Table 3. The monetary value of these man-days is also shown. The commercial fishery value attributable to various habitats was calculated

TABLE 2
 ACRES OF WILDLIFE HABITAT IMPACTED BY
 CONSTRUCTION OF THE HIGH LEVEL HURRICANE PROTECTION PLAN

Habitat Type	Average Annual Acres Lost <u>1/</u>	Resource Category <u>2/</u>
Fresh Intermediate Marsh	-108	2
Brackish Marsh	-854	2
Marsh Pond	-233	2
Cypress Tupelo	-114	2
Bottomland Hardwood	-20	2

1/ Acreage change due to the project is calculated on an annualized basis over the life of the impact. The acreages used in these calculations are taken from Hankla (1985) and are converted to a 100-year period of analysis using a methodology similar to that described for the Habitat Evaluation procedures in Appendix A of the U.S. Fish and Wildlife Coordination Act Report (May 1987) found in Appendix A.

2/ Resource categories are used by the USFWS to insure that the level of mitigation recommended is consistent with fish and wildlife resources involved. Resource category two indicates that this habitat rates high for the evaluation species and is relatively scarce or becoming scarce in the ecoregion.

TABLE 3

AVERAGE ANNUAL MAN-DAY, COMMERCIAL FISHERY AND MONETARY LOSSES
ATTRIBUTABLE TO THE LAKE PONTCHARTRAIN, LOUISIANA, HURRICANE
PROTECTION PROJECT

Activity	Man-days	Poundage	Value (\$)
Sport fishing	-15,667		-\$61,101
Commercial fishing		-361,858	- 92,938
Hunting	- 1,078		- 9,550
Wildlife-oriented recreation	- 615		- 2,391
Trapping			- 3,290
Total	-17,360	-361,858	-169,270 ^{1/}

^{1/} Values reported in this table are taken from the Coordination Act Report.

and multiplied by the average annual acres impacted to show the pounds and dollar value of commercial fish affected by the hurricane protection project. The value of trapping losses was similarly calculated. Based on the 1986 net value per acre, an annual loss of \$169,270 could occur due to hurricane project implementation.

4.5. HABITAT IMPACTS

The USFWS has developed a methodology of describing impacts and determining mitigation needs called Habitat Evaluation Procedures (HEP). This system is based on the assumption that all habitat has inherent value to wildlife and that impacts on wildlife habitat in terms of modifications in quality and quantity can be measured and compared. In implementing the HEP (1980 version), a representative list of species or species groups is selected for the project area, and these species (or groups) are used as evaluation elements in determining habitat quality. The habitat suitability for each of the evaluation elements is rated between 0 and 1, with 0 being the poorest and 1 being the optimal score. Rating is done by biologists with the FWS, NOD, and the Louisiana Department of Wildlife and Fisheries. Scores for all sample plots within a particular habitat type are averaged for each species or group, and the resulting number is called the Habitat Suitability Index (HSI) for that evaluation element in that habitat type. A weighted average HSI must be derived for those species that are evaluated in more than one habitat type. The HSI for each evaluation element is then multiplied by the total area (acres) of

available habitat to determine the total number of Habitat Units (HU's). HU's are the product of quality (HSI) and quantity (area) of the habitat for a particular species and provide a standardized basis for comparing habitat changes over time and space. HU's are calculated for certain target years throughout the project life, based on acreage and HSI predictions. The HU values are then annualized to obtain an Average Annual Habitat Unit (AAHU) figure for each species. A comparison of AAHU's under future-with project and future- without-project conditions yields, for each species, the net loss in AAHU's that would result from project implementation. A summary of the results of the HEP analysis of hurricane project impacts is shown in Table 4.

4.6. IMPACTS TO AQUATIC RESOURCES

The recreational/commercial analysis above reflects impacts to wildlife and fisheries caused by marsh, marsh pond, and cypress-tupelo loss. The HEP analysis considers only wildlife losses. Evaluation of the impacts associated with overall aquatic resources was somewhat more subjective due to the absence of an available standardized procedure for habitat analysis. A combination of professional judgment and existing fishery data pertinent to the area was utilized. Fishery losses were based on the acreage of lake bottom impacted by construction (average annual acres) and the estimated importance of the nearshore lake habitat and benthic food chain to sport fish production (Rogillio and Brassette, 1977). Using this rationale, sport fish production could be potentially reduced by as much as 37,100 pounds per year.

TABLE 4

AVERAGE ANNUAL HABITAT UNIT (AAHU) LOSSES ATTRIBUTABLE TO THE LAKE
PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION
PROJECT

Evaluation Element	AAHU Losses due to the Project ^{1/}
Nutria	-404
Muskrat	-470
Raccoon	-408
Shorebird	-332
Deer	-221
Puddle Duck	-443
Diving duck	-332
TOTAL	-2610

^{1/} From USFWS Coordination Act Report in Appendix A.

4.7. NON-QUANTIFIABLE IMPACTS

The acres lost and the accompanying man-days, pounds of fish, furs, and AAHU's can be quantified. However, the wetlands of the area impacted by the hurricane protection project also have numerous other values to which no numbers can be attached. Such areas are esthetically pleasing places to escape urban life. They also serve to store water for flood control and act as buffers against surges from hurricanes.

5. ANALYSIS OF MITIGATION REQUIREMENTS

5.1. Several quantitative methods were used to evaluate mitigation requirements: average annual acres impacted, recreational/commercial wildlife and fishery impacts, and total AAHU's lost.

5.2. Mitigation can be based on replacing the average annual acres lost with an equal number of average annual acres. The USFWS has classified all marsh, marsh pond, and forested wetlands impacted as Resource Category 2 (see Appendix A). Thus, according to USFWS mitigation policy, those losses must be replaced by habitat in Resource Category 2. The tentatively selected plan both fulfills USFWS's obligation and remains consistent with Corps policy, since mitigation is accomplished by the most efficient and cost effective method. To achieve 100-percent mitigation, 1,329 average annual acres must be replaced. The recreational/commercial losses must be replaced with enough acreage to provide \$169,270 yearly to achieve 100-percent mitigation. If total AAHU's are replaced, 2,610 AAHU's would be needed to attain 100-percent mitigation.

5.3. USFWS calculated the mitigation requirement by using HEP. They compared the ratio of AAHU's lost due to the project to AAHU's gained by a specific mitigation alternative. This method gave a different acreage for each species. A sum of squares technique then was used to calculate the size of the optimum mitigation area. Using this approach, this size of the optimum area varies, depending on the quality of habitat. Approximately

4,000 to 5,000 acres of wetlands are necessary to achieve 100-percent mitigation. The acres necessary to mitigate in this manner are referred to as HEP acres.

5.4. The remainder of this report describes efforts to formulate plans to mitigate project impacts and to analyze the beneficial and adverse impacts of these mitigation plans.

6. PROBLEMS AND OPPORTUNITIES FOR MITIGATION

6.1. PROBLEMS

Southeastern Louisiana is losing approximately 40 square miles of wetlands per year (Wicker, 1980). A great deal of this loss is occurring in the Pontchartrain Basin. Between 1956 and 1978, the loss rate of interior marsh generally varied from 0.2 to 1.5 percent per year in the basin. Both natural and man-induced factors cause the land loss: subsidence, saltwater intrusion, animal "eat-outs", hurricanes, leveeing of the Mississippi River, and development. Marsh losses in terms of site acreage within the unprotected basin can exceed 100 acres per year as is evident in St. Charles Parish. In addition, the unprotected shoreline of Lake Pontchartrain is generally eroding at the rate of approximately 20 feet per year. Shoreline erosion is of special concern on public lands in the basin--the Manchac WMA and the Bayou Sauvage National Wildlife Refuge (currently being acquired).

6.2. OPPORTUNITIES FOR MITIGATION

Mitigation can best be achieved by avoidance or design considerations. Where these are not practical, measures to reduce future land loss are appropriate. Foreshore protection is a proven and effective method of reducing land loss. Water level control can prevent future land loss or freshen brackish marsh or reduce turbidity by controlling saltwater

intrusion and reducing tidal flux. Marsh can be created by pumping dredged material into open water. All these methods were considered in plan formulation.

6.3. MITIGATION BY AVOIDANCE

6.3.1. The need for mitigation was minimized by careful project planning. The decision to change the method of hurricane protection from a Barrier Plan to a High Level Plan of protection resulted in preventing numerous acres of wildlife habitat, especially marsh, from being permanently impacted by direct construction activity. To further reduce impacts, levee alignments were restricted to existing levee rights-of-way on previously disturbed or developed areas to the maximum extent practicable. Biologically sensitive areas, including habitats important to endangered species, were identified and avoided. Various methods of levee construction were considered to reduce impacts. Floodwall construction on an existing levee base was utilized to eliminate the area of levee impact and reduce the need for fill material and associated water quality problems. Since the 1984 Final EIS, the use of hydraulic fill from the lake in Jefferson parish has been deleted. A recurved I-wall or levee built of fill hauled from the Bonnet Carre' Spillway will be used. This prevents the disturbance of 636 average annual acres of nearshore lake by borrowing. In addition, the new levee will be built on the existing levee and thus the filling of 453 acres of nearshore lake would be avoided.

6.3.2. Hurricane protection plan designs have incorporated water control structures to maintain the existing hydrologic regime; thus, marsh and wooded habitat would be as nearly similar as possible to preproject conditions. In the originally authorized plan, the levee alignment in St. Charles Parish was along the lakefront. There was extensive environmental opposition to such an alignment because it would enclose 28,000 acres of wetlands and impact 1,000 more by construction. Due to these considerations, the St. Charles portion of the project was put into an indefinitely deferred status in the mid-1970's. The recommended plan in the 1984 EIS moved the St. Charles levee alignment to just north of Airline Highway. This alignment would protect the developed portion of the parish but leave the 28,000 acres of wetlands open to normal interchange with the lake.

7. PLAN FORMULATION

7.1. OVERVIEW

The mitigation planning included considerable public involvement. Numerous meetings were held with state and Federal agencies as well as the local assurers. EIS scoping meetings were held in New Orleans in July 1984, December 1984, and July 1985. The plan formulation process was conducted in accord with the U.S. Water Resources Council "Principles and Guidelines for Planning Water Related Resources." A planning objective and planning constraints were defined. Mitigation measures to address the objectives and constraints were identified. These measures were incorporated into an array of plans that were assessed and evaluated in terms of their efficiency, effectiveness, acceptability, and environmental impacts. Analyzing historical trends formed the base for forecasting future conditions with and without the plans. The two best plans were carried into the final array of planning and compared to select the best plan.

7.2. PLANNING OBJECTIVES

The following planning objectives were established in response to identified problems, needs, and opportunities:

- o Develop the best plan from economic, environmental, and social standpoints that fully mitigates the significant habitat losses as well

as fish, wildlife, and recreation losses resulting from construction of the Lake Pontchartrain, Louisiana, and Vicinity, Hurricane Protection Project.

- o Effect 100 percent replacement of the 2,610 AAHU's lost as well as the the \$169,270 dollars lost annually due to implementation of the hurricane protection project.

7.3. PLANNING CONSTRAINTS

Plans must be responsive to relevant legislative and executive authorities and must specifically demonstrate that they:

- (1) are technically sound and complete;
- (2) focus on significant impacts;
- (3) are effective, efficient, acceptable, and responsive to the planning objectives noted in paragraph 7.2.
- (4) reasonably minimize the acquisition of private land;
- (5) are justified on the basis that monetary and non-monetary benefits of the last management increment added exceed the monetary and non-monetary cost of that added increment;
- (6) fully account for all relevant social, economic, and environmental trade-offs affecting the acceptability and implementability of recommended measures; and
- (7) have institutional arrangements to insure that timely and effective implementation is possible.

7.4. MITIGATION MEASURES

Mitigation measures available include shoreline protection, marsh creation and water level management.

7.5. INITIAL PLAN DEVELOPMENT

7.5.1. Based on the three fundamental mitigation measures and the planning constraints for the study, numerous mitigation sites were examined. Plans were developed for at least one site in each of the impacted parishes: St. Charles, St. Bernard, Jefferson, and Orleans. Two plans were also developed on public land in the Manchac WMA in St. John the Baptist Parish. An additional site was considered in Orleans Parish, east of the exit of Chef Menteur Pass from Lake Pontchartrain. However, further evaluation revealed shoreline and interior marsh erosion were minimal, so this site was deleted from further consideration.

7.5.2. The scoping process revealed that each of the four local assuring parishes desired that one plan that mitigated losses within each of their parishes be formulated. As a result, the most efficient plan possible to achieve this desire was developed.

7.5.3. During the lengthy process of plan formulation, local or private interests started actively implementing some of the plans initially considered. Three marsh management/creation plans in the LaBranche

wetlands of St. Charles Parish and one marsh management plan near Lake Lery in St. Bernard Parish (Plan C) fall into this category. In addition, the Corps of Engineers has refined its plans for construction of the Jefferson Parish Lakefront Levee and marsh creation will no longer be possible on project lands there (Plan G). Thus these five plans have been dropped from consideration.

7.6. DESCRIPTION OF PLANS REMAINING AFTER INITIAL SCREENING

7.6.1. Introduction. Table 5 is an economic comparison of the plans considered and Table 6 summarizes cost data and mitigation effectiveness for the 8 plans that were formulated and carried through to mid-level planning. The 8 plans are described in the following paragraphs. Plate 1 shows the general location of each plan. The elevation of the rock dike foreshore protection, referenced in the following discussion of plans and illustrated in Plate 2, is approximately one foot above normal lake level in most cases. This dike acts as a breakwater to minimize wave attack.

7.6.2. PLAN A - St. Bernard Foreshore Protection (A&B). This plan consists of protection of brackish marsh adjacent to the Mississippi River-Gulf Outlet (MR-GO) through the use of a 2-foot rock dike along the Lake Borgne shoreline and a used-tire/timber pile breakwater along the MR-GO shoreline (See Plate 3).

7.6.3. PLAN B - St. Bernard Foreshore Protection (A&B and marsh creation). This plan consists of marsh creation within the same two units

TABLE 5
ECONOMIC COMPARISON OF PLANS CONSIDERED

PLAN	FIRST COST *	INTEREST DURING CONSTRUCTION (IDC)	GROSS INVESTMENT COST **	PRESENT VALUE OF O&M****	ANNUAL OPERATION MAINTENANCE & REPLACEMENT	I & A ***	AVERAGE ANNUAL COSTS ****	AVERAGE ANNUAL BENEFITS
A	\$7,236,000	\$112,000	\$7,348,000	\$4,915,000	\$161,000	\$241,000	\$402,000	\$24,000
B	\$7,419,000	\$115,000	\$7,534,000	\$4,915,000	\$161,000	\$247,000	\$408,000	\$35,000
D	\$4,692,000	\$73,000	\$4,765,000	\$2,473,000	\$81,000	\$156,000	\$237,000	\$16,000
E	\$14,485,000	\$225,000	\$14,710,000	\$12,118,000	\$397,000	\$482,000	\$879,000	\$10,000
F	\$12,623,000	\$196,000	\$12,819,000	\$2,938,000	\$129,000	\$420,000	\$549,000	\$29,000
M	\$5,062,000	\$78,000	\$5,140,000	\$3,388,000	\$111,000	\$168,000	\$279,000	\$37,000
N	\$13,377,000	\$207,000	\$13,584,000	\$8,242,000	\$270,000	\$445,000	\$715,000	\$43,000
O	\$4,090,000	\$63,000	\$4,153,000	\$2,747,000	\$90,000	\$136,000	\$226,000	\$31,000

* FIRST COST = REAL ESTATE + CONSTRUCTION COSTS

** GROSS INVESTMENT COSTS = FIRST COST + IDC

*** INTEREST AND AMORTIZATION (I&A) = FIRST COST X IDC FACTOR X I&A FACTOR

**** AVERAGE ANNUAL COSTS = I&A + O&M

***** OPERATION, MAINTENANCE AND REPLACEMENT

TABLE 6
COMPARISON OF PLANS ANALYZED IN MID-LEVEL PLANNING

Plan Symbol	Plan Name	Total AAHU's Provided	AAHU's Mitigated	Avg. Ann. Cost/AAHU (\$)	Man-days/Monetary Gain	% Man-days/Monetary Mitigated	Avg. Ann. Preserved by Mitigation	% Avg. Ann. Ac. Mitigated	Avg. Ann. Cost/Avg. Ann. Ac. (\$)	HEP Acres Available	HEP Acres Required	% Mitigation Provided by HEP Acres
A	St. Bernard Foreshore (A&B)	970	37	414	28,340	30	467	35	861	592	986	60
B	St. Bernard Foreshore (AB's Marsh Creation)	989	38	413	38,649	41	509	38	802	592	968	62
D	Orleans Foreshore (rock)	1,088	42	218	26,384	28	554	42	428	6,401	17,407	37
E	Orleans Foreshore (islands)	1,088	42	808	26,384	28	554	42	1,587	6,401	17,407	37
F	Orleans Bypass Restoration	343	13	1,600	28,646	30	304	23	1,806	308	1,921	16
M	Manchac Foreshore (entire)	2,778	106	100	52,254	55	1,189	89	235	7,487	5,464	137
H	Combination in Each Parish											
H	St. Bernard Foreshore A	297	-	-	12,381	-	153	-		181	957	-
H	Orleans Foreshore (rock)	1,088	-	-	26,384	-	554	-		6,401	17,407	-
H	St. Charles Marsh Cres. (unconfined)	705	-	-	21,050	-	389	-		494	1,528	-
	TOTAL	2,160	83	342	68,284	66	1,130	85	652	7,111	20,999	34
	Manchac Foreshore (South)	2,511	96	90	37,774	40	1,282	82	209	4,726	3,803	124
O	Losses due to Hurricane Protection Project Construction	2,610	-	-	95,193	-	-1,329	-	-	-	-	-

that were protected in Plan A. The marsh would be built with material dredged during MR-GO maintenance (See Plate 3).

7.6.4. PLAN D - Orleans Foreshore Protection (Rock). This plan consists of protection of brackish marsh north and west of Chef Menteur Pass from shoreline erosion through the construction of 2-foot high rock dike with marsh planted behind it (See Plate 4). A large portion of this marsh has been designated to become part of the Bayou Sauvage National Wildlife Refuge.

7.6.5. PLAN E - Orleans Foreshore Protection (Islands). This plan consists of protecting the same area as Plan D (see Plate 4), but with an artificial barrier island instead of a rock dike (see Plate 5). This alternative form of shoreline protection was proposed for detailed design and evaluation by Sherwood M. Gagliano, Ph.D., of Coastal Environments Inc. representing South Point Inc., former owners of the area to be protected in Plan E.

7.6.6. PLAN F - Orleans Bypass Restoration. This plan consists of creation of marsh by filling of the GIWW Bypass Channel with hydraulically dredged material taken from the GIWW. The shore of Lake Borgne just south of the bypass would be protected with a rock dike (see Plate 6). This alternative would reverse a previous project impact because the Bypass Channel was excavated as part of the abandoned plans to build a hurricane barrier in the Chef Menteur Pass.

7.6.7. PLAN M - Manchac Foreshore Protection (entire). This plan consists of the protection of the Manchac WMA from shoreline erosion through the use of a 6.25-mile foreshore protection dike with marsh planted behind it (see Plate 8). This alternative is on public lands.

7.6.8. PLAN N - Combination with Mitigation in Each Parish. This plan consists of a combination including Plan D (Plate 4), and the A portion of Plan A (Plate 3), and the C portion of Plan I (Plate 7).

7.6.9. PLAN O - Manchac South Foreshore Protection. This plan consists of protecting the southern portion of the Manchac WMA by a 5-mile foreshore protection dike with marsh behind it. This alternative is on public lands (Plate 8).

7.7. SCREENING OF PLANS

7.7.1. One of the objectives of mitigation is to effect 100-percent replacement of the 2,610 annual habitat units (AAHU's) lost. While cost is not the primary consideration in mitigation, it does become a factor affecting plan implementation due to the depressed economic climate in the study area. Higher costs directly affect the local assurer's ability to cost-share and therefore implement a mitigation plan. Thus, quantity of mitigation, as measured by the percent of the AAHU losses mitigated, in combination with average annual costs, provides the basis for mid-level screening. All plans which mitigate less than 85% and with average annual costs over the arbitrary figure of \$200 per AAHU were eliminated (A, B, D, E, F, and N). It should be noted that all these plans, except D (see

Table 5), have excessive first costs ranging from over \$7,000,000 to more than \$14,000,000.

7.7.2. The two remaining plans, M and O, mitigate 106 percent and 96 percent of the AAHU losses, respectively, and both cost \$100/AAHU or less.

8. FINAL ARRAY OF PLANS

8.1. INTRODUCTION

The alternatives providing foreshore protection for the Manchac WMA, Plans M and O, were selected as final plans for evaluation. Plan O provides 2,511 AAHU's (96 percent of the losses) at a cost of \$90 per AAHU and protects approximately 80 percent (5 miles) of the shoreline of the Manchac WMA. Plan M, which would require construction of foreshore protection along the entire shoreline, provides 2,778 AAHU'S (106 percent of the losses) at a cost of \$100 per AAHU. Both plans would be acceptable to the proposed sponsor, the Louisiana Department of Wildlife and Fisheries.

8.2. MANCHAC FORESHORE PROTECTION PLAN, ENTIRE (PLAN M)

Shoreline protection would be provided to 6.25 miles of that portion of the Manchac WMA shoreline that borders Lake Pontchartrain. The limits of the protection would extend from Pass Manchac to approximately 2,000 feet south of the WMA boundary (Plate 8). A series of discontinuous, 2-foot rock dikes, each approximately 500 feet in length (50-foot gaps between each dike), would be located 180 feet offshore. This shoreline protection would be supplemented by planting of marsh grasses or plants in the area immediately landward of the dike. The results of this plan would be to preserve approximately 600 average annual acres of marsh and cypress and

600 average annual acres of marsh pond from becoming nearshore lake habitat.

8.2.1. Monetary Costs and Benefits. The first costs estimated at \$5,062,000 (Table 5). Based on 3-1/8 percent rate of return and a 100-year project life, the average annual costs for the plan are approximately \$279,000 and include average annual operation, maintenance, and replacement (OM&R) costs of \$111,000 and interest and amortization of \$168,000. The benefits attributable to implementing this plan are estimated to average \$37,000 annually and are derived from sport and commercial wildlife and fishery usage on the acreage of marsh protected from shoreline erosion (Table 7). All estimates are adjusted to October 1987 price levels.

8.2.2. Cost Allocation. All costs for the construction and OM&R of the plan would be allocated to hurricane protection, since losses to be mitigated were incurred as a result of providing hurricane protection.

8.2.3. Cost Apportionment. Under cost-sharing policies, which apply to the project due to legislative authority, the total investment cost (the gross investment cost and present value of OM&R from Table 5) to complete the project, \$8,528,000, would be apportioned \$5,970,000 to the Federal Government and \$2,558,000 to non-Federal interests (Table 8).

TABLE 7
MONETARY BENEFITS

Activity	PLAN M MANCHAC ENTIRE			PLAN O MANCHAC SOUTH		
	Baseline	Without Mit.	With Mit.	Baseline	Without Mit.	With Mit.
Sport Fishing & Hunting	\$428,800	\$419,800	\$443,000	\$256,500	\$244,700	\$265,000
Commercial Fishing	228,600	228,500	239,400	135,300	134,000	142,800
Trapping	37,300	36,900	38,800	22,200	21,700	23,200
TOTALS	\$694,700	\$685,200	\$721,700	\$414,000	\$400,500	\$431,000
Net Average Annual Benefits		\$36,500			\$30,500	

TABLE 8
FEDERAL/NON-FEDERAL COST SHARING RESPONSIBILITIES

Plan	Construction		Operation & Maintenance				Total Share	
	70% Federal	30% Non-Federal	Present Value OM&R	70% Federal	30% Non-Federal	Federal	Non-Federal	
M	5,140,000	3,598,000	1,542,000	3,388,000	2,372,000	1,016,000	5,970,000	2,558,000
O	4,153,000	2,907,100	1,245,900	2,747,000	1,922,900	824,100	4,830,000	2,070,000

*GROSS INVESTMENT COSTS - CONSTRUCTION COSTS AND INTEREST DURING CONSTRUCTION

8.2.3.1. The project construction responsibility is all Federal and the gross investment cost (including construction and interest during construction) is estimated to be \$5,140,000. The Federal share of these costs will be \$3,598,000 and the non-Federal share will be \$1,542,000 to be provided by the local sponsor prior to initiation of the construction.

8.2.3.2. The actual OM&R of the project will be a non-Federal responsibility. The present value of such work is estimated to be \$3,388,000 over the life of the project. The Mitigation Cooperation Agreement will provide for the Federal government to pay its \$2,372,000 share to the non-Federal in a single payment at the initiation of maintenance. Non-Federal interests will perform all OM&R of the project. The non-Federal share for OM&R is \$1,016,000.

8.3. MANCHAC FORESHORE PROTECTION PLAN (SOUTH), PLAN 0

Shoreline protection would be provided for approximately 5.0 miles of the portion of the Manchac WMA bordering Lake Pontchartrain. The portion of the shoreline to be protected would extend from 2,000 feet south of the WMA boundary to First Canal (Plate 8). A series of low level rock dikes supplemented with marsh plantings between the shoreline and dikes would be utilized to reduce marsh loss and shoreline erosion. These foreshore protection dikes would be non-continuous, each being approximately 200 feet in length, 2 feet in height, with 50-foot gaps between each dike length. The rock dike would be extended approximately 2,000 feet beyond the

southern boundary of the WMA to produce a "shadow effect," thus eliminating erosion of the shoreline around the end of the dike. At the northern end, a similar shadow would extend 200 feet beyond First Canal. The dike extension required to produce the shadow effect on the northern end of protection is reduced due to the additional protection afforded by the berm along the First Canal.

8.3.1. Costs and Benefits. The first cost of providing this type of foreshore protection is estimated at \$4,090,000 (Table 5). Based on 3-1/8 percent rate of return and a 100-year project life, the average annual costs would be approximately \$226,000 and include the average annual OM&R costs of \$90,000 and interest and amortization of \$136,000. The benefits attributable to implementing this plan are estimated to average \$31,000 annually and are derived from sport and commercial wildlife and fishery usage on the acreage of marsh protected from shoreline erosion. All costs are adjusted to October 1987 price levels.

8.3.2. Cost Allocation. All costs for construction, operation, and maintenance of the plan would be allocated to hurricane protection, since losses to the mitigated were incurred as a result of providing hurricane protection.

8.3.3. Cost Apportionment. Under cost-sharing policies, which apply to the project due to legislative authority, the total investment cost to complete the project, \$6,900,000 would be apportioned \$4,830,000 to the Federal Government and \$2,070,000 to the non-Federal interests.

8.3.3.1. The project construction responsibility is all Federal and the gross investment cost (including construction and interest during construction) is estimated to be \$4,153,000. The Federal share of these costs will be \$2,907,100 and the non-Federal share will be \$1,245,900 to be provided by the local sponsor prior to initiation of the construction.

8.3.3.2. The project OM&R will be a non-Federal responsibility and the present value is estimated to be \$2,747,000 over the life of the project. The Mitigation Cooperation Agreement will provide for the Federal government to pay its \$1,922,900 share to the non-Federal sponsor in a single payment at the initiation of maintenance. The non-Federal sponsor will perform all OM&R of the project. The non-Federal share for OM&R is \$824,100.

8.4. ADEQUACY OF MITIGATION

Corps guidance and regulations provide for the evaluation of fish and wildlife resources upon both monetary and non-monetary values. Because these values arise primarily from the quantity and quality of the habitat in the impacted area, a habitat-based methodology, such as HEP, is utilized to assess mitigation needs, in terms of AAHU's, average annual acres, and HEP acres. Typically, a user-day or other monetary method of evaluation is used for comparative purposes and to project gains and/or losses. For detailed explanation of the HEP methodology, refer to the Fish and Wildlife Coordination Act Report (Appendix A). For aquatic resources, determining

the adequacy of mitigation is somewhat more subjective since there are no standardized procedures such as HEP. Therefore, the various alternatives were evaluated based on their ability to preserve or create habitat known to be productive for fishery resources. Both Plans M and O protect large quantities of highly productive fishery habitat. In addition, "The Prairie" and shallow nearshore lake habitat are protected by both plans.

8.4.1. Manchac Foreshore Protection (Entire). The HEP shows that the construction of the High Level Hurricane Protection Plan would create a loss of 2,610 AAHU's. Plan M would provide an annualized gain of 2,778 AAHU's or 106 percent of the AAHU's lost (Table 6)^{1/}. This plan compensates for 137 percent of the acreage required, based on HEP. In terms of average annual acres alone (not using HEP) this plan mitigates approximately 89 percent. Man-day/monetary analysis reveals that this plan mitigates 55 percent of the recreational losses.

8.4.2. Manchac Foreshore Protection (South). Plan O would provide an annualized gain of 2,511 AAHU's; thus, it would compensate 96 percent of the AAHU losses (Table 6). This plan compensates for 124 percent of the HEP acreage losses and 82 percent of the losses based on the average

^{1/} Appendix E discusses habitat losses incurred after the FEIS and Final Coordination Act Report were completed. These acres were not annualized, but they are shown to indicate that the overmitigation is less than discussed in this paragraph.

annualized acres alone (not using HEP). In addition, 40 percent of the recreational man-day/monetary losses are mitigated.

8.5. INCREMENTAL ANALYSIS

8.5.1. Separation of foreshore protection and marsh planting for incremental analysis is not practicable since these two components function together as one feature. The foreshore protection eliminates marsh loss due to shoreline erosion and simultaneously protects the marsh plantings. These plantings enhance shoreline protection through sediment capture and wave dissipation.

8.5.2. Several methods for implementing foreshore protection were evaluated; these included protected and unprotected marsh plantings, timber/tire breakwaters, and rock dike breakwaters. Based on consultations with the Corps of Engineers Waterways Experiment Station (WES), the use of unprotected marsh plantings would not be feasible due to the high energy wave environment at the site. Because of this high energy environment, the size of the timber/tire breakwater required would reduce cost effectiveness. While the rock breakwater may be somewhat more expensive, WES noted that the rock breakwater would be more reliable in this high energy environment. Once the engineering design was fixed, the only remaining variable is length of shoreline protection. During planning, various incremental lengths of protection were analyzed in an effort to determine how much shoreline could be economically protected and still maximize the mitigation of AAHU losses.

8.5.3. Plan M was developed first. It would protect the entire shoreline at a cost of \$100/AAHU and mitigates 106 percent (2,778 AAHU's) of the 2,610 AAHU loss. This plan overmitigates the losses calculated in HEP acres by 37 percent. During mid-level planning, to avoid overmitigation, protection of a shorter length of shoreline was studied. This abbreviated version of shoreline protection could not be determined arbitrarily for it is dependent on geographic features that provide firm ground for attachment of the dike and a suitable management unit on the WMA. Since "The Prairie" is the most valuable habitat in the WMA, a plan was developed that would protect the shoreline from First Canal to the southern boundary of the WMA. The natural embankment along First Canal provides a semi-confined management unit, plus high ground which could serve as a location where the dike could be connected. This plan was designated as Plan O. Plan O could be built at a cost of \$90/AAHU and mitigates 96 percent of the AAHU losses, but still overmitigates HEP acres by 24 percent.

8.5.4. Comparing costs, Plan O has an average annual cost of \$226,000 and provides 2,511 AAHU's while Plan M has an average annual cost of \$279,000 and provides 2,778 AAHU's. Therefore, only an additional 267 AAHU's (10%) are provided by protecting the additional increment of shoreline from First Canal to Pass Manchac (Plate 8). In actuality, only 99 AAHU's are needed to achieve 100 percent mitigation. However, the geographical constraints mentioned above make provision of 99 AAHU's exceedingly difficult. The average annual cost of this additional 267 AAHU's is \$53,000 (\$279,000 minus \$226,000). This calculates to \$199/AAHU compared to the \$90/AAHU of Plan O. The results indicate that an average annual expenditure of \$53,000 to build the last increment to obtain the additional 267 AAHU's is not

justified. Plan 0 still overmitigates HEP acres, but it undermitigates both by man-day monetary analysis and by average annual acres (see Table 6). The 96 percent mitigation of AAHU's is considered acceptable in light of the additional cost to achieve 100 percent mitigation of AAHU's.

9. AFFECTED ENVIRONMENT

9.1. STUDY AREA LOCATION

The study area includes the Lake Pontchartrain Basin with special emphasis placed on the wetland areas where mitigation alternatives have been formulated (see Plate 1).

9.2. GENERAL DESCRIPTION OF STUDY AREA

The study area is located in southeastern Louisiana. The dominant physiographic feature is Lake Pontchartrain, a shallow body of water with an area of 640 square miles, lying in the middle of an estuarine complex. The major human feature is the New Orleans Metropolitan area which is mostly concentrated on the south shore between the lake and the Mississippi River. The 1980 population of the area was 1.3 million people. The abundance of natural resources, including waterways, minerals, fisheries, wildlife, and a mild climate have contributed to the business and industrial development of the study area. Shopping, tourism, wholesale trade, and commercial fisheries are important to the economy. Unemployment in the area was 9.2% in November 1987. Marsh is the dominant habitat type in undeveloped areas. Marshes support a variety of mammals, waterfowl, wading birds, and reptiles. They also provide spawning and nursery areas for freshwater and estuarine fish and shellfish. The lake supports both a sport and commercial fishery for several species. Fossil clam shells are harvested from the lake. Sewerage-contaminated storm water and domestic

and industrial discharges enter the lake, especially along the south shore. Primary contact recreation is not recommended within 1/4-mile of the south shore. Residential development is also increasing on the north shore and contributing to the pollution of the lake. The study area contains many significant cultural resources listed in the National Register. Two forts, one town, three lighthouses, and two archeological sites are so listed. Numerous other archeological sites are located throughout the study area. These sites are characteristically Rangia shell middens located on relict natural levee ridges, beaches, and shorelines. Navigation through Lake Pontchartrain has existed since the early exploration of Louisiana. Numerous historic shipwrecks have been reported from the lake. The waters and wetlands provide extensive recreational opportunities for boating, waterfowl hunting, and observing wildlife. Sport fishing, crabbing, and shrimping are extremely popular.

9.3. SIGNIFICANT RESOURCES

The resources of the study area were analyzed and those that are significant and are impacted by mitigation are described in Table 9. A resource is considered to be significant if it is identified in the laws, regulations, guidelines, or other institutional standards of national, regional, and local public agencies; it is specifically identified as a concern by local public interests; or it is judged by the responsible Federal agency to be of sufficient importance to be designated as significant. Section 10 describes the baseline condition of each significant resource and compares it to the future with and without mitigation.

TABLE 9
Significant Recognition

RESOURCE	ECOLOGICAL ATTRIBUTES	CULTURAL ATTRIBUTES	ESTHETIC ATTRIBUTES	INSTITUTIONAL RECOGNITION	TECHNICAL RECOGNITION	PUBLIC RECOGNITION
MARSH	Habitat for fish and wildlife, especially waterfowl, wading birds and furbeaters. Prime nursery area for estuarine-dependent fish and shellfish.	Supports the traditional extractive economy of the Pontchartrain basin. Also protects archeological and historic sites located within these areas.	Typical Louisiana scenery includes ducks in a marsh.	Coastal Zone Mgmt. Act of 1972, La. State and Local Coastal Resource Mgmt. Act of 1978, EO 11900, EO 11988, Estuary Protection Act.	Habitat for 14 Species of Special Emphasis. Approximately 40 square miles being lost per year in coastal Louisiana. On a scale of 0-10, study area marsh ranks from 3-4 in value to wildlife. Marsh is assigned Resource Category 2 by USFWS, which means they recommend no net loss of in-kind habitat.	Environmental groups, sportsmen, and the general public desire preservation of marsh.
MARSH PONDS	Similar to marsh, but of more value to waterfowl, wading birds, and alligators.	Utilized for traditional extractive economy.	Ponds break the expanse of marsh and make the vista more pleasing.	Same as marsh.	On a scale of 1-10, ranks as 3 for wildlife. Resource Category 3, recommend minimizing in-kind losses.	Same as marsh.
NEARSHORE LAKE	Habitat for fish and wildlife. Major nursery area for estuarine dependent fish and shellfish.	Utilized for traditional extractive economy.	Expansive waterfront vistas provided around shoreline.	Clean Water Act of 1977, La. Water Control Law, Estuary Protection Act, Lake Pontchartrain has been proposed as a special management area.	Major nursery area. Habitat for 6 Species of Special Emphasis. On 1-10 scale, ranks as 0-4 for wildlife. Resource Category 3.	Environmental groups, sportsmen, and general public desire preservation of Lake Pontchartrain.
FISHERIES	Numerous species of fish and shellfish utilize the study area.	Traditional life-styles of many residents involve fishing.	---	Fish and Wildlife Coordination Act.	1 Species of Special Emphasis in study area.	Extensive recreational fishing occurs in study area.
WILDLIFE	Numerous species of wildlife utilize the study area.	Similar to fishing.	---	Fish and Wildlife Coordination Act.	23 Species of Special Emphasis in study area.	Some recreational hunting occurs in study area.
ENDANGERED SPECIES	---	---	---	Endangered Species Act, Bald Eagle Act.	---	---
BIRDS ON AUDUBON SOCIETY "BLUE LIST"	Showing decline in numbers or decrease in range.	---	---	Audubon Society.	1 Species on Blue List is a Species of Special Emphasis.	---
CULTURAL RESOURCES	None.	Serves as the Nation's official list of properties worthy of preservation for their significance in American history, architecture, archeology, and culture.	Many National Register properties in study area, such as Fort Pike, Lighthouses, Mandeville, 11591, archeological values.	National Historic Preservation Act of 1966, as amended, the National Historic Act of 1960, as amended, PL 11591, Archeological Resources Protection Act of 1979.	20 of the National Register properties are recognized for their national significance by designation as National Historic Landmarks.	Public recognition and support of historic preservation is strong. Reflecting national trends.
MANGLAC WILDLIFE MANAGEMENT AREA (WMA)	Area preserved for use by wildlife-marsh and pond.	---	Scenic marsh vistas. Little evidence of man's activity.	State WMA.	Habitat for numerous species of special emphasis.	Heavily utilized for public hunting and fishing.
RECREATION	Habitat for wildlife, potential for observing and interacting with nature, also conducive to recreational hunting and fishing.	---	---	Land and Water Conservation Fund Act of 1965.	Area currently satisfies 100,000 man-days of recreation annually.	Public desires expansion of lakefront recreation base, i.e., upgrading facilities, development of new marinas and additional boat ramp development.
SECTION 122 ITEMS	---	---	---	River and Harbor Flood Control Act of 1970 Section 122.	---	Public concern for these items is strong.

10. BASELINE, FUTURE WITHOUT PROJECT, AND EFFECTS OF PROJECT

10.1. INTRODUCTION

For each significant resource mentioned, the baseline condition will be described. Then, the future without mitigation will be discussed. Lastly, the impacts of the plan will be stated. Average annual acres present with and without mitigation will be compared. Then, the direct impacts of mitigation construction will be pointed out. See Table 10 for the system of accounts and comparative impacts of alternatives. The impacts of each plan on the following accounts are analyzed: National Economic Development (NED), Environmental Quality (E), Regional Development (R), and Social Well Being (S), and Other Social Effects (O). This table summarizes the information presented in the remainder of this chapter.

10.2. MARSH

10.2.1. Baseline for Manchac Foreshore Protection (Entire). The marshes in the Manchac WMA are of intermediate salinity - 0 to 7 parts per thousand (ppt). Predominant vegetation is bulltongue, deer pea, maidencane, and wiregrass. At the start of mitigation (1992), there would be 6,300 acres of marsh in the area (see Table 11). These marshes act as storm buffers between Lake Pontchartrain and developed areas of the coastal zone, have the capacity to absorb water pollutants, and provide nutrients and detritus to the productive coastal waters. The intermediate marsh functions as valuable habitat for waterfowl, furbearers, and the American alligator.

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Plan M		Plan O	
	Baseline	Without Mitigation	Manchac Foreshore Protection (Entire)	Manchac Foreshore Protection (South)
I Plan Description	N/A	N/A	<p>Located in St. John Baptist Parish; Protection of 6.25 miles of the Manchac WMA from shoreline erosion through use of a 2 ft. non-continuous foreshore protection dike. Protection supplemented with marsh plantings between dike and shoreline.</p>	<p>Located in St. John the Baptist Parish; would provide foreshore protection for approximately 5 miles of the Manchac WMA, with similar measures to Plan M.</p>
II Other factors in plan formulation				
a. Acceptability	N/A	<p>There is considerable concern about marsh loss in the study area and in South Louisiana in general.</p>	<p>Because this is a State WMA, there is local and State concern for its protection. In addition the Department of Wildlife and Fisheries has provided a letter of intent of its monetary support of the plan. Local assurers may or may not support this plan.</p>	<p>Similar to Plan M. Slightly less acceptable to state since less protection provided to WMA.</p>

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O
		Manchac Foreshore Protection (Entire)	Manchac Foreshore Protection (South)	
b. Efficiency	N/A	Cost per AAHU slightly higher than Plan O.	Cost per AAHU lowest.	Cost per AAHU lowest.
c. Effectiveness	N/A	Existing condition is least effective in meeting primary objective of 100% mitigation.	Very effective: Mitigates 106 percent of AAHU losses. Can be implemented in a brief period of time due to the simplicity of construction, no land acquisition requirements, and letter of intent to provide local share of funding. Plan provides immediate protection to badly damaged reach of WMA shoreline critical to the protection of a large expanse of marsh and pond.	Slightly less effective than Plan M (mitigates only 96 percent of AAHU losses). Otherwise, same as Plan M.
d. Risk & Uncertainty	N/A	Without mitigation there is a great risk of allowing marshes and associated wildlife resources to deteriorate to the extent that neither the marshes nor their benefits can be revived. The certainty of this loss is fairly high.	While marsh loss associated with shoreline erosion is expected to be eliminated by the plan, the certainty of the exact amount of loss prevented is moderate. It is based on the existing period of record for calculation of shoreline retreat, subsidence and estimated weather conditions. These risks and uncertainties are reflected in the conservative structures design and engineering.	Same as Plan M.

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O
		Without Mitigation	Manchac Foreshore Protection (Entire)	
Marsh (E)	The Manchac WMA under full protection has 6300 acres of intermediate marsh. South portion of the Manchac WMA contains 3600 acres of intermediate marsh.	At Manchac shoreline erosion severe, 5100 average annual acres present over project life. In southern portion of Manchac area, 2900 average annual acres present.	Shoreline erosion prevented. 5550 average annual acres present, Mitigation promotes net gain of 450 average annual acres. Approximately 140 acres should develop in accreted area.	Shoreline erosion prevented. 3200 average annual acres present, net savings of 300 average annual acres. Slightly less than 100 acres should be established through accretion and marsh plantings.
Cypress Community (E)	Manchac has 200 acres in fully protected area and slightly less in southern zone.	Shoreline erosion severe. 50 average annual acres present in fully protected area, essentially none in southern area.	Erosion prevented, 200 average annual acres present. Net gain of 150 average annual acres.	Shoreline erosion prevented, 200 average annual acres present. Net gain of 200 average annual acres.

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O
		Without Mitigation	Manchac Foreshore Protection (Entire)	
Marsh Ponds (E)	Highly valuable for fish and wildlife resources. Manchac -750 acres, mostly in the Prairie. Slightly less valuable for fish & wildlife resources than marsh.	At Manchac, severe shoreline erosion would destroy the Prairie. Interior subsidence would result in presence of 900 average annual acres in entire area and 500 in southern portion.	Shoreline erosion prevented. The Prairie preserved. 1500 average annual acres present. Net gain of 600 average annual acres.	Southern Manchac 1100 average annual acres present, net gain of 600 average annual acres. Prairie preserved.
Nearshore Lake (E)	Manchac (Entire) 200 acres, Manchac (South) 200 acres. Water quality of most areas fair.	In entire Manchac, 1400 average annual acres. Manchac South, 1300 average annual acres. Water quality would worsen.	200 average annual acres present. Water quality similar to without project, but temporary turbidity & reduced D.O. associated with construction & maintenance. 140 acres temporarily altered by floatation canals, 9 acres covered by levee, 140 acres become marsh behind dike.	200 average annual acres present. Water quality similar to Plan M. 100 acres temporarily altered by floatation channel, 7 acres covered by dike, 110 acres become marsh behind dike.
Fisheries (E)	Numerous sport & commercial shell fish & finfish. Annual fishery production attributable to marsh 2,135,000 Manchac (Entire). Southern Manchac 1,302,000.	Average annual fishery: Manchac - 1,517,000, Manchac (South) 893,000.	Average annual fishery 2,135,000. Net gain of 318,000. Construction & maintenance activities interrupt fishing.	Average annual fishery 999,000 net gain 106,000.

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O
		Without Mitigation	Manchac Foreshore Protection (Entire)	
Wildlife (E)	Numerous species of wildlife utilize mitigation sites, especially migratory waterfowl and wading birds.	Manchac - loss of marsh & marsh pond would reduce wildlife use. Manchac South similar to above.	Reduction in loss of wildlife over without condition, ducks and shore birds benefitted especially.	Reduction in wildlife loss. Slightly less than Plan M.
Recreation (E)	Fishing & hunting population. Based on marsh present Manchac Entire, 87,000 man-days. Manchac South, 50,200.	Manchac Entire, 70,600. Manchac South, 39,800.	Gain of 6,200 man-days over without condition.	Gain of 5,000 mandays over without.
Manchac WMA (E)	Owed by La. Dept. Wildlife & fisheries. Hunting & fishing population. Trapping occurs.	Would remain public land. Would lose 40% of existing acreage by 2095 in entire area and 44% in southern area.	Erosion protection would preserve marsh - only lose 23% existing land by 2095.	Similar to Plan M, but only 22% of existing marsh lost.

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O
		Without Mitigation	Manchac Foreshore Protection (Entire)	Manchac Foreshore Protection (South)
Displacement of people	No one lives on project lands. 20-40 live adjacent to Manchac.	Manchac - some might move due to erosion.	Minor beneficial	Minor beneficial
Displacement of Farms	No farms.	No impact	No impact	No impact
Public Facilities & Services (O)	Some RR track protected at Manchac.	Erosion could expose tracks at Manchac to wave action.	Minor beneficial	Minor beneficial
Tax Revenue (R,O)	Sales taxes generated by seafood industry & recreational fishing & hunting sales.	Manchac - Minor adverse.	Minor beneficial	Minor beneficial
Community & Regional Growth (R)	Linked to seafood industry & recreational fishing & hunting.	Manchac - Minor adverse.	Minor beneficial	Minor beneficial

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O	
		Without Mitigation	Manchac Foreshore Protection (Entire)	Manchac Foreshore Protection (South)	Manchac Foreshore Protection (South)
Land Use (R)	Manchac-public land. Others-private land. Camps adjacent to Manchac and L.Lery.	Manchac (w) Minor adverse. St. Charles - No impact. Manchac (P) Minor adverse. L.Lery - No impact.	Minor beneficial	No impact	Manchac-Minor beneficial L.Lery - None
Property Values (R,O)	Associated with fish and wildlife resources.	Manchac (w) Minor adverse. St. Charles No impact. Manchac (P) Minor adverse. L.Lery - No impact.	Minor beneficial	Minor beneficial	Minor beneficial
Business & Industrial Activity (R,O)	Generated by fishing & hunting equipment sales commercial fish & fur harvest depend on marsh.	Manchac (w) Minor adverse. St. Charles - No impact. Manchac (P) Minor adverse. Lake Lery - No impact.	Minor beneficial	Minor beneficial	Minor beneficial
Employment Labor Force (R,O)	Commercial fishing & trapping, equipment sales, swamp tour at Manchac.	Manchac (w) Minor adverse. St. Charles No impact. Manchac (P) Minor adverse. Lake Lery - No impact.	Minor beneficial	Minor beneficial	Minor beneficial

TABLE 10
COMPARATIVE IMPACTS OF ALTERNATIVES AND SUMMARY COMPARISON OF PLANS

Item (Account)	Baseline	Plan M		Plan O	
		Without Mitigation	Manchac Foreshore Protection (Entire)	Manchac Foreshore Protection (South)	Minor beneficial
Community Cohesion (O)	Depends on wildlife & fishery resources.	Manchac - Minor adverse.	Minor beneficial	Minor beneficial	Minor beneficial
Esthetic Values (E,R,O)	High	Manchac - Minor adverse.	Minor beneficial & temporary turbidity	Minor beneficial & temporary turbidity	Minor beneficial & temporary turbidity
Noise (E)	Little ambient noise.	Little ambient noise.	Minor adverse	Minor adverse	Minor adverse
Energy (R)		No impact	Minor use	Minor use	Minor use
Implementation Responsibilities (NED)	N/A	N/A			
1. Gross Investment Costs*					
a. Federal			\$3,598,000	\$2,907,100	
b. Non-Federal			\$1,542,000	\$1,245,900	
c. Total			\$5,140,000	\$4,153,000	
2. Operation Maintenance & Replacement (present value)					
a. Federal			\$2,371,600	\$1,922,900	
b. Non-Federal			\$1,016,400	\$ 824,100	
c. Total			\$3,388,000	\$2,747,000	

* Gross investment costs = Total First Cost & Real Estate Costs & Interest during construction.

TABLE 11

BASELINE, FUTURE WITHOUT MITIGATION (FWOM), AND
FUTURE WITH MITIGATION (FWM) Habitat Acres

	BASELINE	FWOM	FWM	AVERAGE ANNUAL	
	(1992)	(2095)		FWOM	FWM
<u>MANCHAC FORESHORE ENTIRE</u>					
NEARSHORE LAKE	200	2,200	200	1,400	200
MARSH POND	750	1,300	2,200	900	1,500
INTERMED. MARSH	6,300	3,950	4,850	5,100	5,550
CYPRESS	200	0	200	50	200
<u>MANCHAC FORESHORE SOUTH</u>					
NEARSHORE LAKE	200	1,900	200	1,300	200
MARSH POND	700	700	1,500	500	1,100
INTERMED. MARSH	3,600	2,100	2,800	2,900	3,200
CYPRESS	200	0	200	0	200

Migratory waterfowl heavily utilize these more vegetatively diverse marshes for food and cover; resident waterfowl nest there. One way to compare the value of habitats is to total the habitat suitability index for the evaluation species. The total habitat suitability index for intermediate marsh wildlife is 2.03.

10.2.1.2. All marshes provide spawning, feeding, and nursery areas for many commercial and sport fish and shellfish. Most of the fishery (offshore as well as inshore) is linked to these marshes at some point through dependency on the food base or spawning habitat. Turner (1979) reported that Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands (marsh) and that the area of inshore water does not seem to be associated with the average shrimp yields. An analysis by Cavit (1979) determined that yields of menhaden increase in proportion to the ratio of marsh to open water. Juvenile menhaden use marsh and shallow water as their primary habitat. Marshes contribute vast amounts of organic detritus to adjacent estuarine water (Odum, et al., 1973) which is necessary for enhanced plankton production. Two dominant commercial fishery components, crab and shrimp, are extremely dependent on the marshes, ponds, and the nearshore lake habitats of the study area during some portion of their life cycles.

10.2.2. Future Without Manchac Foreshore (Entire). The shoreline of the Manchac WMA is severely eroding at the rate of 20 feet per year. Without the project, portions of the shoreline would be breached. This would result in connecting Lake Pontchartrain with the interior marsh ponds and

adjoining marshes. The combination of the introduction of higher salinity water combined with the increased potential for interior erosion and subsidence would result in the loss of a total of 2,350 acres of marsh between 1992 and 2095 (Table 11). Thus, over the life of the project, there would be 5,100 average annual acres present.

10.2.3. Future With Manchac Foreshore (Entire). With the project in place, shoreline erosion would be halted. Marsh losses associated with interior erosion of marsh ponds and subsidence would continue. Over the 100-year project life, a total of 1,450 acres of marsh would be lost. Thus, on an annual basis, there would be 5,550 acres of marsh present in the area. Mitigation would thus promote a net gain of 450 average annual acres. Approximately 15 acres of marsh would be planted and maintained between the foreshore protection dike and the existing shoreline. Approximately 125 acres of additional marsh may develop in the accreted area behind the entire length of the foreshore protection system. The total marsh created by the protection system between the dike and shoreline would be 140 acres (See Table 12).

10.2.4. Baseline for Manchac Foreshore (South). In 1992, there would be 3,600 acres of marsh in the southern portion of the Manchac area.

10.2.5. Future Without Manchac Foreshore (South). Approximately 5 miles of the Manchac Wildlife Management Area (WMA) would continue to experience shoreline erosion resulting in an annualized presence of 2,900 acres of intermediate marsh.

TABLE 12

IMPACTS OF MITIGATION PLANS (ACRES)

	Nearshore Lake		Marsh
	Dike	Flotation Channel	Accreted or Planted (from nearshore lake)
Manchac Foreshore, Entire	-9	-140	+140
Manchac Southern	-7	-100	+110

10.2.6. Future With Manchac Foreshore (South). The intermediate marshes along 5 miles of the Manchac WMA would be protected from shoreline erosion. On an annual basis, there would be 3,200 acres of marsh. Mitigation results in a saving of 300 average annual acres. In addition, another 110 acres of marsh would be established between the foreshore protection dike and shoreline through natural accretion and marsh planting.

10.3. CYPRESS COMMUNITY

10.3.1. General and Baseline for Manchac Foreshore (Entire). This community is located along the Lake Pontchartrain shoreline of the Manchac WMA. This community varies in width from 150 to 2,000 feet. It presently covers approximately 200 acres.

10.3.1.1. While the community is dominated by cypress, it appears to be the remnant of a large cypress tupelo swamp that once covered the area and has been subsequently lost through a combination of subsidence, saltwater intrusion, and shoreline erosion. The saltwater intrusion seems to have halted. While dominated by sparse stands of cypress, the canopy is generally open. The understory consists of occasional young growth of cypress, tupelo, red maple, hackberry, live oak, water oak, elderberry, grasses and in some areas, bulltongue, lizard tail, or other aquatic species. The area does provide some food and cover for deer, rabbits, and raccoon. Detritus from the marsh can be held in this community long enough that it may be converted to nutrient components that are gradually released into the lake. Nutrients from this community itself also enter the system. During high water, the area may serve as a nursery for many aquatic animals and as a refuge for many fish, frogs, turtles, and snakes. One of the most important functions of this community is related to the shoreline protection it provides to the extensive marsh system located behind it. Due to the ever decreasing width of this community, the protection it provides is being actively diminished.

10.3.2. Future Without Manchac Foreshore (Entire). The Manchac WMA would continue to experience shoreline erosion resulting in an annualized presence of 50 areas of cypress habitat. All of this habitat would be lost by the year 2040. This would result in rapid increase in saltwater intrusion and shoreline erosion, as well as an acceleration of loss in the marshes presently being protected by the cypress community.

10.3.3. Future With Manchac Foreshore (Entire). Shoreline erosion and loss of the cypress community would be eliminated. Therefore, approximately 200 average annual acres of cypress habitat would exist over the life of the project.

10.3.4. Baseline For Manchac Foreshore (South). Approximately 200 acres of this habitat presently exist in the southern portion of the Manchac WMA. It is subject to shoreline erosion and subsidence.

10.3.5. Future Without Manchac Foreshore (South). Shoreline erosion would continue, which would result in essentially no cypress in the southern segment by the end of project life.

10.3.6. Future With Manchac Foreshore (South). The losses in this habitat attributable to shoreline erosion would be eliminated. This would result in a presence of 200 average annual acres of this habitat over the project life.

10.4. MARSH PONDS

10.4.1. General. These are open water areas surrounded by marsh and isolated from any nearby waterbodies. All of these ponds are warm, shallow, intermittently turbid (depending on wind conditions), and normally high in nutrients. Salinities are similar to those of the surrounding marshes. Common submerged aquatics include widgeongrass, southern naiad, and pondweed. These ponds provide sheltered feeding areas for various

species of migratory waterfowl as well as wading birds. They are inhabited by forage fish and various bottom-dwelling aquatic organisms that may be utilized by furbearers, waterfowl, and the American alligator. In the southern portion of the Manchac WMA, a large pond, known as The Prairie, provides especially valuable habitat for waterfowl and fish. The total habitat suitability index for wildlife is 3.1. Thus, ponds on the Manchac WMA are slightly more valuable for the wildlife evaluated in HEP than is marsh.

10.4.2. Baseline For Manchac Foreshore (Entire). In 1992, there would be 750 acres of marsh pond in the Manchac area. Nearly all this habitat is associated with The Prairie.

10.4.3. Future Without Manchac Foreshore (Entire). Shoreline erosion would cause The Prairie to be classified as nearshore lake. Interior subsidence would continue, which would result in the presence of approximately 900 average annual acres of new marsh pond in the Manchac WMA over the project life.

10.4.4. Future With Manchac Foreshore (Entire). With the project in place, shoreline erosion would be eliminated, thus protecting the marsh pond habitat. As a result of project implementation, 1,500 average annual acres of marsh pond would be present. Thus, the project would cause a net gain of 600 average annual acres of this valuable habitat. This habitat is far more beneficial to various waterfowl, furbearer, and fishery species than the alternative nearshore lake habitat at that would result without

the project. The creation of marsh pond with the project in place occurs from expansion of existing marsh pond from subsidence and interior erosion.

10.4.5. Baseline For Manchac Foreshore (South). In 1992, there would be 700 acres of marsh pond in the southern Manchac area.

10.4.6. Future Without Manchac Foreshore (South). Continued shoreline erosion combined with the present rate of subsidence in the interior marshes of the southern Manchac area would result in the presence of 500 average annual acres of marsh pond over the project life. This loss is produced by the expansion of nearshore lake. The Prairie would become classified as nearshore lake.

10.4.7. Future With Manchac Foreshore (South). With the project in place, shoreline erosion would be reduced in the southern Manchac area. This would result in reducing the loss of marsh pond habitat. In addition, subsidence would continue and thus still contribute to marsh pond creation. The ultimate result would be a net gain of marsh pond. Over the project life, there would be 1,100 average annual acres of pond present. Thus, there would be a gain of 600 annual acres compared to without mitigation.

10.5. NEARSHORE LAKE

10.5.1. General. The nearshore lake environment is that portion of Lake Pontchartrain immediately adjacent to the shoreline and extending into the

lake to a depth of approximately four feet. This shallow water is not vegetated near the Manchac WMA. The shallow-waters are of little use to wildlife. The total wildlife habitat suitability index at Manchac is 0.07. Diving ducks and shorebirds are the principal wildlife users. These areas are habitat for many bottom-dwelling organisms important to offshore fishery production. In addition, they provide protected spawning and nursery areas necessary for sustaining the coastal fishery of Louisiana. Based on data from studies by Louisiana Wildlife and Fisheries approximately 57% of the sport fish standing crop (83 pounds per acre) is attributable to water less than eight feet in depth (Rogillo and Brassette, 1977). Juvenile menhaden utilize the nearshore beach habitat (Stone et. al., 1980). The nearshore area off the Manchac WMA is composed of clayey silt. Designated quality-dependent uses of Lake Pontchartrain include primary and secondary contact recreation and the preservation and propagation of desirable aquatic and semi-aquatic species. Oil and gas exploration and production, fossil clam shell dredging, and municipal and industrial wastewater disposal are non-quality dependent uses of the lake. The trophic state of Lake Pontchartrain is in the mesotrophic to oligotrophic range; that is, between moderate enrichment and nutrient deficiency. Adsorption of plant nutrients to suspended particulates followed by saline water induced flocculation and eventual settling might account in part for the relatively low nutrient concentrations found in the lake. Nutrient concentrations are normally highest in the spring and lowest in the summer, coincident with fluctuation in fresh water inflow to the lake. Pass Manchac, the Tchefuncte and Tangipahoa Rivers, and the drainage canals of metropolitan New Orleans are primary nutrient sources.

High nutrient loading frequently stimulates algal blooms near points of major freshwater inflow. The freshwater inflows, particularly the south shore drainage canals, are also primary sources of high nearshore bacteria densities that limit recreational use. Generally, only weak vertical water temperature and dissolved solids stratification is evidenced in the lake throughout the year. Freshwater inflows in the western portion of the lake, however, induce a pronounced west-to-east salinity gradient. The low salinity zone encompasses approximately the most westerly 60 percent of the lake area. Normally, minimum salinities are measured in the spring and peak in the fall.

10.5.2. Future Without All Plans. Significant improvement in the overall water quality of Lake Pontchartrain and its tributary wetlands is not anticipated. Some reduction in the concentration of conventional pollutants (COD, BOD, suspended and dissolved solids, nitrogen, and phosphorus) might result from increased efficiencies of upgraded and new wastewater treatment facilities. Additionally, the eventual cessation of treated sanitary wastewater discharges to the lake will be beneficial. However, industrialization of the Pontchartrain Basin will continue, and the total mass loading of conventional and exotic pollutants to the lake is likely to increase. Urban and industrial stormwater discharges are a major cause of water quality degradation in the lake. Unfortunately, significant efforts toward treatment of urban and industrial storm waters discharged to the lake and tributary wetlands are unlikely to be initiated in the foreseeable future. Non-quality dependent uses of Lake Pontchartrain and its tributary wetlands, which often unfavorably impact water quality, will continue.

10.5.3. Baseline For Manchac Foreshore (Entire). In 1992 there would be 200 acres present.

10.5.4. Future Without Manchac Foreshore (Entire). Shoreline erosion would continue at such a rate along the Manchac area that early in the twenty-first century, the narrow portion of shoreline protecting the wetlands and the Prairie would be eliminated. After breaking through the shoreline, the nearshore lake habitat would rapidly increase at the expense of marsh and marsh ponds, such as the Prairie. The nearshore lake habitat would continue to gain through unchecked erosion. Approximately 2,200 acres of nearshore lake would be in the area by 2095. Over project life, there would be 1,400 average annual acres present (Table 11).

10.5.5. Future With Manchac Foreshore (Entire). Shoreline erosion and consequent gain in nearshore lake habitat would be significantly reduced or eliminated. Approximately 200 acres of nearshore habitat would exist in 2095. There would be 200 average annual acres present, a net reduction of 1,200 average annual acres over the future without mitigation. In addition, approximately 150 acres of this habitat would be permanently lost from dike construction and marsh accretion. Another 140 acres would be temporarily disturbed by construction and backfilling of flotation channels. Water quality impacts are expected to be directly related to the initial construction and subsequent periodic maintenance activities. Consequently, degradation of water quality in the vicinity of the work area should be intermittent and of relatively short term. Locally depressed dissolved oxygen concentration, elevated chemical and biochemical oxygen

demand, and intensified suspended particulate and turbidity levels constitute the principal expected water quality impacts. The construction activity would take place near an area where normal tidal velocities are not high. Some sediments would be lost and dispersed to the water column during the initial excavation, use, and subsequent backfilling of the flotation channel. Dissociation of toxic trace metals and organic contaminants from sediment dispersed in the water column by the flotation channel excavation and backfilling would not be expected to be significant. The broadest area of water quality impact would be generally defined by the areal extent and intensity of construction-generated turbidity. Local conditions at the construction site during the progress of the work would dictate the size, duration, and intensity of construction-related turbidity plumes.

10.5.6. Baseline for Manchac Foreshore (South). In 1992 there would be 200 acres in the southern Manchac area.

10.5.7. Future Without Manchac Foreshore (South). Shoreline erosion would continue to cause a gain in nearshore lake at the expense of the adjacent marshes and the Prairie in the southern Manchac area. By the year 2095, 1,900 acres of nearshore lake would exist, which represents 1,300 average annual acres over the project life.

10.5.8. Future With Manchac Foreshore (South). This plan would eliminate shoreline erosion along the southern Manchac area. Therefore, a subsequent reduction in gain of nearshore lake is expected. Thus, approximately 200

average annual acres of nearshore lake would exist over project life. This represents a loss in nearshore lake of 1,100 average annual acres when compared to the without plan condition. In addition to the losses noted above, approximately 117 acres of the nearshore habitat would be permanently lost by dike placement and accretion along with a temporary loss of another 110 acres from construction and backfilling of flotation channels. Water quality impacts would be similar to those described for the entire Manchac plan.

10.6. FISHERIES

10.6.1. General and Baseline for All Plans. Numerous finfish and shellfish species fill a wide range of niches in the study area. Frequently pursued sport fishes found in fresh to slightly brackish water near the Manchac WMA are largemouth bass, black crappie, white crappie, channel and blue catfish, bluegill, and other sunfish. As the waters near Manchac become more brackish in the summer and fall, and fish and shellfish such as sheephead, seatrout, Atlantic croaker, black drum, red drum, menhaden, blue crabs, and white shrimp are present. Commercial fish harvest from the study area is high. Recreational shrimping and crabbing, along with sport fishing, comprise another economically important fishery separate from the commercial operations in the lake. The sport fishing standing crop is estimated to be 11,100,000 pounds for Lake Pontchartrain (Rogillo and Brassette, 1977). Moderate quantities of the road clam, other clams, and worms are present in the nearshore waters off Manchac. As described earlier, there is a direct relation between fish production and

marsh. Therefore, losses in marsh and pond can be directly responsible for quantifiable losses in fishery. In 1992, according to USFWS, the entire Manchac area could support 2,134,800 pounds of commercial fish, and the southern portion 1,302,100 pounds.

10.6.2. Future Without Manchac Foreshore (Entire). Without the implementation of the mitigation plan, the marsh could be converted to nearshore lake, which is less favorable habitat for the majority of the more economically valuable sport and commercial fish species. An estimated 1,816,900 pounds of commercial fish could be supported on an annual basis by the marsh present without the project. As the shoreline erodes and the marsh ponds presently behind the existing shoreline are joined with the lake, alterations in species composition could be expected to occur within these former marsh pond habitats. While the species composition may change because the habitat is more favorable for the estuarine pelagic species, increased predation resulting from the large expanse of unprotected open water may also be reflected in changes of the relative abundance of certain species.

10.6.3. Future With Manchac Foreshore (Entire). With the project in place approximately 2,134,800 pounds of commercial fish could be supported on an average annual basis, a net gain of 317,900 pounds over the without-mitigation condition. Approximately 9 acres of new benthic habitat would be permanently created by the placement of the rock dike. However, while the benthos in this area would be buried or displaced, the interstitial substrate among the rocks would provide habitat for various benthic

organisms. This diversity of habitat represented by the surface area of the rocks, interstitial substrate, and adjacent lake bottom could produce a more diverse benthic and periphytic community than originally inhabited the area. There could be a reduction in bottom feeding fish and a slight increase in "grazing" fish. An additional 140 acres of lake bottom located between the shoreline and the dike toe would eventually become marsh as planting and accretion occurs. Since the substrate would be gradually accreted over a long period of time, it is not expected to have any adverse effects on the existing benthic population in the area. Since the substrate would either remain similar in composition to that existing or undergo such gradual change, the benthic community in the area is expected to readily adjust or diversify as the need arises. Long-term benefits to the fishery would result from this marsh. Another 140 acres of lake bottom would be temporarily altered by the construction of flotation channels. The existing benthic population in these areas would be either displaced, buried, or destroyed during construction. However, all flotation channels are to be backfilled with the material removed during construction.

10.6.3.1. Therefore, repopulation of the affected areas is expected to occur very quickly through recruitment from adjacent communities. A change in species composition may occur, depending on the similarity of adjacent benthic population and the consistency of the substrate to be inhabited. Increased levels of turbidity are expected during dredging operations; it should not cause any significant adverse affects to a fishery that is already adapted to a highly turbid wind-driven lake habitat. Dissolved oxygen would be decreased during dredging and primary productivity would be

temporarily reduced. Commercial and sport fishing activities in the immediate vicinity of construction would be interrupted. However based on the USFWS fishery data (Fish and Wildlife Coordination Act Report: Appendix A Table B-5) this plan mitigates 86% of the sport and commercial fishery losses resulting from the hurricane protection project.

10.6.4. Future Without Manchac Foreshore (South). The types of fishery losses attributed to future without mitigation would be similar, but smaller, than those discussed in the section on future without the entire Manchac Foreshore Protection plan. Without the project, approximately 893,300 pounds of commercial catch could be produced on an average annual basis from the southern area of Manchac.

10.6.5. Future With Manchac Foreshore (South). Shoreline erosion would be eliminated in the southern Manchac area, thus greatly reducing the marsh loss and the associated fishery losses. The post project annual commercial fishery harvest would be 999,300 pounds on an average annual basis, a net gain of 106,000 pounds. This alternative mitigates approximately 80% of the sport and commercial fishery losses resulting from the hurricane protection project based on USFWS data.

10.7. WILDLIFE

10.7.1. General and Baseline For All Plans. Numerous game and non-game species occur in the study area. However, because of the migratory nature of birds, abundance and presence of most species fluctuate seasonally.

Migratory waterfowl are abundant winter residents of nearly every habitat type in the study area. The largest concentrations of puddle ducks occur in the intermediate marsh. Common species include mallard, American wigeon, gadwall, northern pintail, blue-winged teal, green-winged teal, mottled duck, and northern shoveler. Diving ducks concentrate on Lake Pontchartrain and marsh ponds. Common divers that winter in the study area include ring-necked duck, canvasback, redhead, red-breasted merganser, and lesser scaup. Of these, the lesser scaup is present in the largest concentrations. The mottled duck, wood duck, and hooded merganser all nest in the study area. The mottled duck is the only ground-nesting duck and it nests in all marsh types. Other common game birds include rails, gallinules, American coot, and common snipe. While waterfowl may be found in all areas proposed for mitigation, the Manchac area has been designated as a waterfowl concentration area for puddle ducks by the U.S. Fish and Wildlife Service in their Ecological Atlas for the Mississippi Deltaic Region, 1981. Wading birds such as herons, egrets, and ibises are abundant in the marsh, marsh pond, swamp, and occasionally in the nearshore lake. Numerous economically important animals occur in the study area. The white-tailed deer is the only big-game species and while generally associated with wooded habitat, significant populations also occur in marsh and swamp, especially where higher ground is available. Common small-game mammals are rabbits and racoons. Commercially important furbearers found in the area are the nutria, muskrat, and raccoon. Nutria reach their highest populations in fresh to intermediate marshes. Peak populations of muskrat are associated with brackish marshes and lush stands of Olney's threesquare. Amphibians are generally restricted to fresher habitats in

the study area; frogs, toads, and salamanders are present. Reptiles common in the marshes and swamp include the American alligator, turtles, anoles, water snakes, and the cottonmouth.

10.7.2. Future Without Manchac Foreshore (Entire). The replacement of swamp and intermediate marsh with marsh ponds and nearshore lake habitat would reduce the numbers of furbearers present. The existing low deer populations would dwindle. Rabbits would also be affected by the loss in cover, food, and breeding areas. Waterfowl resources would be severely impacted as the marsh ponds and marshes are converted to the more turbid, unprotected nearshore lake environment. Puddle ducks would experience the greatest impact through loss of habitat important to feeding and resting, and in some cases (mottled duck) nesting. Some reduction in shorebird populations could also be expected due to marsh loss. Alligator populations in the area could also be affected as the loss of marsh would indirectly affect their food supply.

10.7.3. Future With Manchac Foreshore (Entire). With mitigation, a reduction in the loss of wildlife habitat is expected. The species described in the without mitigation section above would be benefited by the protection of wetlands and marsh ponds. The amount of wildlife benefits received depend on the type of habitat utilized. Those species heavily dependent on marsh (duck and shorebirds) would receive the greatest benefits and would not decline as severely as under without-mitigation conditions. Those species utilizing the marsh pond habitat would not decline as much as they would without mitigation. Table 13 shows the

Table 13

NET CHANGES IN AVERAGE ANNUAL HABITAT UNITS CREATED BY MITIGATION

Evaluation Species	Plan M	Plan O
Nutria	+155	+ 89
Muskrat	-260	-283
Raccoon	+ 25	- 31
Shorebirds	- 15	- 36
Deer	- 10	- 38
Puddle Ducks	+450	+375
Diving Ducks	-175	-180

average annual habitat units (AAHU's) that this plan would develop over the without-mitigation condition. It can be seen that puddle ducks and nutria would benefit the most.

10.7.4. Future Without Manchac Foreshore (South). The wildlife losses experienced as a result of shoreline erosion are similar, but of somewhat lesser magnitude than those described for the future without the Manchac Foreshore Protection Plan, Entire.

10.7.5. Future With Manchac Foreshore (South). In the southern Manchac area the reduced loss in habitat would result in increased wildlife productivity similar to, but slightly less than, those discussed for the entire Manchac Foreshore Protection Plan. See Table 13 for AAHU gains with this plan.

10.8. RECREATION

10.8.1. General. The Manchac WMA is a very popular area for waterfowl and small game hunting, and fishing. Most of the WMA is accessible only by boat. In 1992 hunting and fishing in the entire Manchac area would be 87,000 annual man-days; and in the southern Manchac area affected, it would be 50,200 annual man-days.

10.8.2. Future Without Manchac Foreshore (Entire). Loss of habitat translates into a loss of recreational hunting and fishing man-days. For the without-project condition, it is anticipated that, over the life of the project, 66,100 annual man-days of sport fishing and 4,500 annual man-days of sport hunting would be present, a total of 70,600 man-days.

10.8.3. Future With Manchac Foreshore (Entire). It is anticipated that 71,700 annual man-days of sport fishing and 5,100 annual man-days of hunting will be present over the life of the project for a combined total of 76,800 annual man-days. Thus, there would be a net gain of 6,200 annual man-days. This plan would mitigate 53% of the sport fishing and hunting losses caused by the hurricane protection project.

10.8.4. Future Without Manchac Foreshore (South). Approximately 37,400 annual man-days of sport fishing and 2,400 annual man-days of hunting would exist over project life, a total of 39,800 annual man-days.

10.8.5. Future With Manchac Foreshore (South). There would be 41,700 annual man-days of sport fishing and 3,100 annual man-days of hunting over the life of the project for a total of 44,800 annual man-days, a net gain of 5,000 annual man-days. This plan would mitigate 40% of the sport fishing and hunting losses incurred by the hurricane protection project.

10.9. MANCHAC WILDLIFE MANAGEMENT AREA

10.9.1. General. This 8,325-acre tract is located in the northeastern corner of St. John the Baptist Parish and is owned and operated by the Louisiana Department of Wildlife and Fisheries. Habitat types are intermediate marsh, marsh pond, and cypress-tupelo swamp. This area is open to the public for small game and waterfowl hunting, but receives its highest usage from waterfowl hunting. Permit trapping of nutria, muskrat, and raccoon is normally allowed.

10.9.2. Future Without Mitigation - All Plans. The Manchac WMA would remain as public land. However by year 2095 it would have lost 40% of its existing marsh in the entire area and 44% in the southern area. Marsh pond and nearshore lake would expand. The Manchac WMA would be far less valuable as a public hunting area.

10.9.3. Future With Manchac Foreshore (Entire). Since erosion protection would preserve marsh, by year 2095 only 23% of the existing marsh would be lost. Thus, the WMA could support more hunting than if mitigation did not occur.

10.9.4. Future With Manchac Foreshore (South). Similar to Plan M, but 22% of existing marsh in the southern area would be lost.

10.10. ENDANGERED SPECIES

10.10.1. Baseline For All Plans. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service were contacted to determine what endangered/threatened species might be found in the study area. This coordination resulted in the identification of the endangered bald eagle as the only species of concern within the study area. The bald eagle is known to nest in the vicinity of the study area.

10.10.2. Future With And Without All Plans. It is our opinion, as well as that of the U.S. Fish and Wildlife Service, that none of the present mitigation plans are expected to adversely impact the bald eagle. Both mitigation plans would preserve marsh and marsh pond habitat in the Manchac WMA, which would preserve bald eagle hunting areas.

10.11. AUDUBON SOCIETY BLUE LIST

10.11.1. Baseline for All Plans. This is a listing of birds that are not yet considered threatened by the U.S. Fish and Wildlife Service, but that are showing a noncyclical decline in numbers or a significant decrease in range. This is basically an "early warning system." Table 14 lists such birds, describes their abundance in the project area, and indicates the habitats each utilizes.

TABLE 14
AUDUBON SOCIETY BLUE LIST (1982)

BIRD	OCCURRENCE ^{1/}		HABITAT ^{2/}
	Study Area	State	
Western Grebe	e	e	P
American Bittern	c	c	M, P
Red-shouldered Hawk	c	c	M
Swainson's Hawk	u	e	M
Marsh Hawk	c	c	M
King Rail	c	c	M
Piping Plover	c	r	M
Snowy Plover	r	r	M
Long-billed Curlew	r	r	M, P
Least Tern	c	c	M, P
Black Tern	c	c	M, P

^{1/} c = relatively common
u = unknown

r = rare
e = extremely rare

^{2/} M = marsh and beach
P = pond and lake

10.11.2. Future Without All Plans. Without mitigation, there would be a loss in marsh, which would adversely impact the 10 species that use marsh. Species that are associated with lakes and ponds would also be adversely affected because much of their food base is marsh-dependent.

10.11.3. Future With Manchac Foreshore, Entire. The marsh species would significantly benefit by the marsh/pond preservation afforded by this plan.

10.11.4. Future With Manchac Foreshore, South. The preservation of marsh and pond in the southern portion of the WMA would be a benefit.

10.12. CULTURAL RESOURCES

10.12.1. Baseline For Mitigation, All Plans. A National Register property in proximity to the mitigation site is the Pass Manchac Light. No archeological sites are presently known in the Manchac area. The Manchac site is located in an area of high probability of a shipwreck due to Pass Manchac's significance in historic navigation.

10.12.2. Future Without Mitigation - All Plans. The marsh would continue to erode and subside. This erosion would destroy any archeological sites that may exist in this area. Shipwrecks that may exist offshore from this area would not be affected by marsh deterioration.

10.12.3. Future With Manchac Foreshore (Entire). The project would not physically affect the Pass Manchac Light. It would, however, cause a minor

alteration to the property's esthetic environment. The dike would be about one foot above the water surface and would be located more than 2,000 feet away from this property and adjacent to the distant shore. Consultation with the State Historic Preservation Officer will be pursued regarding impacts to the light. The project would have a beneficial impact on any archeological resources that might exist in the protected area. The proposed foreshore dike and adjacent barge channel have no likelihood of impacts to historic shipwrecks. The erosion rate along the Lake Pontchartrain shoreline in this area is 20 feet per year. In 1946, the shoreline extended approximately 400 feet lakeward of its present position, negating the possibility of historic wreck sites in the primary impact zone. The barge access channels, however, will involve dredging in historic lake bottoms. Remote sensing surveys will be conducted to locate any significant shipwrecks in these areas. Again, it is assumed that the channels can then be designed to avoid any impacts to these resource.

10.12.4. Baseline for Manchac Foreshore (South). No National Register properties exist in the area.

10.12.5. Future with Manchac Foreshore (South). The impacts are similar to those discussed under Plan M, with the exception that the Pass Manchac Light would not be affected by the foreshore dike.

10.13. LAND USE

10.13.1. Baseline For All Plans. Land use in the areas affected by mitigation is for fish and wildlife habitat, as described in earlier

sections. The land immediately adjacent to WMA includes about 5 acres of residential land, a sporting club, and the Illinois Central Railroad roadbed. Another 10 acres immediately west of the railroad are used for about 10 camps, mobile homes, and other residences; a retail fuel supply station and lounge; and a swamp tour landing. Immediately west of U.S. Highway 51 is an elevated section of Interstate Highway 55 (I-55).

10.13.2. Future Without Mitigation-All Plans. The improvements between the marsh and the railroad could be threatened by erosion.

10.13.3. Future With Manchac Foreshore (Entire). This mitigation plan would reduce the rate of marsh loss and, thus, reduce the threat of erosion to the small group of structures between the railroad and the marsh.

10.13.4. Future With Manchac Foreshore (South). Similar to future with the entire plan for the Manchac area except slightly less land would be protected.

10.14. PROPERTY VALUES

10.14.1. Baseline For All Plans. The property values of the mitigation lands are mainly associated with the fish and wildlife resources they support. Areas adjacent to mitigation lands often have slightly higher property values since they are developed.

10.14.2. Future Without Mitigation-All Plans. Property values in the WMA would decline slightly as the marsh is lost. Values of adjacent lands would also decline due to the threat of erosion.

10.14.3. Future With Manchac Foreshore (Entire). Property values would decline slightly in the Manchac WMA due to marsh loss. Values in the area between the WMA and the railroad would remain similar to the baseline.

10.14.4. Future With Manchac Foreshore (South). Similar to future with entire plan for Manchac area, except slightly less area would be protected.

10.15. BUSINESS AND INDUSTRIAL ACTIVITY

10.15.1. General. The only business activities associated with mitigation lands are commercial fishing and trapping. Some recreational fishermen sell a portion of their catch to offset their costs. An undetermined amount of business is generated by the sport and commercial fishery, and sport-hunting, boats, motors, rods and reels, nets, fuel, guns, etc. Numerous restaurants depend on a local supply of reasonably priced seafood.

10.15.2. Baseline For Manchac Foreshore (Entire). In 1992, the average value of the commercial fishery, sport fishery, sport hunting and trapping attributable to marshes in the area would be \$694,700. (See Table 8 for details).

10.15.3. Future Without Manchac Foreshore, Entire. As marshes decline, the average annual hunting, fishing, and trapping value would be \$685,200. Sale of sport and commercial fishing and hunting equipment would decrease slightly. Business for boat launch operators would drop. Some marginally successful restaurants may be affected by the decline in supply and increases in price of seafood.

10.15.4. Future With Manchac Foreshore (Entire). Average annual hunting, fishing, and trapping values attributable to this area would be \$721,700, a net gain of \$36,500 per year over without-project conditions. Sales of fishing and hunting equipment would decline less than under without project conditions. Restaurants should not be affected.

10.15.5. Baseline For Manchac Foreshore (South). The annual hunting, fishing, and trapping value of marshes in the southern Manchac area would be \$447,800.

10.15.6. Future Without Manchac Foreshore (South). Average annual hunting, fishing, and trapping values would be \$708,300. Other conditions would be similar to those in the Manchac area without the project.

10.15.7. Future With Manchac Foreshore (South). Average annual hunting, fishing, and trapping values would be \$749,800 a net gain of \$41,500 without-project conditions. Sales of hunting equipment could increase due to the increase in the attractiveness of the area to waterfowl.

10.16. EMPLOYMENT/LABOR FORCE ACTIVITY

10.16.1. General And Baseline For All Plans. Employment in the immediate vicinity of the mitigation sites is low because they are wetlands. The fish and wildlife resources dependent on the sites engender employment in commercial fishing and trapping, sales of hunting and fishing equipment, and the restaurant trade. A swamp tour business exists at Manchac.

10.16.2. Future Without Mitigation-All Plans. As the wetlands disappear, there would be a slight decrease in employment in the businesses mentioned. Employment in the swamp tour might decline.

10.16.3. Future With Manchac Foreshore (Entire). Preservation of marsh would help sustain employment in the above businesses, especially the swamp tour. There could be a slight increase in employment in sales of hunting equipment associated with the improvement of waterfowl habitat.

10.16.4. Future With Manchac Foreshore (South). Similar to future with entire Manchac plan.

10.17. DISPLACEMENT OF PEOPLE

10.17.1. Baseline For All Plans. No people live permanently on lands to be utilized for mitigation. Approximately 20-40 people live adjacent to the Manchac area.

10.17.2. Future Without Mitigation-All Plans. The adjacent population (some of whom are commercial fishermen) might move due to the slight decline in fish and wildlife related employment and increased erosion threat.

10.17.3. Future With Manchac Foreshore (Entire). Since wetland loss would be reduced, and erosion to adjacent development removed, the adjacent population would not decline as much as with without condition.

10.17.4. Future With Manchac Foreshore (South). Similar to entire plan except slightly fewer benefits.

10.18. DISPLACEMENT OF FARMS

All Plans. There are no farms in the mitigation areas and, thus, no impacts to farms.

10.19. PUBLIC FACILITIES AND SERVICES

10.19.1. General. All mitigation areas are outside the Lake Pontchartrain Hurricane Protection levee.

10.19.2. Baseline For All Plans. Approximately 2,500 feet of Illinois Pacific Railroad track are protected from the force of lake waves by the presence of the wetlands of the WMA.

10.19.3. Future Without Mitigation-All Plans. As the wetlands in the Manchac WMA erode, approximately 2,500 feet of the Illinois Pacific Railroad would be more directly exposed to wave action of the lake.

10.19.4. Future With Manchac Foreshore (Entire). The railroad bed would receive an unquantified level of additional protection from erosion.

10.19.5. Future With Manchac Foreshore (South). Similar to future with entire plan for Manchac area.

10.20. TAX REVENUES

10.20.1. General. Sales taxes include those generated directly and indirectly by the seafood industry and recreational fishing and hunting. Additional revenue is collected through the sale of fishing and hunting licenses.

10.20.2. Baseline For All Plans. The existing wetlands contribute to commercial fishing and trapping, and sport fishing and hunting. In turn, those activities slightly increase the tax base.

10.20.3. Future Without Mitigation-All Plans. Loss of wetlands would cause a minor decrease in tax revenues.

10.20.4. Future With Manchac Foreshore (Entire). Reducing the decline of wetlands would slightly reduce the above mentioned loss of tax revenues.

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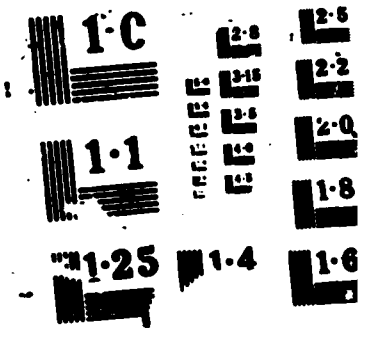
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10.20.5. Future With Manchac Foreshore (South). There would be a slight increase in tax revenue over the future without as decline in wetlands in the southern portion of the area is reduced.

10.21. COMMUNITY AND REGIONAL GROWTH

10.21.1. General And Baseline For All Plans. Growth of the small community near the mitigation area (Ruddock) is linked to the seafood industry, and recreational fishing and hunting. Growth of the region is less dependent on such a base, since it is only a proportion of the total regional resources.

10.21.2. Future Without Mitigation-All Plans. The loss of wetlands would have a slight adverse effect on community growth, and a very minor adverse effect on regional growth.

10.21.3. Future With All Plans. The reduction in wetland loss would mean less adverse impacts on community growth than the without condition. Reduced loss to regional growth would be minor.

10.22. COMMUNITY COHESION

10.22.1. Baseline All Plans. Some of the economic and social harmony existing in the area is dependent on fishery and wildlife resources of the area.

10.22.2. Future Without Mitigation-All Plans. Community cohesion would be weakened by the reduction in resources.

10.22.3. Future With Manchac Foreshore (Entire). Reduction of the wetland loss rate would have a beneficial impact on community cohesion.

10.22.4. Future With Manchac Foreshore (South). Beneficial impact on community cohesion slightly less than for entire plan.

10.23. ESTHETICS

10.23.1. Baseline All Plans. Primary esthetic values at mitigation site is associated with a blend of marshes, swamp, bayous, ponds, and the lake.

10.23.2. Future Without Mitigation-All Plans. The wetlands would erode and the proportion of open water would increase.

10.23.3. Future With Manchac Foreshore (Entire). Approximately 5,750 average annual acres of wetlands would be maintained, thereby retaining esthetic values in the area. Turbidity and equipment associated with dike construction and 20-year maintenance would be displeasing, but temporary and remote.

10.23.4. Future With Manchac Foreshore (South). Approximately 3,400 average annual acres of wetlands would be maintained. Temporary turbidity would occur during construction and maintenance.

10.24. NOISE

10.24.1. Baseline And Future Without Mitigation For All Plans. Noise common to all the mitigation site is outboard motors. The noise of traffic on I-55 is noticeable in the Manchac WMA, but only faintly so at the dike site.

10.24.2. Future With All Plans. Construction and maintenance activities would increase noise levels above the baseline. However, the site is remote and few people would be impacted. Wildlife would vacate the vicinity during building activities.

10.25. ENERGY

Impacts With All Plans. Energy expenditure (fossil fuels) for construction and maintenance of both plans in the final array would be essentially similar.

10.26. VECTORS

10.26.1. Baseline and Future Without for All Plans. Vectors in the project area include a variety of mosquitoes with the most common generally being Anopheles, Aedes, and Culex. Some species inhabit a wide variety of habitats while others are more restricted. Some species, such as Aedes sollicitans, breed only in temporary water while others, such as Culex salinarius, require permanent water for breeding. The most common

vector-borne diseases are infectious equine anemia, anaplasmosis, and Venezuelan equine encephalitis.

10.26.2. Future With All Plans. Future conditions would be approximately similar to the baseline with little increase in vectors.

11. TENTATIVELY SELECTED PLAN

11.1. RATIONALE FOR THE TENTATIVELY SELECTED PLAN (TSP)

11.1.1. Plan O (Plate 8) which provides foreshore protection to 80 percent of the Manchac WMA, is the TSP. Plan O was chosen over Plan M (Manchac Entire) because Plan O provides 96 percent of the AAHU mitigation at a cost of \$90/AAHU (see Table 15); the cost of the extra increment to protect the entire area is \$191/AAHU. Thus the TSP is incrementally justified (see section 8.5), cost effective (lowest cost/AAHU), and nearly achieves the goal of 100 percent of the AAHU losses with a habitat type similar to that adversely impacted by the project. Based on the USFWS Draft Coordination Act Report (Appendix A), the TSP fully compensates (124 percent) all adverse acreage loss impacts to wildlife resources as determined by their HEP.

11.1.2. Another advantage of this particular plan is that it can be constructed on publicly owned land within the vicinity of the Lake Pontchartrain Hurricane Protection Project and therefore eliminates the purchase of land.

11.1.3. As mentioned earlier in the plan development discussion (Section 7.5), an effort was made to satisfy the wishes of local assurers by developing a plan that would include mitigation sites in each parish. A plan was developed and analyzed (Plan N, Table 6) but was not cost effective (\$342/AAHU). Since the multi-parish plan was not feasible, the TSP is perceived as a good compromise, because it is politically neutral.

TABLE 15
 COMPARISON OF MITIGATION COST AND EFFECTIVENESS
 FOR PLANS O&M

	PLAN M	PLAN O
Total AAHU's provided	2778	2511
% AAHU's mitigated	106	96
Av. Ann. Cost/AAHU	100	90
Man-day/Monetary Gain	\$52,254	\$37,774
% Man-days/Monetary Mitigated	55	40
Av. Ann. Acres Preserved by Mitigation	1189	1282
% Av. Ann. Cost/Av. Ann. Ac.	\$235	\$209
HEP Acres Available	7487	4726
HEP Acres Required	5464	3803
% Mitigation Provided by HEP Acres	137	124

This neutrality arises from its location outside the assuring parishes but on publically owned land where the wildlife benefits of the mitigation can be utilized by all parishes. Additionally, the Louisiana Department of Wildlife and Fisheries supports the plan and has provided a letter of intent to cost-share in the mitigation (See section 11.3.2.).

11.1.4. The final aspect of this plan, which makes it a favorable choice for implementation, is its simplicity in engineering design. This factor, combined with the elimination for the need to purchase land, allows this plan to be expeditiously constructed.

11.1.5. In summary, the TSP mitigates the great majority of the wildlife losses, it is cost effective, supported by both Federal and state environmental resource agencies, requires no purchase of land, is politically neutral, can be expeditiously constructed, and has an intended assurer to share the cost of the plan.

11.2. DESCRIPTION OF THE TENTATIVELY SELECTED PLAN

As described in Paragraph 8.3, Plan O (Plate 8) provides foreshore protection to approximately 5 miles shoreline of the Manchac WMA. A series of two-foot high rock dikes each 200 feet in length along with marsh plantings shoreward of the dikes, would be utilized. The marsh plantings would be placed in 20-foot strips shoreward of the dikes. This vegetation would be upgraded every 10 years by replacing 25 percent of the plants.

11.3. IMPLEMENTATION OF THE TENTATIVELY SELECTED PLAN

11.3.1. DIVISION OF RESPONSIBILITIES

11.3.1.1. Federal Responsibilities. Contingent upon the approval of this document by the Division Commander, filing of the final EIS with EPA, signing of the Record of Decision, receipt of supplemental assurances from non-Federal interests to carry out provisions of the project, the Federal Government will be responsible for preparing additional detailed designs and plans and bearing 70 percent of the total investment cost.

11.3.1.2. Non-Federal Responsibilities. In accordance with Public Law 89-298, which authorized the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project, non-Federal interests must, prior to initiation of construction of major design changes, assure the Secretary of the Army, with respect to the major design changes, that without cost to the United States they will:

- a. Provide all lands, easements, and rights-of-way, including borrow and excavated material disposal areas necessary for construction, operation, and maintenance of the mitigation features;
- b. Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities required by the construction of the mitigation features;
- c. Hold and save the United States free from damages due to the construction, operation, and maintenance of the mitigation features, except where such damages are due to the fault or negligence of the United States or its Contractors;

d. Bear 30 percent of all costs associated with the mitigation features including the first cost; interest and amortization cost; present worth of operations, maintenance, and replacement costs; and the cost of lands, easements, and rights-of-way;

e. Comply with applicable provisions of the Uniform Relocations Assistance and Real Property Acquisitions Policies Act of 1970 (PL 91-646); and

f. Agree to the requirements of the Flood Control Act of 1979, whereby damages will be paid for noncompliance of assurances furnished for the mitigation features and such assurances shall be enforceable by the United States in the appropriate District Court.

11.3.1.3. Mitigation Cooperation Agreement. A Mitigation Cooperation Agreement (MCA) will be negotiated with the non-Federal sponsor. The actual construction of the mitigation feature of the project will be performed by the Federal Government. The actual operation, maintenance, and replacement (OM&R) work of the mitigation feature will be performed by the non-Federal sponsor. The following table indicates that estimated cost of mitigation and the proposed sharing of that cost.

	Gross Investment	Present worth of OM&R
Federal (70%)	\$2,907,100	\$1,922,900
Non-Federal (30%)	\$1,245,900	\$824,100

The MCA will require the non-Federal sponsor to provide its share of the gross investment cost prior to initiation of construction. The Federal

Government will be required to pay its share of OM&R in the form of a single payment to the non-Federal sponsor prior to commencement of OM&R.

11.3.2. Current Status of Letter of Intent

11.3.2.1. Following a scoping meeting on the mitigation project, held 29 July 1985, a letter was received acknowledging the support of the Louisiana Department of Wildlife and Fisheries (LDWF) for the Manchac Foreshore Protection plan for the entire shoreline (Plan M). The letter noted that it was their intent to provide the 30 percent local cost share required to implement the entire Manchac Plan (Plan M).

11.3.2.2. Since that time the Corps has coordinated with the LDWF staff on various alternative mitigation plans developed for the Manchac area, especially Plan O, a 20 percent reduction in the scope of the above plan. We are presently coordinating with LDWF on details of a new letter of intent addressing Plan O specifically.

12. PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

12.1. PUBLIC INVOLVEMENT

12.1.1. Public and interagency scoping meetings were the primary means by which the views of the public were obtained. Three public scoping meetings were held at the University of New Orleans, Lakefront, on June 23, 1984, December 13, 1984, and July 29, 1985. All agencies, organizations, and individuals known to have an interest in the Lake Pontchartrain Project received a written notice of the meetings. In addition to requests for oral comments and questions during the meetings, a one month written comment period was provided after each of the meetings. Several new alternative mitigation areas were identified for study as a result of these public scoping meetings.

12.1.2. An interagency scoping meeting was held at the New Orleans District on January 10, 1985. This meeting was attended by representatives of the U.S. Fish and Wildlife Service, U.S. Soil Conservation Service, and the Louisiana Department of Wildlife and Fisheries. The primary purpose of this meeting was to identify modifications to the plans in an effort to improve their effectiveness. Previous written comments provided by the agencies as part of the public scoping process were also reviewed and discussed.

12.1.3. In addition to the above-mentioned scoping meetings, a series of informal scoping meetings was held with the local assuring agencies and

affected landowners. The purpose of these meetings was to solicit their views and opinions and keep them informed on the progress of mitigation planning.

12.1.4. The alternatives and issues addressed in the Lake Pontchartrain Mitigation Study/EIS are a product of the information, questions, and recommendations obtained through formal and informal scoping activities. The major public views that this scoping process revealed were: 1) habitat losses should be mitigated within the parish where they occurred; 2) there is an urgent need to deal with the problem of wetland loss in the study area; and 3) water level management should be investigated as a specific mitigation measure. The following paragraphs contain discussions of how these views were incorporated into the decision-making process.

12.1.5. As displayed in Table 6, at least one mitigation plan was developed and evaluated in each of the impacted parishes. In addition, a combination plan (Plan N) was developed, providing mitigation in each parish. Evaluation revealed, however, that the combination plan was not incrementally justified when compared to the economic efficiency of other plans.

12.1.6. All mitigation plans evaluated in this study at least partly addressed the public concern with wetlands. This concern was addressed by either protecting the marshes from erosion with a foreshore protection dike, creating marsh pond by water management, or freshening brackish marsh through water level management.

12.1.7. Finally, in response to the interest in water level management, three separate mitigation plans were initially developed using this management measure. Local interests subsequently initiated implementation of all of these plans. The third water level management plan would be rendered ineffective by the Caernarvon Freshwater Diversion Plan. In conclusion, the array of mitigation plans evaluated was very much a product of the public views obtained during the scoping process.

12.2. REQUIRED COORDINATION

This EIS is being furnished to members of Congress, Federal and state agencies, and other interested parties for review and comment. Circulation of this EIS accomplishes the remaining required coordination with both the U.S. National Park Service (NPS) and the Louisiana State Historic Preservation Officer, as provided under the National Historic Preservation Act; with the NPS, as provided under the Federal Water Project Recreation Act; and with the EPA as provided under the Estuary Protection Act. It also partially fulfills our responsibility under the National Environmental Policy Act.

12.3. STATEMENT RECIPIENTS

The following agencies and individuals have received this EIS for review and comment. All other interested parties have been notified by a "Notice of Availability."

FEDERAL

Honorable J. Bennett Johnston

Honorable Jerry Huckaby

Honorable Lindy (Mrs. Hale) Boggs

Honorable John B. Breaux

Honorable Robert L. Livingston

Honorable Richard Baker

Honorable Jimmy Hayes

Honorable Billy Tauzin

Honorable Clyde Holloway

Department of the Interior
Washington, D.C.

Jean Lafitte National
Historical Park
Lafitte, LA

U.S. Environmental Protection
Agency
Dallas, TX
Washington, D.C.

U.S. Department of Commerce
Washington D.C.

U.S. Dept. of Agriculture
Alexandria, LA
Washington, D.C.
Norco, LA

U.S. National Marine Fisheries
Service
St. Petersburg, Florida
Baton Rouge, LA

U.S. Forest Service
Atlanta, GA

Department of Energy
Washington, D.C.

Federal Emergency Management
Administration
Washington, D.C.

Federal Highway Administration
Baton Rouge, LA

Centers for Disease Control
Atlanta, GA

Department of Health and Human
Services
Washington, D.C.

U.S. Department of Housing and
Urban Development
Forth Worth, Texas

Advisory Council on Historic
Preservation
Washington, D.C.
Golden, CO

STATE AND LOCAL

Governor of Louisiana

Lieut. Governor of Louisiana

Secretary of State Louisiana

Attorney General of Louisiana

STATE AND LOCAL (Cont'd)

Department of Environmental Quality Water Pollution Control Division	Department of Natural Resources Office of Environmental Affairs
Department of Natural Resources Office of Environmental Affairs	Louisiana Department of Wildlife and Fisheries
Commissioner of Agriculture of Louisiana	Department of Health and Human Resources
Louisiana Department Transportation and Development	Center for Wetland Resources Louisiana State University
Louisiana Dept. of Agriculture and Forestry	Curator of Anthropology Louisiana State University
Department of Natural Resources Division of State Lands	Coastal Studies Institute Louisiana State University
Department of Natural Resources Coastal Resources Program	Louisiana Department of Agriculture
Louisiana Dept. of Commerce	Louisiana Geological Survey
State Historic Preservation Officer	Governors Coastal Protection Task Force
State of Louisiana Office of State Parks	Louisiana State Planning Office
New Orleans City Council	LA Cooperative Extension Serv. Louisiana State University
Lake Pontchartrain Sanitary District	Planning and Zoning Department St. Charles Parish
Board of Commissioners Lake Borgne Levee District	St. Bernard Parish Police Jury
Board of Commissioners Orleans Levee District	Board of Commissioners Jefferson Levee District
Orleans Levee Board	New Orleans City Planning Commission
Regional Planning Comm. Jefferson, Orleans, St. Bernard, St. Tammany	Environmental Impact Office Jefferson Parish

STATE AND LOCAL (Cont'd)

Terrebonne Parish Council

St. Charles Parish Coastal Zone
Management Office

South Control Planning and
Development Council

ENVIRONMENTAL

National Audubon Society

Delta Chapter, Sierra Club

National Audubon Society
Field Research Director

Chappeeela Group Siera Club
(Florida Parishes)

National Wildlife Federation
Washington, D.C.

Louisiana Wildlife Federation

Natural Resources Defense
Council, Inc.

League of Women Voters
of Louisiana

South Louisiana Environmental
Council

The Fund for Animals, Inc.

Gulf States Marine Fisheries
Commission

Sea Grant Legal Program, LSU

Bonnet Carre' Rod and Gun Club

South Control Planning and
Development Council

Iberia Rod and Gun Club

Mr. Oliver Houck

LIBRARIES

New Orleans Public Library

Livingston Parish Library

Jefferson Parish Library

St. Tammany Parish Library

Tangipahoa Parish Library

St. Bernard Parish Library

St. Charles Parish Library

Louisiana State University

Tulane University

University of New Orleans

Library Coastal Studies
Institute

St. John the Baptist Library

12.4. PUBLIC VIEWS AND RESPONSES

Section 12.1. describes how the results of scoping were incorporated into this study.

12.5. CONSULTATION WITH U.S. FISH AND WILDLIFE SERVICE

12.5.1. Coordination and consultation with the U.S. Fish and Wildlife Service (USFWS) during plan development and habitat analysis was an integral part of mitigation planning. In an effort to standardize base condition for mitigation analysis the Corps and USFWS jointly developed the land use projections and shoreline erosion rates for the various mitigation sites. The mitigation planning effort was also coordinated with the USFWS's endangered species office to verify if any endangered species exists in the project area. In addition, all field evaluations utilizing the Habitat Evaluation Procedure (HEP) were done jointly with the USFWS.

12.5.2. As a result of this close coordination and early involvement in mitigation planning the USFWS has given their support to the Corps' TSP. Although the USFWS concurs with the Corps' TSP, they recommend the following refinement to the plan: maintaining the plan through project life plus additional time required for adverse effects of the project to cease to occur; expeditious implementation of the plan; consultation with Louisiana Department of Wildlife and Fisheries (LDWF) and USFWS during detailed design; and the Corps' assumption of ultimate responsibility to install and maintain the proposed mitigation features.

12.5.3. The Corps has considered all of the USFWS' recommendation and concurs that the TSP should be expeditiously implemented and that the LDWF and USFWS would be consulted during the detail design phase of the TSP. However, no mechanism now exists for maintenance beyond the project life, but consideration of long-term maintenance would be evaluated if such feasibility and mechanism is established in the future.

12.5.4. The mitigation plan fully mitigates the wildlife losses over the project life and some portion of the benefits of the mitigation features will continue after the project life.

12.5.5. The USFWS also noted that the Corps should be responsible for maintenance. The Corps will cost share in OM&R as discussed earlier. All OM&R will be done to Federal specifications, therefore quality of work should be consistent.

12.6. APPENDIXES AND SUPPORTING DOCUMENTATION

12.6.1. The Fish and Wildlife Coordination Act Report, Section 404 (b)(1) Evaluation, Coastal Zone Management Consistency Determination, Impacts Since 1984 Final EIS, Status of Local Cooperation, and the Endangered Species correspondence are included as appendixes to the EIS.

12.6.2. In addition, the following data is available as supporting documentation and can be obtained upon request from the New Orleans District:

Engineering Cost Data
Recreation Data
Economic Data

13.0 LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement:

NAME	DISCIPLINE/EXPERTISE	EXPERIENCE	ROLE IN EIS PREPARATION
Mr. Larry Hartzog	Fisheries Biologist Limnology-Aquatic Ecology	8 years, environmental studies, New Orleans District; 4 years, fisheries research, Florida Game and Freshwater Fish Commission; 2 years, water quality analyst, Hercules Chemical 2 yrs. Associate, Louisiana State University	Shared initial project management; Coordination of Report/EIS, preparer of biological input, revisions and modifications of main report and preparation of Plan Formulation and rationale for EIS.
Mr. David Garney	Wildlife Biologist/ Waterfowl Management	1 yr. EIS Studies, Corps of Engineers New England Division; 8 yrs. EIS Studies, COE, New Orleans District	Shared project management; Initial preparation of Main Report
Ms. Suzanne R. Hawes	Marsh Ecologist	16 years, environmental studies, New Orleans District	Review and technical assistance, and aid in incremental analysis
Mr. John C. Weber	Zoology	16 years, environmental studies, New Orleans District	Plan formulation and technical review
Mr. David L. Reece	Wildlife and Fish Ecology	2 years, Research Associate; 4 years, Biologist, Florida Game and Freshwater Fish Commission; 8 years, Biologist, Corps of Engineers, New Orleans District	Coastal Zone Management Consistency Determination
Mr. Michael E. Stout	Archeologist	9 years, archeologist, New Orleans District	Effects on cultural resources

13.0 LIST OF PREPARERS (Cont'd.)

Mr. Stephen F. Finnegan	Landscape Architect	9 years, landscape architect, New Orleans District	Effects on recreation
Mr. Robert D. Lacy	Regional Economist	14 years, economic studies, New Orleans District	Preparation of general descriptions of socio-economic conditions and socioeconomic impact assessment.
Mrs. Jessica M. Fox	Regional Economist	6 years, economic studies, New Orleans District 3 years as economist with U.S. Bureau of Census	Compiled and completed the economic analysis
Mr. Nicholas G. Constan	Regional Economist	17 years, economic studies, New Orleans District	Review of economic benefit and social impact analysis
Mr. James Warren	Sanitary/Environmental Engineer	1 year, Civil Engineer, Arkansas State Highway and Transportation Dept.; 9 years, Environmental Engineer, Corps of Engineers New Orleans District	Water Quality, Input to 404(b)(1) Evaluation

14. CONCLUSIONS

14.1. The existing hurricane protection project (the project) and the Record of Decision of the Director of Civil Works which modified the existing project has been reviewed. The tangible and intangible benefits of Plan O, the Tentatively Selected Plan (TSP) for mitigation are the greatest. Plan O is the most efficient mitigation alternative considered; it mitigates for 96 percent of the adverse impacts of the project at a total investment cost of \$6,900,000. The proposed cost-sharing sponsor for mitigation is the State of Louisiana Department of Wildlife and Fisheries.

14.2. A Mitigation Cooperation Agreement (MCA) will be negotiated with the non-Federal sponsor. The actual construction of the mitigation feature of the project will be performed by the Federal Government. The actual operation, maintenance, and replacement (OM&R) work of the mitigation feature will be performed by the non-Federal sponsor. The following table indicates that estimated cost of mitigation and the proposed sharing of that cost.

TABLE 16
Estimated Cost Sharing for Mitigation
October 1987 - 3-1/8 Interest

	Gross Investment	Present worth of OM&R	Total
Federal (70%)	\$2,907,100	\$1,922,900	\$4,830,000
Non-Federal (30%)	\$1,245,900	\$824,100	\$2,070,000

14.3. The MCA will require the non-Federal sponsor to provide its share of the gross investment cost prior to initiation of construction. The Federal Government will be required to pay its share of OM&R in the form of a single payment to the non-Federal sponsor prior to commencement of OM&R.

14.4. The total project is estimated to cost \$6,900,000 of which \$4,830,000 will be provided by the Government and \$2,070,000 of which will have to be provided by the non-Federal sponsor.

15. RECOMMENDATIONS

15.1. I recommend that the existing hurricane protection project for Lake Pontchartrain and Vicinity, authorized by PL 89-298 on 27 October 1965, as modified in the Record of Decision by the Director of Civil Works on 7 February 1985, be further modified to include mitigation and that the TSP for mitigation as described in this report be approved for implementation by the Division Commander. This recommendation is made with the provision that the non-Federal sponsor will provide new assurances prior to implementation of these mitigation features. The estimated first cost of the TSP, based on October 1987 price levels, is \$4,090,000. Interest during construction is \$63,000. The average annual cost of the TSP is \$226,000, of which \$136,000 is for interest and amortization, and \$90,000 is for operation, maintenance, and replacements.

15.2. I make these recommendations with the provision that prior to the commencement of construction, non-Federal interests will agree to comply with the following requirements:

a. Provide all lands, easements, and rights-of-way, including borrow and excavated material disposal areas necessary for construction, operation, and maintenance of the mitigation features;

b. Accomplish all necessary alterations and relocations to roads, railroads, pipelines, cables, wharves, drainage structures, and other facilities required by the construction of the mitigation features;

c. Hold and save the United States free from damages due to the construction, operation, and maintenance of the mitigation features, except where such damages are due to the fault or negligence of the United States of its Contractors;

d. Bear 30 percent of all costs associated with the mitigation features including the first cost; interest and amortization cost; present worth of operations, maintenance, and replacement costs; and the cost of lands, easements, and rights-of-way;

e. Comply with applicable provisions of the Uniform Relocations Assistance and Real Property Acquisitions Policies Act of 1970 (PL 91-646); and

f. Agree to the requirements of the Flood Control Act of 1979, whereby damages will be paid for noncompliance of assurances furnished for the mitigation features and such assurances shall be enforceable by the United States in the appropriate District Court.

15.3. The recommendations contained herein reflect the information available at this time and current Departmental policies governing

formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels with the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for authorization or implementation funding.

Date

LLOYD K. BROWN
Colonel, CE
Commanding

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APPENDIX A

**FISH AND WILDLIFE COORDINATION
ACT REPORT**



United States Department of the Interior
FISH AND WILDLIFE SERVICE

POST OFFICE BOX 4305
103 EAST CYPRESS STREET
LAFAYETTE, LOUISIANA 70502

May 21, 1987

Colonel Lloyd K. Brown
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Colonel Brown:

The attached revised draft supplemental Fish and Wildlife Coordination Act (FWCA) report on the mitigation plan for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project was prepared under authority of the FWCA (48 Stat. 401, as amended; 16 U.S.C. et seq.). A copy of this report is being provided to the Louisiana Department of Wildlife and Fisheries and the National Marine Fisheries Service for review. Comments received from those agencies will be included in the final report.

We look forward to continued cooperation with your staff on this project. Please keep us apprised of any changes in the tentatively selected plan and advise us once a recommended plan has been designated.

Sincerely yours,

David W. Frugé
David W. Frugé
Field Supervisor

Attachment: as stated

cc: EPA, Dallas, TX
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
NMFS, Baton Rouge, LA
FWS, Atlanta, GA (AWE)
FWS, Jackson, MS (FWE)
FWS, Washington, D.C. (FWE/FP)

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT, MITIGATION STUDY:
REVISED DRAFT SUPPLEMENTAL FISH AND WILDLIFE COORDINATION ACT REPORT

SUBMITTED TO:
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PREPARED BY:
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U.S. FISH AND WILDLIFE SERVICE
SOUTHEAST REGION
ATLANTA, GEORGIA

APRIL 1987

EXECUTIVE SUMMARY

Attached is the revised draft supplemental Fish and Wildlife Coordination Act Report (FWCAR) of the Fish and Wildlife Service (FWS) on the mitigation measures proposed for the Corps of Engineers' (Corps) Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. That project was authorized by the Flood Control Act of 1965 (Public Law 82-298). A detailed description of the hurricane protection project features and project area were provided in the Main Report and Final Supplement I to the July 1984 Environmental Impact Statement. In its FWCAR which accompanied that document, the FWS noted that the hurricane protection plan did not include sufficient measures to offset project impacts on fish and wildlife resources. This supplemental report provides the findings and recommendations on the Corps' tentatively selected mitigation plan (TSMP) for that project.

The goal of the TSMP is to protect about 5 miles of Lake Pontchartrain shoreline, and the adjacent wetlands of a majority of the State-owned Manchac Wildlife Management Area (WMA), from wave erosion. The shoreline protection would be accomplished via construction of 2-foot-high rock dikes located 180 feet offshore. The rock dike protection would be supplemented by planting marsh vegetation in the area between the shoreline and the dike.

That portion of Manchac WMA affected by the proposed mitigation plan can be broadly classified as coastal wetlands, including cypress-tupelo, fresh/intermediate marsh, and marsh pond cover types.

The area provides valuable habitat for a wide range of fish and wildlife which have high recreational and commercial value. Detritus produced in the marshes of the area is transported into adjacent estuarine waters where it forms the basis of the food web. The marshes and shallow ponds also provide essential nursery habitat to numerous estuarine-dependent fishes and shellfishes. Numerous freshwater sport and commercial fishes also occur on the area.

Manchac WMA supports an array of wildlife species, many of which are sought for sport or commercial purposes. These include the American alligator, most species of ducks found in the Mississippi Flyway, rails, gallinules, wading birds, white-tailed deer, swamp rabbit, nutria, raccoon, muskrat, river otter, and mink. Manchac WMA lies within the 95,000-acre Lake Maurepas Unit, which has been identified by the FWS as one of 14 key waterfowl wintering areas along the Central Gulf Coast. During 1976 and 1977, the Lake Maurepas Unit wintered an average of nearly 70,000 ducks, principally mallards. The mottled duck, wood duck, and hooded merganser also use the area for nesting and brood rearing.

Vegetated wetlands on Manchac WMA are being threatened by shoreline erosion, which is estimated to be about 20 feet per year, and by subsidence. The purpose of the proposed mitigation plan is to eliminate wetland loss caused by shoreline erosion. The FWS's Habitat Evaluation Procedures analysis indicates that implementation of that plan would fully offset wildlife habitat losses associated with the hurricane protection features. Results of the man-day monetary analysis indicate that, when compared to future without-mitigation

conditions, the mitigation plan is expected to produce a net average annual gain in the benefitted area of over 13,800 man-days of sport fishing, sport hunting, and wildlife-oriented recreation and almost 286,800 pounds of commercially harvested estuarine-dependent fish. The proposed mitigation is expected to offset nearly 80 percent of the sport and commercial fishery losses and over 76 percent sport hunting and wildlife-oriented recreation losses that are attributable to the hurricane protection project features. Fur harvest impacts would be fully offset. It should be noted that any accretion of vegetated wetlands between the rock dike and shoreline is expected to increase fish and wildlife production and increase the percentage of man-day and monetary losses that are offset by implementation of the TSMP. This potential increase was not included in the man-day/monetary estimates.

The Corps' TSMP has been selected by the FWS as the preferred mitigation alternative based on the following:

1. the mitigation plan will fully compensate all adverse project impacts to wildlife resources as quantified by the HEP analysis and will offset, at a minimum, nearly 80 percent of the fishery resource losses as quantified by the man-day and monetary analysis;
2. the cover type (forested and marsh) composition of the area adversely impacted by the project and the area benefitted by the mitigation plan are very similar;

3. the proposed mitigation area is publicly owned and lies within the project area; and
4. a letter of intent to provide local cost-sharing necessary to implement the proposed mitigation plan has been received by the Corps.

The FWS recommends the following measures be taken to offset remaining project impacts to fish and wildlife resources.

1. The TSMP, i.e., shoreline protection adjacent to Manchac WMA, be implemented and maintained for the life of the project plus such additional time required for the adverse effects of the project to cease to occur.
2. Because over 85 percent of the project damages have already occurred, we recommend that construction of mitigation features begin at the earliest possible date.
3. The LDWF and FWS be consulted by the Corps during the detailed design phase of mitigation features.

The FWS strongly supports expedited implementation of the TSMP. It is also the position of the FWS that the Corps, as the lead construction agency, would assume the ultimate responsibility to install and maintain the proposed mitigation features.

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INTRODUCTION

The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project was authorized by the Flood Control Act of 1965 (Public Law 82-298) and described in House Document 231, 89th Congress, First Session. A detailed description of the project was provided in the July 1984 Main Report and Final Supplement I to the Environmental Impact Statement (EIS) for this project, prepared by the U.S. Army Corps of Engineers, New Orleans District. As pointed out by the Fish and Wildlife Service (FWS) in its July 1984 Fish and Wildlife Coordination Act report (FWCAR) and by the Department of Interior in its comments on the draft Main Report and draft Supplement I to the EIS, no means or measures to fully offset project impacts on fish and wildlife resources were included in the above-referenced Corps of Engineers (Corps) documents. This deficiency was recognized by the Corps in its Main Report and Final Supplement I to the EIS. Since completion of those documents, the Corps has worked diligently toward the development of an acceptable mitigation plan. As proposed, the tentatively selected mitigation plan (TSMP) has the potential to be completed prior to the end of construction of the hurricane protection features for this project. The Corps is currently preparing a draft Main Report and draft Supplement II to the EIS for the mitigation portion of this project.

The purpose of this supplemental report is to describe and quantify the benefits, to fish and wildlife resources, attributable to the proposed mitigation plan and to officially transmit the findings and recommendations of the Department of the Interior to the Corps on the

recommended mitigation plan for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. When finalized, this report will constitute the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

DESCRIPTION OF THE SELECTED PLAN

During the development of a mitigation plan, the Corps, FWS, and Louisiana Department of Wildlife and Fisheries (LDWF) considered a host of mitigation alternatives. The FWS mitigation policy (Federal Register 1981a) gives priority to those plans that are within the planning area and are to be accomplished on public lands; the TSMP meets those criteria. Several of the plans considered, including some of those that would affect portions of St. Bernard Parish and St. Charles Parish, have either been implemented, are being implemented, have a high probability of being implemented, or would provide limited benefits to fish and wildlife resources. Therefore, those plans were eliminated from further consideration.

The TSMP involves the construction of about 5 miles of shoreline protection measures along Lake Pontchartrain from First Canal to about 2,000 feet south of the southernmost boundary of the Manchac Wildlife Management Area (WMA) (Figure 1). The shoreline of Lake Pontchartrain in the vicinity of Manchac WMA has eroded at a rate of about 20 feet per year. During the period 1956 to 1978, it is estimated that over 250 acres of valuable fish and wildlife habitat were lost or degraded

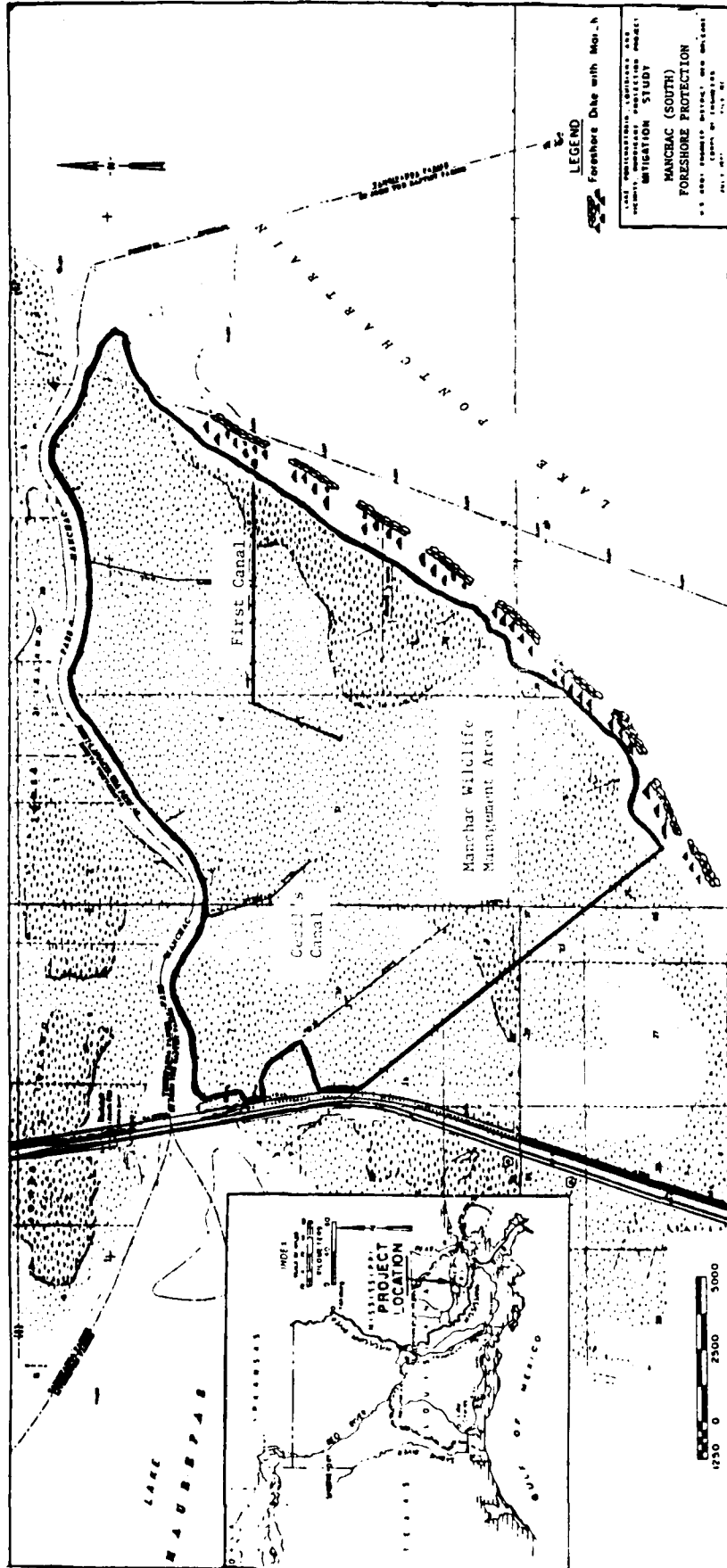


Figure 1. Vicinity map of the tentatively selected mitigation project for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

due to shoreline erosion along this portion of the lake. The loss or degradation of such valuable habitat appears to be continuing and is a serious concern to the FWS.

Shoreline protection would be provided by a series of rock dikes, each 2-feet high, 16-feet wide, and 200-feet long, with 50-foot gaps between each dike. The dikes would be located about 180 feet offshore. The shoreline protection would be supplemented by the planting of marsh vegetation in the area between the shoreline and the dike. The purpose of the TSMP is to protect that portion of the Lake Pontchartrain shoreline bordering Manchac WMA, along with the adjacent wetlands, from wave erosion for the life of the project (i.e., 1995 to 2095).

DESCRIPTION OF THE STUDY AREA

The project area is located in southeastern Louisiana within the Mississippi Deltaic Plain Region. The Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project area, as described in the authorizing document, includes Lakes Maurepas, Pontchartrain, and Borgne and adjacent wetlands that would be inundated by hurricane tides. The area of project impact was described in detail in the FWS's planning-aid letter of November 17, 1981, and attached to the July 1984 FWCAR.

The proposed mitigation area is located in the northeast corner of St. John the Baptist Parish in southeastern Louisiana (Figure 1). The anticipated benefits of the proposed mitigation plan would be limited to a 4,726-acre portion of Manchac WMA. The area to be benefitted is bounded on the east and south by Lake Pontchartrain, on the north by First Canal, Cecil's Canal, and Pass Manchac, and on the west by the Illinois Central Gulf Railroad and the southwest boundary of Section 37, Township 9 south, and Range 8 east.

Major area waterbodies, including Lake Maurepas, Lake Pontchartrain, and Pass Manchac, have a significant influence on the proposed mitigation area. Pass Manchac is the principal waterway connecting the two large lakes. Lake Pontchartrain salinities near Pass Manchac vary from 0 to 1 part per thousand (ppt) during most of the year. Salinities increase to 5 to 7 ppt during late summer, especially in those years when low rainfall results in relatively low input of freshwater into the Lake Pontchartrain Basin (Thompson and Fitzhugh 1985). The completion of major man-made navigation channels including the Mississippi River-Gulf Outlet, Gulf Intracoastal Waterway, and Inner Harbor Navigation Canal has facilitated the inflow of saline water from the Gulf of Mexico into Lake Pontchartrain. Openings of the Bonnet Carre Floodway in some recent years have served to maintain very low salinities in the western end of Lake Pontchartrain.

Climate in the area is subtropical with high humidity, hot summers, and mild winters. Average annual rainfall slightly exceeds 60 inches. The area is plagued by typical storms and hurricanes that bring high

winds, storm tides, and torrential rains. Land elevations in the proposed mitigation area are below 5 feet mean sea level.

Cockerham et al. (1973) and the U.S. Department of Agriculture, Soil Conservation Service (undated) classified the dominant soils of this area as Maurepas muck, a unique soil having a deep organic layer formed from the decomposition of swamp plants. The authors of the latter report stated that, prior to the mid-1900's, the area was vegetated by a relatively sparse overstory of baldcypress and dense understory of maidencane.

The U.S. Department of Agriculture, Soil Conservation Service, (undated) provided the following history of the vegetation and soils and degradation of the proposed mitigation area cover types. Historically, the soil-building process had been able to offset subsidence, erosion, and sea level rise through the production of relatively high volumes of organic material. Anaerobic conditions minimized plant decomposition below sea level, while rapid oxidation and plant decomposition above sea level reduced soil elevation to near sea level. In the early to mid-1900's the virgin cypress were removed and the delicate soil-building process interrupted. To facilitate the logging process, channels were cut through the shorelines of Lake Pontchartrain and Pass Manchac to virtually every point in the proposed mitigation area. These channels have allowed for the more rapid movement of water through the WMA resulting in greater tidal fluctuation, increased salinities, lower water levels and associated greater oxidation of the soils, and erosion of highly organic soils. This, coupled with high volumes of more saline waters brought into the

area by hurricanes Betsy in 1965 and Camille in 1969 and completion of the aforementioned navigation channels, are thought to have brought about a substantial change in the vegetational composition of the area. These recent changes continue to adversely affect the Manchac WMA fresh/intermediate marsh zone, which is thought to have been in a state of steady degradation since the 1960's.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Description of Cover Types

The cover types of Manchac WMA can be broadly classified as coastal wetlands which include cypress-tupelo, fresh and intermediate marsh, and marsh pond. The nearshore lake cover type lies adjacent to Manchac WMA and is included as a separate cover type in this report. Cover types and associated acreages within the WMA are changing as a result of shoreline erosion, subsidence, and salt-water intrusion. Projected acreages of the various cover types under future without-mitigation (FWOM) conditions are provided in Table 1.

Cypress-tupelo

In accordance with the wetland classification system established by Cowardin et al. (1979), the cypress-tupelo cover type is classified as

Table 1. Cover type acreages, by target year and annualized, under future without-mitigation conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Target year	Cover type			
	Cypress-tupelo	Marsh	Marsh pond	Nearshore Lake
1992	191	3,686	687	162
1995	179	3,639	710	197
2000	159	3,562	749	255
2001	155	3,547	191	833
2010	119	3,405	265	937
2020	79	3,252	342	1,053
2030	39	3,104	414	1,169
2040	0	2,961	480	1,285
2050	0	2,790	535	1,401
2060	0	2,626	583	1,517
2070	0	2,468	625	1,633
2080	0	2,317	660	1,747
2090	0	2,171	690	1,865
2095	0	2,101	702	1,923
ANNUALIZED	44	2,889	514	1,279

palustrine forested wetland. Within the project area, forested wetlands are generally located along the shorelines of Lake Pontchartrain and Pass Manchac. Common vegetation in these areas include baldcypress, red maple, black willow, sugarberry, live oak, locust, common persimmon, Eastern baccharis, smartweed, elephant ear, deer pea, Walter's millet, sprangletop, and giant ragweed. Historically, much of Manchac WMA was forested. Logging activities in the early to mid-1900s eliminated those virgin forests and subsequent erosion, subsidence, and, more recently, increased salinities have prevented regeneration of the cypress forest and facilitated the transition to marsh.

Fresh/Intermediate Marsh

According to Cowardin et al. (1979), fresh marsh is classified as palustrine emergent wetland, and intermediate marsh is classified as estuarine emergent wetland. Due to the low salinities in the intermediate marsh and the similarity in vegetation and habitat values between intermediate marsh and fresh marsh, the two marsh types have been lumped into a fresh/intermediate marsh designation. The dominant plant species in this cover type are bulltongue and smartweed. Other common plant species include Walter's millet, sprangletop, deer pea, and bacopa.

Also interspersed in the marsh cover type are channels, which are classified by Cowardin et al. (1979) as riverine open water or

estuarine open water depending upon salinity. These channels are relatively narrow and provide access to the WMA.

Marsh Pond

This cover type includes marsh lakes and ponds, and can be classified as estuarine or palustrine open water based on size, hydrology, and salinity of the water areas involved. Within the proposed mitigation area is a 530-acre estuarine open water area known as "the prairie". This area was historically a maidencane-dominated fresh marsh. That marsh is thought to have been "burned" by high salinities brought into the area by one of the major hurricanes in the 1960s, and has never recovered sufficiently to support emergent vegetation (U.S. Department of Agriculture, Soil Conservation Service, undated). The area is normally covered by water and beds of widgeon grass (i.e., estuarine aquatic bed), a preferred waterfowl food. This shallow lake provides preferred feeding areas for numerous species of waterfowl and serves as a refuge for waterfowl seeking more sheltered waters when adverse weather conditions force them from Lake Pontchartrain.

The ponds found throughout the WMA are classified as palustrine open water where salinities remain below 0.5 ppt or as estuarine open water where salinities exceed the 0.5 ppt limit.

Nearshore Lake

The most notable lake in the study area is Lake Pontchartrain, which is classified as estuarine open water. Due to shoreline erosion, Lake Pontchartrain is continuously encroaching on the vegetated portion of Manchac WMA. Only that portion of Lake Pontchartrain that lies within 180 feet of the existing shoreline was considered in this study and, as such, was categorized as nearshore lake. Because this area is shallow and has not been impacted by dredging, it is thought to provide habitat for a more diverse assemblage of biota than is found in the deeper portions of Lake Pontchartrain. The nearshore lake also absorbs the wave energy and, thereby, reduces shoreline erosion.

Fishery Resources

The fresh to low salinity waters of the study area provide habitat for many fishes and shellfishes of commercial and recreational importance. Freshwater sport fishes include largemouth bass, black crappie, white crappie, bluegill, redear sunfish, spotted sunfish, warmouth, and several species of catfish. Commercially important freshwater fishes include freshwater drum, bowfin, carp, buffaloes, and several species of catfish and gar. The low-salinity waters and wetlands of the area also provide feeding and nursery habitat for many species of estuarine-dependent fishes and shellfishes. These include southern

flounder, red drum, black drum, sand seatrout, Atlantic croaker, bay anchovy, Gulf menhaden, striped mullet, blue crab, and white shrimp.

The marshes of the project area produce vast amounts of organic detritus which is transported into adjacent estuarine waters where it forms the basis of the food web. The marshes and shallow ponds also provide nursery habitat that is critical to the production of numerous estuarine-dependent fishes and shellfishes. The dependence of sport and commercial fish production on marshes has been well documented and is discussed in the July 1984 FWCAR prepared for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. In that report, it was assumed that the magnitude of future declines in marsh acreages would determine the extent of future declines in estuarine-dependent finfish and shellfish yields. Based on this assumption and the man-day/monetary evaluation presented in Appendix B, the sport and commercial fish values of the area were calculated for the economic life of the mitigation project (i.e., 1995 to 2095). An estimated average of nearly 44,000 man-days will be expended annually in the pursuit of sport fish produced by the wetlands of the proposed mitigation area under future without-mitigation (FWOM) conditions. These wetlands also produce almost 1,030,500 pounds of commercially harvested fish and shellfish annually¹.

1. The commercial fisheries values used in this report were calculated using the same baseline values reported in the July 1984 FWCAR. Monetary values used in subsequent sections of this report reflect value to the fisherman (i.e., gross ex-vessel value). Retail values have been reported to be several times greater than even the gross ex-vessel value.

Wildlife Resources

Manchac WMA supports an array of wildlife species that are largely dependent upon marsh habitat. Hebrard and Stone (1980) provided a detailed list of higher vertebrates in the Lake Pontchartrain area; a discussion of some representative species follows.

Amphibians and Reptiles

The bullfrog and pig frog are pursued for recreational and/or commercial purposes. Economically important reptiles either known or likely to inhabit the area include the American alligator, common snapping turtle, alligator snapping turtle, spiny softshell turtle, and smooth softshell turtle. Several species of water snakes and the western cottonmouth are the most common snakes in the proposed project area.

Birds

Migratory waterfowl are important winter residents of Manchac WMA. In recent years, the FWS, in cooperation with State fish and wildlife agencies and other knowledgeable individuals, identified key privately-owned wetland areas along the Central Gulf Coast that were

considered vital habitat for wintering waterfowl (U.S. Department of the Interior, Fish and Wildlife Service, 1982). The Manchac WMA is included in one of those key wetland units, i.e., the Lake Maurepas Unit.

The Lake Maurepas Unit was ranked tenth out of the 14 units identified in the Central Gulf Coast. This unit encompasses about 95,000 acres, including that area between Lake Maurepas and Lake Pontchartrain and the swamp/marsh area south of Lake Maurepas. Because no annual waterfowl surveys are normally flown over this area, separate inventories of Lake Maurepas and Manchac WMA in January 1976 and 1977 were used to estimate an average population of 98,804 ducks and coots wintering in this key unit. Principal species included mallard (45,788), gadwall (11,650), and American coot (30,000). Some of the other waterfowl species using the area include American wigeon, green-winged teal, blue-winged teal, pintail, canvasback, and lesser scaup.

The mottled duck, wood duck, and hooded merganser utilize the area throughout the year. Of these, only the mottled duck is a ground nester. The wood duck and hooded merganser are cavity nesting species, which ordinarily nest in trees, or, when available, man-made nest boxes that are over or adjacent to water. This nest-site requirement limits these species to the forested portions of the project area for nesting, but broods are capable of moving into the marsh habitats.

Other common game birds in the study area include rails, gallinules, common snipe, and American woodcock. These latter two species are absent from the area in summer. The king rail, clapper rail, purple gallinule, and common gallinule all nest in the project area marshes.

Wading and shorebirds are abundant in the shallow marsh waters and along the shorelines of Lake Pontchartrain, "the prairie", and other shallow-water habitats. Wading birds such as great blue heron, little blue heron, Louisiana heron, green heron, great egret, snowy egret, white-faced ibis, and white ibis are common in the marshes and forested wetlands of the project area. A review of the Atlas of Wading Bird and Seabird Nesting Colonies in Coastal Louisiana, Mississippi, and Alabama: 1983 (Keller et al. 1983) indicated that no nesting colonies occurred in the project area.

Mammals

Many of the mammals occurring on the Manchac WMA are sought for sport or commercial purposes. The white-tailed deer and swamp rabbit are the principal game species. Commercially important furbearers include nutria, muskrat, mink, river otter, and raccoon.

Sport and Commercial Value

An analysis of the man-day and monetary values of the wildlife resources of the proposed mitigation area is contained in Appendix B. This analysis indicated that an average of over 5,400 man-days would be expended annually for sport hunting and non-consumptive, wildlife-oriented recreation under FWOM conditions.

Endangered and Threatened Species

The only endangered species that is likely to occur in the mitigation area is the bald eagle. An eagle nest has been recently located in Tangipahoa Parish north of Lake Maurepas and about 10 miles from the proposed construction. In Louisiana, the American alligator, which is listed as "threatened" under the Similarity of Appearance clause of the Endangered Species Act of 1973 (Federal Register 1981b), is harvested for sport and commercial purposes.

This discussion should not be construed as fulfilling the Corps responsibilities under Section 7 of the Endangered Species Act of 1973, as amended. The FWS contact regarding endangered species in the project area is:

Field Supervisor
Endangered Species Field Office
U.S. Fish and Wildlife Service
200 East Pascagoula Street, Suite 300
Jackson, Mississippi 39201

Wildlife Management Areas

The entire mitigation project is to be performed adjacent to Manchac WMA. The LDWF has been intimately involved in the development of this mitigation plan. That agency's full support of the proposed mitigation is evidenced by the LDWF offer, by letter dated October 2, 1985, to cost share in the construction of the proposed shoreline protection feature.

FISH AND WILDLIFE CONCERNS AND PLANNING OBJECTIVES

The principal objective of the Mitigation Study for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project was to develop a plan that would fully offset unavoidable damages associated with implementation of all project features. Fish and wildlife resource impacts associated with the hurricane protection project features were quantified by cover type acreages, habitat values, and human usage in our July 1984 FWCAR. Those estimates were modified in a June 1985 planning-aid report (Hankla 1985) and are summarized in Tables 2, 3, and 4.

Table 2. Cover type acreage impacts associated with the hurricane protection features of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Cover type	Acreage change ¹ due to the project	Resource category ²
Coastal wetlands ³	-1,329	2
Nearshore lake	-447	3

1. The acreage change due to the project is calculated on an annualized basis over the life of the impact. The acreages used in these calculations are taken from Hankla (1985) and are converted to a 100-year period of analysis using a methodology similar to that described for the Habitat Evaluation Procedures in Appendix A.
2. Resource categories are used to define mitigation goals and are defined in the Fish and Wildlife Service Mitigation Policy (Federal Register 1981a). Resource categories are further discussed and described in the "Fish and Wildlife Conservation Measures" section of this report. Only those cover types for which mitigation is sought are included in this table.
3. For the purpose of mitigation, the forested wetlands (primarily cypress-tupelo), marsh, and marsh pond were classified as coastal wetlands.

Table 3. Average annual habitat unit (AAHU) losses attributable to the hurricane protection features of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Evaluation element	AAHU losses due to the project ¹
Nutria	-403.5
Muskrat	-470.2
Raccoon	-408.2
Shorebird	-332.4
Deer	-221.1
Puddle duck	-442.6
Diving duck	-332.4

1. AAHU losses reported in this table are limited to impacts associated with the hurricane protection features of this project as reported by Hankla (1985) and modified according to the methodology described in Appendix A of this report.

Table 4. Average annual man-day and monetary impacts attributable to the hurricane protection features of the Lake Poychartrain, Louisiana, Hurricane Protection Project.¹

Activity	Man-days	Poundage	Monetary value (\$)
Sport fishing	-15,667		-\$61,101
Commercial fishing		-361,858	-92,938
Hunting	-1,078		-9,550
Wildlife-oriented recreation	-615		-2,391
Trapping			-3,290
TOTAL	-17,360	-361,858	-169,270

1. Values reported in this table were based on the average annual loss as reported by Hankla (1985) and compressed to a 100-year period of analysis. That acreage was multiplied by the appropriate pounds, man-day, or monetary value per acre reported in Appendix B.

EVALUATION METHODOLOGY

An assessment of the mitigation project's anticipated impacts on fish and wildlife resources was completed using three analyses: cover type acreage, the FWS's Habitat Evaluation Procedures (HEP), and a man-day/monetary evaluation. These analyses addressed the period from the beginning of construction to the end of project life, i.e., 1992 to 2095.

The fundamental tool used for assessing impacts on fish and wildlife is the estimation of project-related changes in acreages of specific cover types, as compared to trends that are expected to occur without the proposed project. These data form the basis of the other evaluations conducted. Shoreline erosion rates were based on historic data and were provided by the Corps to the FWS via letter dated May 1, 1986. The baseline acreages in the area to be influenced by the mitigation project were provided by the Corps to the FWS via letter dated July 3, 1986.

For the cover type acreage analysis, it was assumed that, without implementation of the TSMP, the shoreline would continue to erode at a rate of 20 feet per year throughout the project life. It was also assumed that, with implementation of the TSMP, shoreline erosion would be arrested throughout the life of the hurricane protection project. Marsh loss due to subsidence was calculated independent of shoreline erosion; the rate of marsh loss due to causes other than shoreline erosion is expected to remain constant with or without implementation of the TSMP.

It is FWS policy (Federal Register 1981a) to use HEP as its basic tool for evaluating project impacts and formulating subsequent recommendations for mitigation of habitat value losses. In most cases compensation of habitat value losses should result in the replacement of fish and wildlife populations and human uses; where it does not, the Service will recommend additional mitigation measures. A complete discussion of the HEP and man-day/monetary evaluations is included in Appendices A and B.

PROJECT IMPACTS

The principal impacts of the proposed mitigation measures on fish and wildlife resources, when compared to FWOM conditions, include an average annual net "increase" (i.e., a net reduction in loss) of almost 1,082 acres of coastal wetlands. This includes an average annual net savings of 135 acres of cypress-tupelo, 344 acres of marsh, and 603 acres of marsh pond over the life of the project (Table 5). Associated with this net savings of valuable fish and wildlife habitat is a substantial increase in average annual habitat units (AAHUs) for a number of evaluation elements (Table 6) and full mitigation of wildlife habitat (AAHU) losses attributable to the hurricane protection portion of this project (Appendix A).

A man-day/monetary evaluation of the TSMP was completed and is included in Appendix B. The results of that analysis indicate that implementation of the TSMP will, when compared to FWOM conditions,

Table 5. Comparison of cover type acreages, by target year and annualized, under future without-mitigation (FWOM) and future with-mitigation (FWM) conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Target year	Cover type							
	Cypress-tupelo		Marsh		Marsh pond		Nearshore Lake	
	FWOM	FWM	FWOM	FWM	FWOM	FWM	FWOM	FWM
1992	191	191	3,686	3,686	687	687	162	162
1995	179	179	3,639	3,639	710	710	197	197
2000	159	179	3,562	3,594	749	756	255	197
2001	155	179	3,547	3,585	191	765	833	197
2010	119	179	3,405	3,505	265	854	937	197
2020	79	179	3,252	3,418	342	931	1,169	197
2030	39	179	3,104	3,334	414	1,016	1,169	197
2040	0	179	2,961	3,252	480	1,098	1,285	197
2050	0	179	2,790	3,171	535	1,178	1,401	197
2060	0	179	2,626	3,093	583	1,256	1,517	197
2070	0	179	2,468	3,016	625	1,333	1,633	197
2080	0	179	2,317	2,942	660	1,407	1,749	197
2090	0	179	2,171	2,869	690	1,480	1,865	197
2095	0	179	2,101	2,833	702	1,516	1,923	197
ANNUALIZED	44	179	2,889	3,233	514	1,117	1,279	196
CHANGE (FWM)		+135		+344		+603		-1,083

Table 6. Average annual habitat unit (AAHU) changes attributable to the hurricane protection portion of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project as compared to AAHU changes attributable to the tentatively selected mitigation plan.¹

Evaluation species	AAHUs		Net change
	Hurricane protection project features	Mitigation project features	
Nutria	-403.5	+492.6	+89.1
Muskrat	-470.2	+187.1	-283.1
Raccoon	-408.2	+377.4	-30.8
Shorebird	-332.4	+296.2	-36.2
Deer	-221.1	+183.5	-37.6
Puddle ducks	-442.6	+817.9	+375.3
Diving ducks	-332.4	+156.5	-175.9

1. The Habitat Evaluation Procedures methodology and calculations used to develop the values displayed in this table are described in detail in Appendix A.

result in the average annual net gain of over 12,500 man-days of sport fishing, nearly 286,800 pounds in commercial fish and shellfish harvest, and nearly 1,300 man-days of hunting and wildlife-oriented recreation (Table 7). When the fisheries and wildlife portions of this analysis are combined, the net average annual man-day gain attributable to implementation of this mitigation project is almost 13,800 man-days. These increases only apply to those resources dependent on the wetlands to be affected by the TSMP. When the overall area affected by the hurricane protection project is considered, there will be an average annual net loss of 402 man-days of hunting and wildlife-oriented recreation, an average annual net loss of about 75,100 pounds of estuarine-dependent commercial fish harvest, and an average annual net loss of over 3,150 man-days of sport fishing (Appendix B). This analysis indicated that the TSMP would offset nearly 80 percent of project-related impacts on estuarine-dependent commercial fish and shellfish harvest; over 20 percent of those losses would potentially remain unmitigated. However, some of the marsh pond acreages included in the average annual acreages impacted by the hurricane protection project features and used to calculate commercial fish harvest and man-days of sport fishing effort are probably of a reduced value to estuarine fish production. For this reason, it is thought that fisheries losses are lower for the hurricane protection features of this project than is stated in Appendix B, which, in effect, reduces the unmitigated fisheries losses stated above. It should also be noted that any accretion of vegetated wetlands between the rock dike and shoreline would be expected to increase fish and wildlife production; however, such an increase was not included in our man-day/monetary estimates.

Table 7. Average annual man-day and monetary gains attributable to implementation of the tentatively selected mitigation plan for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Activity	Man-days	Poundage	Monetary value (\$)
Sport fishing	12,513		\$48,801
Commercial fishing		286,761	73,650
Hunting	790		9,059
Wildlife-oriented recreation	501		1,948
Trapping			4,962
TOTAL	13,804	286,761	138,420

1. The methodology used to calculate the man-day, poundage, and monetary values displayed in this table are described in detail in Appendix B.

Any increase in production would further decrease the apparent inequities between project-related losses and mitigation-related gains in fish and wildlife populations and human usage. Because of these considerations no additional mitigation features were recommended.

FISH AND WILDLIFE CONSERVATION MEASURES

As is established in this report and in the FWCAR for the hurricane protection features of this project, the coastal wetlands impacted by this project are of high value to fish and wildlife resources. It is of grave concern to the FWS that Louisiana is losing these valuable wetlands at an estimated rate of 50 square miles per year (Day and Craig 1982) to saltwater intrusion, erosion, subsidence, canal dredging, encroachment of development, and many other causes. The value and vulnerability of these coastal wetlands make it imperative that wetland impacts attributable to the hurricane protection features of this project be fully mitigated.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

- (a) avoiding the impact altogether by not taking a certain action or parts of an action;
- (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- (d)

reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.

The FWS supports and adopts this definition of mitigation and considers its specific elements to represent the desirable sequence of steps in the mitigation planning process.

For this project, the Corps has substantially reduced project impacts through implementation of the High-Level Plan rather than the originally authorized Barrier Plan and realignment of the St. Charles Parish levee reach. However, the average annual loss of 1,329 acres of coastal wetlands and over 2,600 AAHUs would remain in the absence of the proposed mitigation measures. The Corps has determined that changes or modification in project design to further reduce or rectify damages to the fish and wildlife resources attributable to the hurricane protection project features are not in the public interest.

Impacts to fish and wildlife resources that would still remain after the above measures have been considered should be compensated by a mitigation plan that would involve preservation and/or management of existing wetlands. The FWS Mitigation Policy (Federal Register, 1981a) has designated four resource categories that are used to insure that the level of mitigation recommended by FWS biologists will be consistent with the fish and wildlife resource values involved. The mitigation planning goals and recommendations should be based on those four categories, as follows:

Resource Category 1 - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this Resource Category is that there should be no loss of existing habitat value.

Resource Category 2 - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.

Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.

Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

All cover types impacted by the project hurricane protection features and mitigation features were classified by Resource Category; those cover types placed in Resource Category 2 or 3 (i.e., those for which compensation is considered appropriate) are listed in Table 8. Based

Table 8. Acreages and Resource Category classification of cover types impacted by the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Cover type	Average annual acres impacted (net change)	Resource category ¹	Rationale ¹
<u>Hurricane protection features</u>			
Coastal wetlands ²	-1,329	2	High value, severe threat
Nearshore lake	-447	3	Medium to high value abundant, minimal threat
<u>Mitigation features</u>			
Coastal wetlands	+1,082	2	High value, severe threat
Nearshore lake	-1,083	3	Medium to high value, abundant, minimal threat

1. Resource categories are defined and the rationale for classifying cover types are provided in the report text and Federal Register (1981a); only those cover types for which compensation is recommended are included.

2. Coastal wetlands is a general cover type classification which includes forested wetlands (primarily cypress-tupelo), marsh, and marsh pond cover types.

on the above criteria and the foregoing discussion, the coastal wetlands of the project area have been placed in Resource Category 2 and nearshore lake has been placed in Resource Category 3.

The coastal wetlands of the project area include the cover types previously described in this report, principally cypress-tupelo, fresh/intermediate marsh, and associated marsh ponds. It is recognized that there is a significant structural difference between the cypress-tupelo and marsh/marsh pond cover types included in this broad coastal wetland classification. However, it is felt that the composition (type and mix) of the coastal wetlands adversely impacted by the project and of those to be benefitted by the proposed mitigation plan are similar enough to negate the need for a further breakdown of cover types or AAHU losses and gains by cover type. Only 134 of the 1,329 average annual acres of coastal wetlands directly affected by the hurricane protection project features were forested, while 135 of the 1,082 average annual acres of coastal wetlands that would be gained as a result of the proposed mitigation plan are forested. Using this information and the technical discussion in the previous section and Appendix A, we have concluded that implementation of the TSMP will provide full, in-kind compensation of adverse project impacts to wildlife habitat.

Because the forested wetlands (principally cypress-tupelo swamp) impacted by the project are valuable, their losses must be fully mitigated to the extent possible, even by separable mitigation plans when other alternatives are not available. Several of the other mitigation alternatives that were evaluated only benefitted marsh

cover types. For these and other reasons, those alternatives were less acceptable than the TSMP. The Corps' TSMP has been chosen by the FWS as the preferred alternative based on the following rationale:

- 1) the mitigation plan would fully compensate all adverse project impacts to wildlife resources as quantified by the HEP analysis and will offset, at a minimum, nearly 80 percent of the fishery resource losses as quantified by the man-day and monetary analysis;
- 2) the cover type (forested and marsh) composition of the area adversely impacted by the project and the area benefitted by the mitigation plan are very similar;
- 3) the proposed mitigation area is publicly owned and lies within the project area; and
- 4) the letter of intent to provide local cost-sharing necessary to implement the proposed mitigation plan has been received by the Corps.

RECOMMENDATIONS

The FWS recommends the following measures be taken to offset all remaining project impacts to fish and wildlife resources:

1. The TSMP, i.e., shoreline protection adjacent to Manchac WMA, be implemented and maintained for the life of the project plus such additional time required for the adverse effects of the project to cease to occur.
2. Because over 85 percent of the project damages have already occurred, we recommend that construction of mitigation features begin at the earliest possible date.
3. The LDWF and FWS be consulted by the Corps during the detailed design phase of mitigation features.

FISH AND WILDLIFE SERVICE POSITION

The FWS strongly supports expedited implementation of the TSMP and urges implementation of that project feature at the earliest possible date. It is also the position of the FWS that the Corps, as the lead construction agency, would assume the ultimate responsibility to install and maintain the proposed mitigation features.

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT, MITIGATION STUDY:
SUPPLEMENTAL FISH AND WILDLIFE COORDINATION ACT REPORT

APPENDIX A

HABITAT EVALUATION PROCEDURES (HEP) ANALYSIS

The Fish and Wildlife Service's (FWS) Habitat Evaluation Procedures (HEP) were developed to help document the quality and quantity of available habitat for fish and/or wildlife species in a given area. Using the HEP, habitat quality and quantity can be measured for baseline conditions and predicted for future without-mitigation (FWOM) and future with-mitigation (FWM) conditions. This standardized, species-based methodology allows a numeric comparison of each future condition and hence provides an estimate of project-induced impacts on fish and wildlife resources. The 1980 version of HEP, which has become the most widely accepted technique for assessing wildlife impacts, was modified and used for this project. The methodology employed follows that described in the FWS's November 8, 1982, planning-aid report on hurricane protection features of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection project. The only FWM condition considered in this analysis is the Manchac (South) alternative, which includes protection of the Lake Pontchartrain shoreline along the southernmost 5 miles of Manchac Wildlife Management Area (WMA). The Corps of Engineers (Corps) has designated this alternative as the tentatively selected mitigation plan.

In the proposed mitigation area, four cover types were delineated under FWOM and FWM for the determination of habitat values; these include cypress-tupelo (palustrine forested wetland), marsh (palustrine/estuarine emergent wetland), marsh pond (palustrine/estuarine open water), and nearshore lake (estuarine open water). A description of these cover types is provided in the main report. Baseline cover type acreages were provided by the Corps and

projected into the future based on historic (1956-1978) habitat change rates (Table A-1). A brief description of the methodology and assumptions used to predict future habitat acreages is included as Attachment 1 to this Appendix.

The same evaluation elements were used to assess habitat quality on the proposed mitigation area as were used for the hurricane protection portions of the project. These include nutria, muskrat, raccoon, shorebird, deer, puddle ducks, and diving ducks, i.e., wildlife taxa which are considered to be economically important and represent various trophic levels within the study area. These taxa were used to evaluate all cover types within the mitigation area. On August 29, 1984, seven sample sites were inspected by a team of biologists representing the Louisiana Department of Wildlife and Fisheries, Corps, and FWS.

In the strictest application of HEP, habitat suitability is based on detailed field measurements of various parameters that limit the relative population density of a particular species. However, in an effort to accelerate the HEP process, the interagency team visited the sample sites and estimated habitat suitability for each evaluation element on a scale of 0 to 10, with 0 being the poorest and 10 being the optimal score. These estimates were based on written summaries of habitat requirements of the species involved and on the professional judgment of the biologists assigning habitat suitability values. This rating is termed the habitat suitability index (HSI). For compatibility with the Service's HEP, these ratings were converted to a scale of 0.00 to 1.00 by simply moving the decimal one digit to the

Table A-1. Comparison of cover type acreages, by target year, under future without-mitigation (FWOM) and future with-mitigation (FWM) conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Target year	Cover type							
	Cypress-tupelo		Marsh		Marsh pond		Nearshore Lake	
	FWOM	FWM	FWOM	FWM	FWOM	FWM	FWOM	FWM
1992	191	191	3,686	3,686	687	687	162	162
1995	179	179	3,639	3,639	710	710	197	197
2000	159	179	3,562	3,594	749	756	255	197
2001	155	179	3,547	3,585	191	765	833	197
2010	119	179	3,405	3,505	265	854	937	197
2020	79	179	3,252	3,418	342	931	1,053	197
2030	39	179	3,104	3,334	414	1,016	1,169	197
2040	0	179	2,961	3,252	480	1,098	1,285	197
2050	0	179	2,790	3,171	535	1,178	1,401	197
2060	0	179	2,626	3,093	583	1,256	1,517	197
2070	0	179	2,468	3,016	625	1,333	1,633	197
2080	0	179	2,317	2,942	660	1,407	1,749	197
2090	0	179	2,171	2,869	690	1,480	1,865	197
2095	0	179	2,101	2,833	702	1,516	1,923	197
ANNUALIZED	44	179	2,889	3,233	514	1,117	1,279	196
CHANGE (FWM)		+135		+344		+603		-1,083

left. Details regarding sample site location, individual sample site scores, and related data are on file in this office.

The average HSI for each evaluation element over all sample sites within a particular habitat type is termed the mean HSI for that cover type. The evaluation species HSI is determined for each target year, from the baseline year to the end of the project life. Target years are established to illustrate significant changes in habitat quality and/or quantity at specific points in time.

The habitat unit (HU) is the basic unit utilized in the HEP for measuring project effects on wildlife. HUs are the product of the evaluation species HSI and the acreage of available habitat at a given target year. Future HUs change according to changes in habitat quality or quantity; these changes are predicted for various target years over the project life, for FWOM and FWM conditions. The HUs are summed and annualized over the project life to determine the average annual habitat units (AAHUs) available for each species. The change (increase or decrease) in AAHUs under FWM, compared to FWOM, provides a quantitative comparison of project impacts that are expected to occur with project implementation. An increase in AAHUs indicates that the project is beneficial to the evaluation species; a decrease in AAHUs indicates that the project is damaging to the evaluation species.

For this project, target years were selected to correspond with increments used for the economic evaluation conducted by the Corps and to indicate project impacts associated with construction, maintenance,

and other significant changes in habitat quality or quantity attributable to marsh loss/shoreline erosion (Table A-2). Evaluation element HSIs were calculated by cover type and are displayed in Table A-3. It was assumed that HSIs remain the same throughout the project life. The product of the HSIs and acreages were calculated by target year for each project condition; a comparison of AAHUs under FWOM conditions and FWM conditions is provided in Table A-4.

For mitigation purposes, the AAHU losses reported by the FWS in its planning-aid report provided to the Corps on June 18, 1985, (Hankla 1985) were modified to include only those losses occurring in Resource Category 2 and Resource Category 3 (as defined in Federal Register 1981) cover types and to convert all project losses and mitigation gains to a common period of analysis. Early in mitigation planning, it was pointed out that upland developed and scrub-shrub (spoil bank) habitats were considered to be Resource Category 4 and, as such, not subject to compensation of unavoidable project damages. Therefore, those AAHU losses occurring in scrub shrub and upland developed habitats were not included in the total AAHU losses displayed in Table A-5. Furthermore, the AAHU losses reported in the above-referenced report were based on various periods of impact, ranging from 128 to 108 years. To convert these losses to the same 100-year period of economic benefit used to analyze AAHU gains attributable to mitigation, a conversion factor was calculated by dividing the period of impact by the 100-year benefit period. Then, for each project reach and each evaluation element, the AAHU change due to the project was multiplied by the conversion factor to calculate AAHUs needed for mitigation. The adjusted AAHU losses attributable to the hurricane

Table A-2. Target years used in the Habitat Evaluation Procedures (HEP) analysis used for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Target year	Reason for selecting target year
1992	Beginning of construction.
1995	End of construction and beginning of the economic life of the project.
2000	Five years after the end of construction, year preceding substantial acreage change (552 acres) of marsh pond converted to nearshore lake.
2001	Year of substantial acreage change (552 acres) of marsh pond converted to nearshore lake.
2010 : :	Ten-year intervals during economic life of the project used to correspond with project economic analysis.
2090	
2095	End of project maintenance and life of the project.

Table A-3. Average habitat suitability index (HSI) values for each evaluation element, by cover type, for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Evaluation element	HSIs by cover type ¹			
	Cypress-tupelo	Marsh	Marsh pond	Nearshore lake
Nutria	0.40	0.75	0.30	0.00
Muskrat	0.13	0.23	0.15	0.00
Raccoon	0.70	0.63	0.20	0.05
Shorebirds	0.12	0.27	0.40	0.05
Deer	0.50	0.25	0.05	0.00
Puddle ducks	0.30	0.77	0.85	0.00
Diving ducks	0.07	0.18	0.50	0.20

1. The HSIs for cypress-tupelo, marsh, and marsh pond are based on data collected during an August 29, 1984, interagency field trip to Manchac Wildlife Management Area. The HSIs for nearshore lake are the same as those used for the hurricane protection portion of this project.

Table A-4. Comparison of average annual habitat units (AAHUs), by evaluation element, under future without-mitigation (FWOM) conditions and future with-mitigation (FWM) conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Evaluation element	AAHUs		Net change ¹
	FWOM	FWM	
Nutria	2,338.6	2,831.2	+492.6
Muskrat	747.3	934.4	+187.1
Raccoon	2,017.8	2,395.2	+377.4
Shorebirds	1,054.8	1,351.0	+296.2
Deer	770.1	953.6	+183.5
Puddle ducks	2,674.5	3,492.4	--817.9
Diving ducks	1,035.8	1,192.3	+156.5

1. The net change in AAHUs was calculated by subtracting AAHUs under FWOM conditions from AAHUs under FWM conditions and represents the AAHU gains due to mitigation.

Table A-5. A parish-by-parish tabulation of average annual habitat units (AAHUs) converted to 100-year period of analysis for each evaluation species for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Life of the impact ¹	Evaluation element	AAHU change due to the project ²	Conversion factor ³	AAHU mitigation needs ⁴
St. Charles ⁵ (1987-2095)				
108	Nutria	-61.0	1.08	-65.9
	Muskrat	-11.2		-12.1
	Raccoon	-27.7		-29.9
	Shorebirds	-3.2		-3.5
	Deer	-14.5		-15.7
	Puddle ducks	-58.9		-63.6
	Diving ducks	-11.7		-12.6
Jefferson (1984-2095)				
111	Nutria	0.0	1.11	0.0
	Muskrat	0.0		0.0
	Raccoon	-20.0		-22.2
	Shorebirds	-20.0		-22.2
	Deer	0.0		0.0
	Puddle ducks	0.0		0.0
	Diving ducks	0.0		0.0
St. Bernard (1967-2095)				
128	Nutria	-80.6	1.28	-103.2
	Muskrat	-69.6		-89.1
	Raccoon	-77.5		-99.2
	Shorebirds	-49.2		-63.0
	Deer	-54.8		-70.1
	Puddle ducks	-67.2		-86.0
	Diving ducks	-50.0		-65.0
Orleans (Actions to date) (1967-2095)				
128	Nutria	-43.2	1.28	-55.3
	Muskrat	-60.8		-77.8
	Raccoon	-41.9		-53.6
	Shorebirds	-48.6		-62.2
	Deer	-17.7		-22.7
	Puddle ducks	-55.0		-70.4
	Diving ducks	-50.0		-64.0

(Continued)

Table A-5. (Continued)

Life of the impact ¹	Evaluation element	AAHU change due to the project ²	Conversion factor ³	AAHU mitigation needs ⁴
Orleans (GIWW Bypass Channel) (1967-2095)				
128	Nutria	-129.6	1.28	-165.9
	Muskrat	-212.3		-271.7
	Raccoon	-148.0		-189.4
	Shorebirds	-130.5		-167.0
	Deer	-82.9		-106.1
	Puddle ducks	-160.7		-205.7
	Diving ducks	-137.3		-175.7
Orleans (High-level plan) (1984-2095)				
111	Nutria	-11.9	1.11	-13.2
	Muskrat	-17.6		-19.5
	Raccoon	-12.5		-13.9
	Shorebirds	-13.1		-14.5
	Deer	-5.9		-6.5
	Puddle ducks	-15.2		-16.9
	Diving ducks	-13.6		-15.1

1. The life of the impact is calculated by subtracting the year construction began from the year that project life ends.
2. The AAHU change due to the project is taken from the Fish and Wildlife Service's Planning-Aid Report provided to the Corps of Engineers on June 18, 1985, (Hankla 1985) and modified to exclude AAHU losses in Resource Category 4 cover types (upland developed and scrub-shrub).
3. The conversion factor is calculated by dividing the life of the impact by the life of the mitigation plan (100 years).
4. The AAHU mitigation needs (expressed as negative values) are the product of the AAHU change (due to the project) and the respective conversion factor.
5. The parish in which the impact occurred is listed along with the life of the impact (from the beginning of construction until the end of project life).

protection project are provided by project reach in Table A-5. The total AAHUs, for which mitigation is required, are reported by evaluation element in Table A-6.

The AAHU losses for which mitigation is sought occur in the nearshore lake cover type and in a complex of forested wetlands (principally cypress-tupelo) and marsh/marsh pond referred to as the coastal wetlands cover type. Because of their high value and relative scarcity, the latter cover type was placed in Resource Category 2, as defined in the FWS Mitigation Policy (Federal Register 1981). That policy calls for Resource Category 2 losses to be mitigated in-kind, i.e., no net loss of in-kind habitat value is allowed. The FWS compensation goal in such a case is to precisely offset the HU losses for each evaluation species. The nearshore lake cover type was placed in Resource Category 3, which permits FWS to recommend out-of-kind mitigation where desirable.

The ideal compensation plan would provide, for each individual species, an increase in HU's equal in magnitude to the HU losses. A mathematical expression of this goal is:

$$\sum_{i=1}^n (M_i + I_i)^2 = 0$$

where M = AAHU's gained through mitigation for a target species,
I = AAHU losses (due to project impacts) for same species,
i = species number, and
n = total number of identified species.

In an effort to determine the optimum compensation acreage, the following formula was utilized; this approach minimizes the total HU

Table A-6. Compensation requirement for average annual habitat unit (AAHU) losses for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Evaluation Element	AAHU losses due to the project (I_i)	AAHU gains due to proposed mitigation (M_i)	M_i^2	$M_i I_i$
Nutria	-403.5	+492.6	242,654.8	-198,764.0
Muskrat	-470.2	+187.1	35,006.4	-87,974.4
Raccoon	-408.2	+377.4	142,430.8	-154,055.0
Shorebird	-332.4	+296.2	87,734.4	-98,456.9
Deer	-221.1	+183.5	33,672.2	-40,571.9
Puddle duck	-442.6	+817.9	668,960.4	-362,003.0
Diving duck	-332.4	+156.5	24,523.6	-52,053.8
		Totals	1,234,982.6	-993,879.0
			Acres to fully mitigate ¹ = 3,803	

1. Acres to fully mitigate is based on the sum of squares technique presented in the text. The candidate compensation area, Manchac Wildlife Management Area, is 4,726 acres.

over-compensations and under-compensations by a sum of squares technique:

$$\text{Optimum Compensation Area} = -A \left(\frac{\sum_{i=1}^n M_i I_i}{\sum_{i=1}^n M_i} \right)^2$$

where M, I, i, and n conform to previous usage, and
A = size of candidate compensation area.

In this case, the compensation acreage required is 3,803 acres (Table A-6).

The TSMP will provide shoreline protection to 4,726 acres or about 124 percent of the 3,803 acres needed to fully mitigate project damages. However, the over-mitigation, as it has been called, can be justified by:

1. If the scope of the mitigation project were reduced, the long-term effectiveness of the entire mitigation plan would become questionable, i.e., it is not considered possible to reduce shoreline protection measures substantially and still maintain an adequate level of protection of the adjacent wetlands.
2. The "excess" AAHU gains can be at least partially offset by unquantified but significant fish and wildlife impacts associated with the proposed borrow sites to be located in Lake Pontchartrain and/or the Bonnet Carre Floodway.

LITERATURE CITED

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ASSUMPTIONS USED TO PROJECT FUTURE COVER TYPE ACREAGES
ON MANCHAC WILDLIFE MANAGEMENT AREA

1. Shoreline erosion is occurring at a rate of 20 feet per year and will continue at that rate throughout the project life under FWOM conditions. (Source: letter from Corps dated May 1, 1986).
2. Based on distance estimates of 80 to 100 yards between the Lake Pontchartrain shoreline and "the prairie" (Source: Bob Love, Louisiana Department of Wildlife and Fisheries' Area Manager for Manchac Wildlife Management Area (WMA), telephone conversation on May 2, 1986) and the 20 feet per year erosion rate, initial breakthrough of the narrow strip of land separating Lake Pontchartrain and the prairie is expected to occur in 1998. By 2001, a substantial portion of the shoreline will have been breeched with conversion of about 550 acres and habitat values (HSIs) from marsh pond to nearshore lake will have occurred at that time.
3. The only factor affecting cypress-tupelo habitat loss from 1978 to 2040 is shoreline erosion. In 2040, all cypress-tupelo habitat will be gone. Impacts from saltwater intrusion and salt accumulation in the soil have stabilized on Manchac WMA and will no longer account for cypress-tupelo degradation. The cypress area is currently limited to higher ground not subjected to saltwater intrusion (Source: telephone communication with Bob Love on July 21, 1986). (NOTE: saltwater intrusion and salt accumulation in the soils are believed to still be affecting

vegetative composition and structure, including cypress-tupelo, in other portions of the Lake Pontchartrain basin).

4. Marsh is being lost to marsh pond at a rate of 0.25 percent per year (Source: Hankla 1985). From 1992 through the end of project life, marsh and marsh pond cover type acreages will be affected by shoreline erosion (independent of subsidence) and subsidence. The rate of marsh loss to shoreline erosion will increase as the cypress-tupelo cover type is eliminated; the rate of marsh and marsh pond cover types lost to erosion is directly proportional to the marsh: marsh pond ratio within the area in a given year. (For example, if 10.0 acres of shoreline erosion comes from marsh and marsh pond cover types and marsh constitutes 75 percent of the combined acreage of those two cover types, then it is assumed that 75 percent, or 7.5 acres, of the loss is at the expense of the marsh cover type.)

5. Under FWM conditions, shoreline erosion will be halted at the end of construction (1995); cypress-tupelo acreage will remain the same throughout the economic life of the project; and marsh loss due to subsidence and other factors is assumed to continue.

LAKE PONCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT, MITIGATION STUDY:
SUPPLEMENTAL FISH AND WILDLIFE COORDINATION ACT REPORT

APPENDIX B

MAN-DAY/MONETARY EVALUATION OF FISH AND WILDLIFE RESOURCES

INTRODUCTION

The anticipated benefits to sport and commercial fish and wildlife harvest and associated monetary values of the proposed Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation features are described in this appendix. These benefits include those associated with sport and commercial fish and wildlife harvest and, to a nominal degree, non-consumptive wildlife-oriented recreation (WOR). These estimates were developed by estimating the carrying capacity and corresponding monetary value of each cover type on a per-acre basis, and by predicting future values based on the area of available habitat under future without-mitigation (FWOM) and future with-mitigation (FWM) conditions. The only alternative considered was the Corps of Engineers' tentatively selected plan which includes protection of the Lake Pontchartrain shoreline along the southernmost 5 miles of the Manchac Wildlife Management Area (WMA). The methodology used in this analysis was discussed in greater detail in the Fish and Wildlife Service's July 1984 Fish and Wildlife Coordination Act Report (FWCAR) for the hurricane protection portion of this project (Strader 1984). For the purpose of comparison, the baseline values (i.e., man-days per acre, pounds per acre, and monetary values) used in this analysis were the same as those used in that July 1984 FWCAR. The results of this analysis should not be used to directly calculate the economic benefits of the mitigation plan.

FISHERIES

The sport and commercial fishery resources of the Lake Pontchartrain/Lake Borgne estuarine complex, of which Manchac WMA is a part, are significant. The fisheries analysis is based on the assumption that marsh acreage is the most important factor influencing estuarine-dependent fisheries production and that every acre of marsh lost or saved results in a proportional loss or gain, respectively, in fisheries production and the corresponding man-day/monetary value of the fisheries. Because most of the area defined as marsh pond is vegetated with submerged vegetation, the acreage of marsh pond was combined with the marsh acreage to calculate fisheries impacts.

For sport fishing, it was assumed that the fish produced from each acre of marsh provide 12.9 man-days of sport fishing per year, and that the fish produced from each acre of cypress-tupelo forest provide 2.2 man-days of sport fishing per year (U.S. Army Corps of Engineers 1977). Annualized acreages (from Table A-1) for FWOM conditions and FWM conditions were then multiplied by the appropriate man-day figure to estimate the average annual man-days of sport fishing. Monetary impacts were calculated by multiplying the man-days of sport fishing by \$3.90, which is the monetary value for a man-day of sport fishing that was used in the July 1984 FWCAR. The results of the sport fishing analysis (Table B-1) indicate that implementation of the proposed mitigation plan will increase the sport fishing potential of the mitigation area by an average of over 12,500 man-days, valued at just over \$48,800, annually.

Table B-1. A comparison of the anticipated sport fishing opportunities under future without-mitigation (FWOM) and future with-mitigation (FWM) conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Project condition	Habitat type	Annualized acreage ¹	Man-days per acre ²	Man-days ³	Monetary value per man-day(\$) ⁴	Total monetary value(\$) ⁵
FWOM	Marsh	3,403	12.9	43,899	\$3.90	171,206
	Cypress-tupelo	44	2.2	97	3.90	378
				Total 43,996		Total 171,584
FWM	Marsh	4,350	12.9	56,115	3.90	218,348
	Cypress-tupelo	179	2.2	394	3.90	1,537
				Total 56,509		Total 220,385
				Net change +12,513	Net change	+48,301

1. Annualized acreages are taken from Table A-1, Appendix A.
2. Man-days per acre are taken from U.S. Army Corps of Engineers 1977.
3. Man-days are calculated by multiplying the annualized acreage by the man-days per acre.
4. Monetary value per acre is the same as that used in the July 1984 FWCAR.
5. The total monetary value is calculated by multiplying the man-days by the monetary value per man-day.

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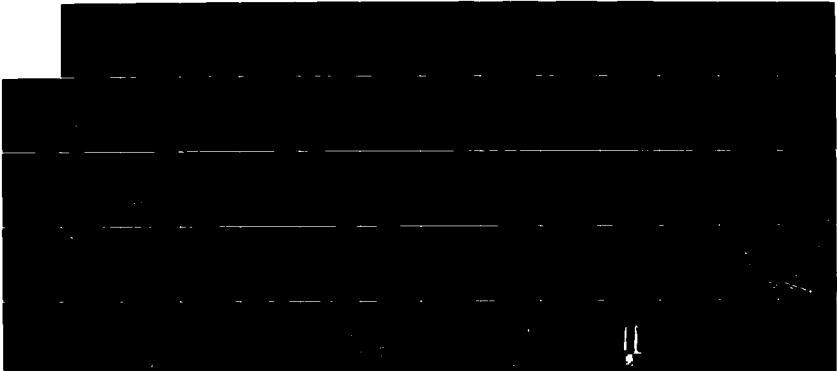
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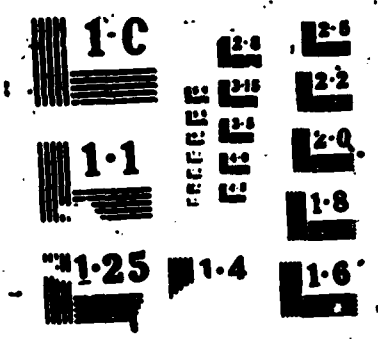
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The average annual commercial harvest of fish and shellfish produced in the mitigation area was calculated on a per-marsh-acre basis. The annualized marsh acreage in the mitigation area under FWOM and FWM conditions is shown in Table B-1. Those acreages were multiplied by the average pounds harvested per marsh acre; the resulting estimates of harvest (pounds) were then multiplied by the appropriate monetary value per pound to calculate the commercial fishery value of the mitigation area under FWOM and FWM conditions (Table B-2). A comparison of these monetary values indicates that implementation of the proposed mitigation plan will increase the average annual commercial fishery value of the mitigation area by almost 286,800 pounds valued at over \$73,600.

WILDLIFE

Sport

This analysis of the man-day and monetary value of sport hunting in the project area is based on the ability of a given cover type to support a stable wildlife population, and the assumption that a certain portion of the wildlife population can be harvested at a sustainable annual rate without adversely affecting that population. Using these assumptions, the potential sport hunting effort (man-days) per acre was calculated for the hurricane protection portion of this project by Strader (1984). Where applicable, those values were used in this analysis (Table B-3).

Table B-2. Comparison of the anticipated harvest and monetary value of the commercial fish produced in the proposed mitigation area under future without-mitigation (FWOM) conditions and future with-mitigation (FWM) conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Species	Average catch ¹ (pounds per acre)	FWOM (3,403 marsh acres)		FWM (4,350 marsh acres)		Net change ⁵		
		Monetary value per ² pound (\$)	Total pounds produced ³	Monetary value	Total pounds produced		Monetary value	
Shrimp	43.13	1.07	146,771	\$157,045	187,616	\$200,749	40,844	\$43,703
Menhaden	115.75	0.06	393,897	23,634	503,513	30,211	109,615	6,577
Seatrout	1.44	0.62	4,900	3,038	6,264	3,884	1,364	845
Spot	0.05	0.13	170	22	218	28	47	6
Red drum	0.42	0.45	1,429	643	1,827	822	398	179
Croaker	5.65	0.21	19,227	4,038	24,578	5,161	5,351	1,124
Crab	11.40	0.32	38,794	12,414	49,590	15,869	10,796	3,455
Oyster	8.87	1.46	30,185	44,070	38,585	56,333	8,400	12,264
Unclassified	116.10	0.05	395,088	19,754	505,053	25,252	109,947	5,497
Total	302.81		1,030,462	264,658	1,317,224	338,309	286,761	73,650

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1. Average catch per marsh acre was calculated from data generated by National Marine Fisheries Service for the period 1963 through 1978. These values are the same as those used in the July 1984 FWCAR (Strader 1984).
2. The per-pound monetary values are the same as those used in the July 1984 FWCAR (Strader 1984).
3. Total pounds produced is calculated by multiplying the average catch per acre by the average annual marsh acreage.
4. The monetary value is calculated by multiplying the net monetary value per pound by the average annual marsh acreage.
5. The net change is the change in total pounds and monetary value from FWOM conditions and FWM conditions.

Table B-3. Sport hunting potential and value by various cover types within the proposed mitigation area for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Cover type	Species	Potential effort per acre (man-days) ¹	Value per man-day(\$) ²	Value per acre(\$) ³
Cypress-tupelo	Rabbit	0.16	\$3.90	\$0.62
	Squirrel	0.17	3.90	0.66
	Deer	0.13	13.80	1.79
	Waterfowl	<u>0.09</u>	13.80	<u>1.24</u>
	Total	0.55		Total 4.31
Marsh	Rabbit	0.16	3.90	0.62
	Marsh birds	0.25	3.90	0.98
	Deer	0.25	13.80	3.45
	Waterfowl	<u>0.49</u>	13.80	<u>6.76</u>
	Total	1.15		Total 11.81
Marsh pond	Waterfowl	0.71	13.80	9.80
Nearshore lake	Waterfowl	0.10	13.80	1.38

1. Potential effort per acre for cypress-tupelo and marsh cover types is taken from Strader (1984); the methodology for calculating potential effort per acre for waterfowl in marsh pond and nearshore lake cover types is discussed in the text.
2. The monetary values per man-day of effort are the same as the monetary values used by Strader (1984) to evaluate impacts for the hurricane protection project features.
3. The value per acre is the product of multiplying potential effort per acre and the corresponding value per man-day.

Because marsh pond and nearshore lake were not recognized as separate cover types in the July 1984 FWCAR, it was necessary to develop man-day per acre values for these two cover types. To calculate the man-day values, it was assumed that these cover types support a huntable population of waterfowl; other game species used in this evaluation are not thought to occur in marsh pond or nearshore lake cover types in huntable populations. It was assumed that the man-day per acre values are directly proportional to the combined habitat suitability indices (HSIs) for puddle ducks and diving ducks, as established in the Habitat Evaluation Procedures analysis (Appendix A). The combined HSIs of marsh pond on Manchac WMA for puddle ducks (HSI = 0.85) and diving ducks (HSI = 0.50) was 1.44 times the combined HSIs of marsh on that area for puddle ducks (HSI = 0.77) and diving ducks (HSI = 0.17). The value of 0.49 man-days per acre used for marsh cover type (from Strader 1984) was multiplied by 1.44 to derive the value of 0.71 man-days per acre used for marsh pond on Manchac WMA.

The man-day value of nearshore lake was calculated using that same methodology. The combined HSIs for puddle ducks (HSI = 0.00) and diving ducks (HSI = 0.20) was only 21 percent of the combined HSIs for puddle ducks and diving ducks in the marsh cover type. The value of 0.49 man-days per acre used for marsh was multiplied by 0.21 to derive the 0.10 man-days per acre value used for the nearshore lake cover type.

The man-day value of the proposed mitigation area for hunting was calculated by multiplying the potential man-day value by the monetary value per man-day of effort (Table B-4).

Commercial

An analysis of the mitigation project benefits to commercial wildlife (i.e., furbearers and alligators) was also completed. This analysis was based on harvest data by cover type, as presented by Strader (1984). Because of the importance of marsh ponds for alligator and nutria harvest, that cover type was given the same value per acre as marsh cover type. A comparison of the average annual commercial wildlife value of the proposed mitigation area was completed (Table B-4).

Wildlife-oriented Recreation

The benefits of the mitigation plan to non-consumptive WOR were also estimated (Table B-4). The estimate of man-day participation in WOR was derived by multiplying the average man-day per acre value by the appropriate acreage. The man-day per acre value used for marsh and marsh pond cover types was 0.46; the value used for cypress-tupelo was 0.48 (U.S. Army Corps of Engineers 1977). These values are the same as were used by Strader (1984). Nearshore lake habitat was assumed to

Table B-4. A comparison of average annual man-day and monetary values for hunting, trapping, and wildlife-oriented recreation (WOR) under future without-mitigation (FWOM) and future with-mitigation (FWM) conditions for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project mitigation area.

Cover type	Average annual acreage		Activity	Potential effort		Potential effort		Monetary value		Monetary value	
	FWOM	FWM		per acre (man-days)	(man-days) ²	per acre (\$)	per acre (\$)	FWOM	FWM	FWOM	FWM
Cypress-tupelo	44	179	Hunting Trapping WOR	0.55	24	98	\$4.31	\$190	\$771		
				Not applicable			1.54	68	276		
Marsh	2,889	3,233	Hunting Trapping WOR	0.48	21	86	1.87	82	335		
				1.15	3,322	3,718	11.81	34,119	38,182		
Marsh pond	514	1,117	Hunting Trapping WOR	Not applicable			5.02	14,503	16,230		
				0.46	1,329	1,487	1.79	5,171	5,787		
Nearshore lake	1,279	196	Hunting Trapping WOR	0.71	365	793	9.80	5,037	10,947		
				Not applicable			5.02	2,580	5,607		
				0.46	236	514	1.79	920	1,999		
				0.10	128	20	1.38	1,765	270		
				Not applicable			0.00	0	0		
				0.00	0	0	0.00	0	0		
Total				5,425	6,716		Total	64,435	80,404		
Net change					+1,291		Net change		+15,969		

1. Average annual acreage is taken from Table A-1, Appendix A.
2. Total effort is calculated by multiplying the average annual acreage by the potential effort per man-day.
3. Monetary value is calculated by multiplying the average annual acreage by the monetary value per acre.

have a negligible value for this type of recreation. The monetary value was calculated by multiplying the average annual man-days of WOR by \$3.90, i.e., the same monetary value that was used in the July 1984 FWCAR to evaluate impacts associated with the hurricane protection features of this project.

IMPACTS ATTRIBUTABLE TO HURRICANE PROTECTION FEATURES

Estimates of man-day and monetary impacts attributable to implementation of the hurricane protection features (i.e., exclusive of the mitigation features) were modified from those reported by Strader (1984) by converting them to the 100-year period of benefit used for mitigation. To accomplish this conversion, the cover type acreage losses reported by Hankla (1985) were annualized and compressed to the 100-year mitigation period using the same methodology used for the Habitat Evaluation Procedures analysis and described in Appendix A. The pounds produced per acre, man-days per acre, and monetary value per acre reported in Table B-1, Table B-2, and Table B-4 were multiplied by the annualized/compressed cover type acreages to establish man-day and monetary impacts to which mitigation gains could be compared. For consistency, the acreages of marsh and marsh pond were combined to calculate fishery impacts. Because mitigation of damages occurring in scrub-shrub and upland developed cover types were deemed unnecessary, impacts occurring in these cover types were not included in this impact analysis.

The results of this analysis indicate that implementation of the hurricane protection features will cause the average annual loss of

nearly 361,900 pounds of commercially harvested, estuarine-dependent fish (Table B-5). The hurricane protection features are also expected to reduce the average sport fishing effort in the project area by nearly 15,700 man-days, the sport hunting effort by almost 1,100 man-days, and the wildlife-oriented recreation by over 600 man-days annually (Table B-5). Implementation of those project features are also expected to reduce the average monetary value of the furbearer harvest by an estimated \$3,300 annually (Table B-5).

SUMMARY

Although the average annual man-day and monetary values of the proposed mitigation area are expected to decline along with the marsh acreage under both FWOM and FWM conditions, implementation of the proposed mitigation plan is expected to provide a substantial net benefit to the fish and wildlife resources of Manchac WMA. The results of this man-day/monetary analysis indicate that, when compared to FWOM conditions, the proposed shoreline protection will increase the average annual sport fishing, hunting, and WOR potential by over 13,800 man-days for the life of the project. The net average annual monetary increase attributable to sport and commercial fishing, hunting, trapping, and WOR is estimated to be \$138,420.

When compared to poundage and man-day values lost due to implementation of the hurricane protection features, the mitigation plan would reduce the net average annual loss of estuarine-dependent commercial fishery harvest to about 75,100 pounds; the net average

Table B-5. A comparison of average annual man-day and monetary changes attributable to the hurricane protection features and the mitigation features of the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Activity	Average annual losses due to the hurricane protection features	Average annual gains due to the mitigation features	Net change due to the project
Commercial fishing	-361,858 pounds	+286,761 pounds	-75,097 pounds
Sport fishing	-15,667 man-days	+12,513 man-days	-3,154 man-days
Sport hunting	-1,078 man-days	+790 man-days	-288 man-days
Trapping	-\$3,290	+\$4,962	+\$1,672
Wildlife-oriented recreation	-615 man-days	+501 man-days	-114 man-days

annual loss of sport fishing, hunting, and wildlife-oriented recreation potential to about 3,550 man-days; and would result in a net gain (average annual) in fur catch valued at nearly \$1,700 (Table B-5).

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APPENDIX B

404(b)(1) EVALUATION

SECTION 404(b)(1) EVALUATION

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT,
MITIGATION PLAN.

I. PROJECT DESCRIPTION

a. LOCATION - The proposed mitigation is located along the western shore of Lake Pontchartrain, on the Manchac Wildlife Management Area (MWMA) shoreline (fig. 1)

b. GENERAL DESCRIPTION. The project consists of constructing a noncontinuous 2-foot high rock dike for a distance of approximately 5.0 miles along the existing shoreline of MWMA. Flotation channels would be dredged to provide barge access. A strip of land approximated 33 feet wide (fig. 1) between the shoreline and dike toe would be planted with oystergrass.

c. AUTHORITY AND PURPOSE. The authority to study wildlife mitigation is based on Public Law 85-624, the Fish and Wildlife Coordination Act of 1958.

d. GENERAL DESCRIPTION OF DREDGED OR FILL MATERIAL

(1) General Characteristics of Material

(a) Flotation channels - very soft clays with layers of silt, sandy silt, and sand.

(b) Rock Dike - quarry stone sized from 40 to 650 pounds.

(2) Quantity of Material

(a) Flotation Channels - approximately 888,000 cubic yards.

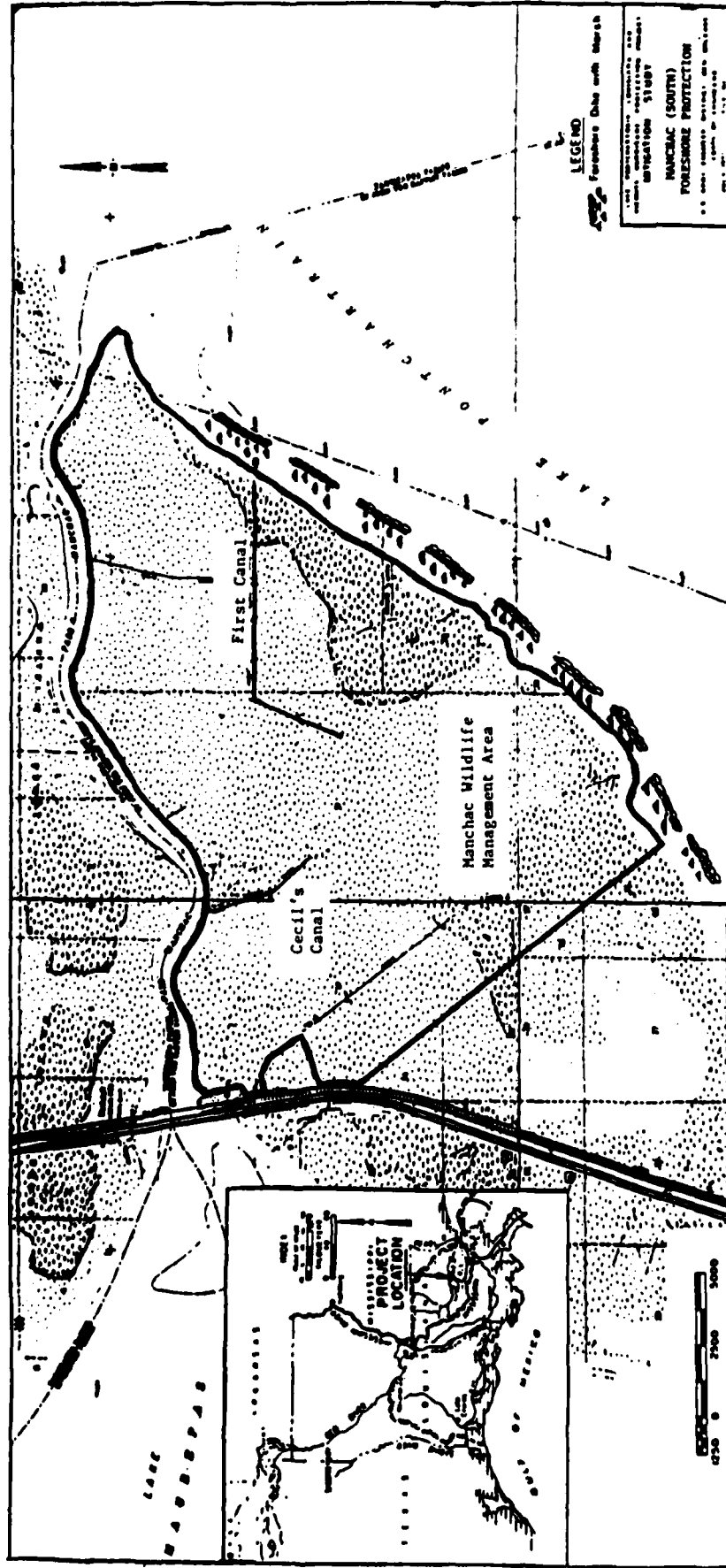


Figure 1. Vicinity map of the tentatively selected mitigation plan for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

(b) Rock dike - Approximate 44,000 tons.

(3) Source of Material

(a) Flotation Channels - Lake Pontchartrain offshore and parallel MWMA.

(b) Rock - Commercially available and quarried in Arkansas & Mississippi.

e. DESCRIPTION OF DISCHARGE METHODS

Dredged material will be temporarily stockpiled along the edge of the flotation channel until dike construction is complete. The dredge would then backfill the channel as it exits after construction.

f. DESCRIPTION OF PROPOSED DISCHARGE SITES

(1) Location, Size, and Type of Site

The backfilled flotation channels would cover 97 acres of lake bottom at right angles or parallel to the shoreline of the MWMA. An area covering 18 acres adjacent to the channels would also be disturbed during stockpiling. The rock dike would cover 7 acres parallel to the MWMA shoreline and approximately 180 feet offshore.

(2) Timing and Duration of Discharge

The project would take 9 months for initial construction. Periodic replacement of the dike would require 8 months every 20 years.

II. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations.

(1) Effects on Substrate Elevation and Slope. Flotation channel stockpiles would be 1-2 feet in height. The disposal for flotation channels would refill the recently dug channels to approximately pre-dredging levels. The dike would be approximately two feet high with a slope of 1 on 2.

(2) Effects on Sediment Type. The sediments stockpiled and then placed in the flotation canals would be the same as were removed. The stone of the dike would represent a totally new "sediment" type.

(3) Effects on Dredged Material Movement. There would be some lateral movement of the stockpiled material. There would be essentially no movement of the rock.

(4) Physical Effect on Benthos. The stockpiling and refilling of the flotation channels would have a minor impact on benthos. Some organisms would have been destroyed when the material was picked up by the dragline and more would be destroyed as the material is dropped. Recovery should occur within one year. Placement of the rock would destroy the benthos over a 7 acre area. The dike would support a different benthic community.

(5) Actions to Minimize Impacts. The flotation channels would be backfilled as the rock placement barge and dredge exits after construction. Stockpiling will be minimal and temporary.

b. WATER CIRCULATION, FLUCTUATION, AND SALINITY DETERMINATIONS.

(1) Effects on Water

(a) Salinity. NA

(b) Water Chemistry. Stockpiling and backfilling of sediment excavated from the flotation channel would cause short-term alteration of local water chemistry. Anticipated changes include elevated oxygen demand, dissolved solids, nitrogen, iron, and manganese concentrations and decreased dissolved oxygen in the immediate vicinity of the work area. The affected surface water should be sufficiently buffered to prevent radical changes in pH. Dilution of interstitial water associated with the excavated sediment would limit the degree and areal extent of water chemistry modifications.

(c) Clarity. The stockpiling and backfilling activities would elevate suspended particulate levels and significantly diminish surface water clarity at the work site during construction.

(d) Color. Elevated suspended particulate concentration would intensify the apparent color of surface water at the work area.

(e) Odor. NA

(f) Taste. NA

(g) Dissolved Gas Levels. The oxygen demand associated with backfilling of the flotation channels would depress dissolved oxygen concentration at the construction site.

(h) Nutrients. Dissolved nitrogen concentration could increase substantially in waters of the immediate work area during replacement of sediment excavated from the flotation channels. Dissociation of phosphorus compounds from disturbed sediment does not normally occur if oxidizing conditions are maintained.

(i) Eutrophication. The proposed construction would not cause long-term nutrient enrichment of surface water at the work site.

(2) Effects on Current Patterns and Circulation.

(a) Current Patterns and Flow. The dike would have minor impacts on current patterns and flow.

(b) Velocity. NA

(c) Stratification. NA

(d) Hydrologic Regime. NA

(3) Normal Water Level Fluctuation. NA

(4) Salinity Gradients. NA

c. SUSPENDED PARTICULATE/TURBIDITY DETERMINATIONS.

(1) Expected Changes in Suspended Particulate and Turbidity Levels in the Vicinity of the Construction Site. Both suspended particulate and turbidity levels are expected to increase substantially at the work site during construction and maintenance. The size and duration

of construction and maintenance-related turbidity plumes would be dictated by local conditions the work site.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Locally elevated suspended particulate concentrations and turbidity levels would diminish the depth of light penetration into the water column.

(b) Dissolved Oxygen. Local dissolved oxygen concentration would be depressed or depleted by the oxygen demand associated with organic bottom sediment that is disturbed during construction activities.

(c) Toxic Metals and Organics. The proposed construction would present opportunities for relocating sediment-bound toxic metals and organics. Disturbed sediments, which might have associated toxic metals and organics, would remain suspended in the water column for only a relatively short period. No significant long-term effects due to redistribution of sediment-bound toxic metals and organics are anticipated.

(d) Pathogens. NA

(e) Aesthetics - Some localized and temporary turbidity plumes would be caused by solids placed in suspension during discharge operations.

(3) Effects on Biota.

(a) Primary Production. Primary production would be impaired by the reduction of the photic zone. Reductions in plankton populations are

possible as a result of clumping and flocculation. Phytoplankton and algae would be destroyed by physical abrasion. However, this temporary loss in primary productivity should not have long-term effects since phytoplankton is not the primary food source in Lake Pontchartrain.

(b) Suspension/Filter Feeders. Turbidity would interfere with filter feeding mechanisms, impede growth, and impair respiratory and excretory functions. The more motile species would quickly migrate out of the area. The motile organisms, along with others remaining on the fringe of the impacted area, would provide recruitment stocks for repopulation of the area.

(c) Sight Feeders. Most of the sight feeders found within Lake Pontchartrain are moderately adapted to its turbid environment. The demersal fish would be the most likely affected. However, these species, along with other highly mobile species, would escape the areas of high turbidity and return when conditions improve.

(4) Action to Minimize Impacts of Suspended Particulate/Turbidity. Flotation channel construction would utilize bucket dredges which would minimize turbidity during discharge by comparison to hydraulic dredging methods. In addition, shallow draft barges would be used to transport the work to the dike construction site, therefore reducing the amount of dredging needed for flotation channel construction. Provision for general protection of the environment would be included in all construction contract specifications.

d. CONTAMINANT DETERMINATION. No introduction of new contaminants nor significant relocation of sediment-bound contaminants would result from the proposed construction and maintenance activities.

e. AQUATIC ECOSYSTEM AND ORGANISM DETERMINATIONS.

(1) Plankton Effects. Primary productivity could be temporarily reduced by physical destruction of phytoplankton and decreased photosynthesis. Turbidity and siltation, although temporary, may impair zooplankton feeding and interfere with their respiratory processes resulting in a temporary reduction of the secondary food base.

Lake Pontchartrain is a wind-dominated system and as a result has frequent periods of high turbidity due to resuspension of bottom sediments. Therefore, it is expected that rapid recovery of plankton populations would occur shortly following the completion of construction.

(2) Benthos Effects. The rock dike would permanently replace natural bottoms; however, it would provide habitat diversity and would be colonized by different species of benthos than those inhabiting the natural bottom. Benthic organisms could recolonize the backfilled flotation channels within one year.

(3) Nekton Effects. Most species would not be directly affected by the project since they would vacate during construction. Some planktonic feeders may be temporarily attracted to turbidity plumes for short-term feeding. During these feeding forays the increased free carbon dioxide associated with dredging activities tends to reduce pH, causing gills of fishes and other biota to be more susceptible to pollutant-laden silt particles (Johnston, 1981). Therefore, some impacts could occur to fishes attracted to areas of increased turbidity. The loss of habitat and changes in benthic organisms could locally affect the composition of the nekton community following discharge.

(4) Aquatic Food Web Effects - Primary production would be slightly reduced due to the aquatic habitat eliminated by the dike placement. Temporary changes in organisms which comprise the benthic food base are expected as a result of the dredged material discharge. Impacts on the food base are considered minimal when viewed in terms of the total benthic habitat available.

(5) Effects on Special Aquatic Sites.

(a) Sanctuaries and Refuges - There may be some temporary increases in turbidities, and decreases in dissolved oxygen along the shoreline of the MWMA. Construction activity may temporarily eliminate access or decrease recreational hunting and fishing usage of the management area. Adverse impacts will be minimal and long-term inputs from foreshore protection provided would be greatly beneficial to the management area.

(b) All other special aquatic sites. N/A

(6) Threatened and Endangered Species - No threatened or endangered species or critical habitat would be affected by the discharge of dredged material.

(7) Other Wildlife - The rock dike may provide loafing areas for some wading and shore birds. The dike may also provide cover and spawning area for some fish species. In addition, periphyton communities which would become part of the dike ecosystem could provide a food base for hard surface feeders such as sheepshead.

(8) Actions to Minimize Impacts. The rock dike is non-continuous to provide biological and nutrient transport between the lake and adjacent

marshes. Utilization of the bucket dredge rather than the hydraulic method would also minimize the amount of turbidity produced during construction.

f. DISPOSAL SITE DETERMINATIONS.

(1) Mixing Zone Determination. Construction of the shoreline protection structure would not involve dredged-material disposal; consequently, a mixing zone determination is not applicable. In view of the limited possibility of contamination, calculation of a mixing zone for the flotation channel would not be necessary. Turbidity levels would be high during construction and refilling, but return to ambient on completion of the project.

(2) Determination of Compliance with Applicable Water Quality Standards. Louisiana state water quality standards applicable to the construction site include a minimum 4.0 mg/L dissolved oxygen, a 6.5 to 9.0 standard unit pH range, and a 35°C maximum surface water temperature. It is probable that during periods when dissolved oxygen is normally low, the dissolved oxygen standard will be locally, temporarily, and intermittently exceeded at the construction site. It is not likely that the proposed construction activities will exceed the pH or temperature standards.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. NA

(b) Recreational and Commercial Fisheries. Recreational and commercial fishing would be temporarily disrupted in the immediate area during construction.

g. DETERMINATION OF CUMULATIVE EFFECTS ON THE AQUATIC ECOSYSTEM:

Losses from the dredged material discharges are considered insignificant when compared to the habitat available and the overall benefits provided by the project.

h. DETERMINATION OF SECONDARY EFFECTS IN THE AQUATIC ECOSYSTEM:

The major secondary effects of the dredged material discharge relate to providing foreshore protection for the MWMA. Approximately 500 acres of marsh and swamp and 600 acres of marsh pond would be preserved over the 100 year project life compared to the without project conditions.

In addition, approximately 115 acres of lake bottom shoreward of the dike is expected to become marsh through planting and/or accretion.

FINDING OF COMPLIANCE FOR THE LAKE PONTCHARTRAIN AND
VICINITY HURRICANE PROTECTION PROJECT, MITIGATION PLAN

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The dredged material would be temporarily deposited along the edge of the flotation channel until dike construction is complete in order to allow rock-carrying barges to enter and levee the site. The dredge would then backfill the channel as it exits following construction. No alternative methods of disposal are justified.

3. Construction of the flotation channel and canal would not be expected to result in significant long-term violations of the Louisiana State Water Quality Standards.

4. The 65 pollutants designated as toxic under Section 307(a)(1) of the Clean Water Act as revised under the EPA Water Quality Criteria Document FRL 1623-3, ("Federal Register", November 28, 1980) have not been adopted by the State of Louisiana and not therefore regulatory as such, and are used in a comparative nature only.

5. Use of the proposed discharge sites would not harm any endangered or threatened species or their critical habitat. The Marine Protection, Research, and Sanctuaries Act of 1972 would not apply.

6. The proposed construction would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. Significant adverse

effects upon aquatic ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values would not occur. Adverse effects that could occur as a result of the proposed dredged material discharge would not be significant.

7. Appropriate steps to minimize potential adverse impacts include the use of dragline dredging in lieu of hydraulic dredging during flotation channel construction, and incorporation of provisions for environmental protection in contracts for construction.

8. On the basis of the application of the guidelines (40 CFR 230), the sites designated for dredged material discharge are specified as complying with the requirements of these guidelines with inclusion of practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

Date

LLOYD K. BROWN
Colonel, CE
Commanding

APPENDIX C

**COASTAL ZONE MANAGEMENT
CONSISTENCY DETERMINATION**

WILDLIFE MITIGATION FEATURE
LAKE PONTCHARTRAIN AND VICINITY, LOUISIANA,
HURRICANE PROTECTION PROJECT

LOUISIANA COASTAL ZONE MANAGEMENT PROGRAM
CONSISTENCY DETERMINATION

INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et seq., requires that "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner that is, to the maximum extent practicable, consistent with approved state management programs." In accordance with Section 307, a Consistency Determination has been made for wildlife mitigation measures for the Lake Pontchartrain and Vicinity, Hurricane Protection Project. Coastal Use Guidelines were written to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. Compliance with the Louisiana Coastal Resources Program, and therefore, Section 307, requires compliance with applicable Coastal Use Guidelines. This Consistency Determination has been prepared to evaluate the impacts of protecting the eastern shoreline of the Manchac Wildlife Management Area (WMA) via rock dikes and vegetation plantings (Plate 1).

In the Final Supplemental (EIS) for the Lake Pontchartrain Hurricane Protection Project, December 1985, fish and wildlife habitat losses were documented. The value of fish and wildlife losses, and mitigation for these losses, has been jointly determined by biologists from the Corps of Engineers, New Orleans District, U.S. Fish and Wildlife Service, and the Louisiana Department of Wildlife and Fisheries.

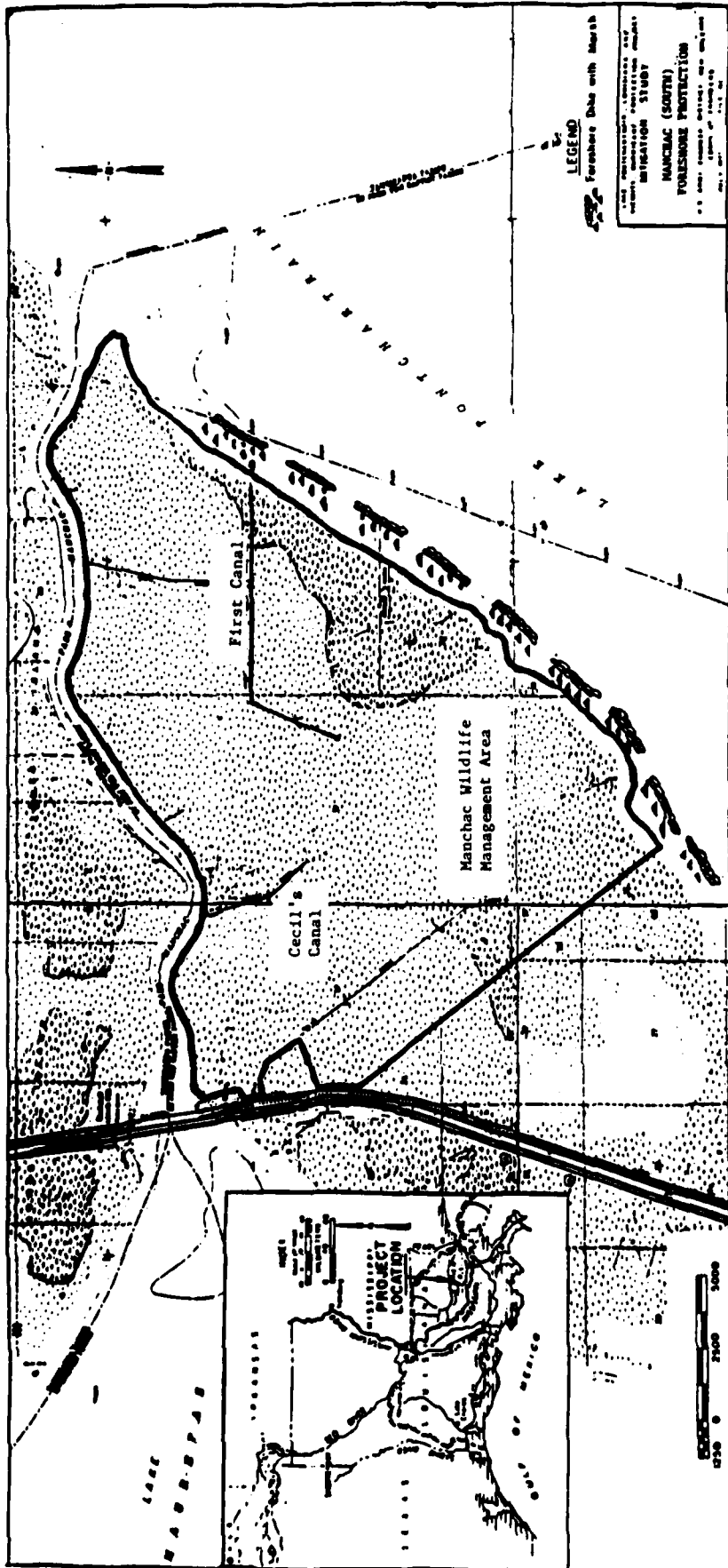


PLATE 1. Vicinity map of the tentatively selected mitigation plan for the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

The Manchac WMA is located in St. John the Baptist Parish and abuts the western shoreline of Lake Pontchartrain. The 6,500 acres of cypress-tupelo and marsh of the WMA are threatened by wave action from the lake, which is eroding approximately 20 feet of shoreline annually. This Consistency Determination and accompanying EIS assess the impacts of implementing this recommended wildlife mitigation plan within the coastal waters of Louisiana.

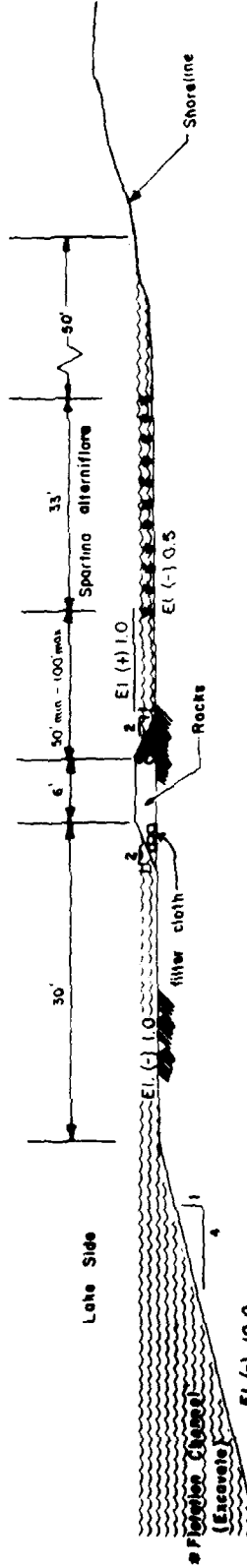
PROJECT DESCRIPTION

Foreshore protection would be provided to the eastern shore of Manchac WMA. Rock dikes, with filter cloth to stabilize sediments, would intermittently extend over approximately 26,400 feet of shoreline. Dikes would be constructed in segments 200 feet long, 14 feet wide, and 2 feet high. A 50-foot gap would be left between succeeding dikes. Therefore, total length of dike would be 21,100 feet. The dike would be placed approximately 180 feet from the existing shoreline. Within this area and extending the entire length of protected shoreline, a 33-foot wide strip of oystergrass would be planted. A 100-foot-wide flotation channel would be excavated on the lakeside of the dike to provide access for rock and equipment-carrying barges. Dredged material would be temporarily stockpiled adjacent to the channel until construction was complete. Then it would be used to refill the channel behind the barge as it left the area. A typical cross section of the foreshore protection work is shown in Plate 2.

Acres of lake bottom directly impacted by the project would be as follows: dike placement, 7; flotation channels, 97; and oystergrass planting, 16. Open water area between the dike and existing shoreline is projected to become marsh. This would occur to approximately 100 acres as a result of sediment buildup leeward of the dike, spread of transplanted oystergrass, and protection from wave-wash afforded by the dike. In addition to the created marsh area, it is projected that 500 average annual acres of marsh



Fretation Channel Section



* See "b" dimensions above left

% Lighter by Weight	Limits of Stone weight (in lbs.)
100%	650 280
50%	280 130
15%	130 40

NOTES:
 Replace 100% of rock every 20 yrs. Assume 100 yr life
 Upgrade vegetation by replacing 25% every 10 yrs.
 Fertilize vegetation every 2 yrs.
 Rockdike in 200' lengths with 50' gaps between.
 No replacement of filter cloth.

LAKE MONTGOMERY LOUISIANA AND VICINITY HURRICANE PROTECTION PROJECT
MITIGATION STUDY
DESIGN FOR FORESHORE PROTECTION
DIKES WITH MARCH VEGETATION
 U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
 CORPS OF ENGINEERS
 JULY 1988
 FILE NO. M-2
PLATE 7

and swamp and 600 acres of marsh pond on the Manchac WMA would be preserved over the life of the project, compared to without-mitigation conditions.

Initial construction would take 9 months. The rock dike would need to be rebuilt every 20 years. Approximately 2 weeks would be spent every 2 years fertilizing the plantings. Additionally, it is projected that 2 weeks would be necessary once every 10 years for replanting approximately 25 percent of the original oystergrass.

Guideline 1.7: It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all uses and activities shall be planned, sited, designed, constructed, operated, and maintained to avoid to the maximum extent practicable:

Guideline 1.7(a): Significant reductions in the natural supply of sediment and nutrients to the coastal system by alterations of freshwater flow.

Response 1.7(a): Not applicable.

Guideline 1.7(b): Adverse economic impacts on the locality of the use and affected government bodies.

Response 1.7(b): Economic aspects should be favorable because of preservation of the state-owned (WMA).

Guideline 1.7(c): Detrimental discharges of inorganic nutrient compounds into coastal waters.

Response 1.7(c): Sediment excavation and stockpiling would not take place in an area subject to high current velocity. Construction-generated turbidity plumes should not be extensive. Inorganic nutrient compounds, though generally in heavy concentrations adjacent to the Pontchartrain shoreline, should not have a detrimental impact as discharge into the water column occurs.

Guideline 1.7(d): Alterations in the natural concentration of oxygen in coastal waters.

Response 1.7(d): During dredging of the flotation channel, a localized and temporary reduction in DO might occur in the immediate area; however, this would not significantly impact aquatic life.

Guideline 1.7(e): Destruction or adverse alterations of streams, wetlands, tidal passes, inshore waters and waterbottoms, beaches, dunes, barrier islands, and other natural biologically valuable areas or protective coastal features.

Response 1.7(e): The rock dike would preserve valuable marsh. Waterbottoms adversely impacted by dredging of the flotation channel would be refilled following construction of the dike.

Guideline 1.7(f): Adverse disruption of existing social patterns.

Response 1.7(f): No adverse impact is anticipated.

Guideline 1.7(g): Alterations of the natural temperature regime of coastal waters.

Response 1.7(g): Increased turbidity would result in slightly raised water temperatures near the dredge. The effect would be local and temporary.

Guideline 1.7(h): Detrimental changes in existing salinity regimes.

Response 1.7(h): None are anticipated.

Guideline 1.7(i): Detrimental changes in littoral and sediment transport processes.

Response 1.7(i): None are anticipated.

Guideline 1.7(j): Adverse effects of cumulative impacts.

Response 1.7(j): This project would reverse the present trend of fresh and intermediate marsh loss.

Guideline 1.7(k): Detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging.

Response 1.7(k): During dredging, suspended solids would be released; however, these would not be significant.

Guideline 1.7(l): Reductions or blockage of water flow or natural circulation patterns within or into an estuarine system or a wetland forest.

Response 1.7(l): A reduction of the intensity of flow into the Manchac marsh would occur. This reduction would benefit the system by slowing sediment loss, which is presently occurring due to shoreline erosion.

Guideline 1.7(m): Discharges of pathogens or toxic substances into coastal waters.

Response 1.7(m): Levels of mercury, PCB, chlordane, parathion, dieldrin, and aldrin have been found to be above EPA criteria in samples collected in the Pass Manchac area. Since dredging would be done with a bucket dredge and since the construction area should not contain higher levels of toxic substances than surrounding areas, only slight adverse impacts or none would be anticipated.

Guideline 1.7(n): Adverse alteration and destruction of archeological, historical, or other cultural resources.

Response 1.7(n): No impacts are anticipated.

Guideline 1.7(o): Fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas.

Response 1.7(o): No significant secondary impacts are anticipated.

Guideline 1.7(p): Adverse alteration or destruction of valuable habitats, critical habitat for endangered species, important wildlife or fishery breeding or nursery areas, designated wildlife management or sanctuary areas, or forestland.

Response 1.7(p): Impacts would be beneficial to the WMA.

Guideline 1.7(q): Adverse alteration or destruction of public parks, shoreline, access points, public works, designated recreation areas, scenic rivers, or other areas of public use and concern.

Response 1.7(q): Gaps in rock dikes would continue to allow access. Alteration of shoreline would be beneficial to this public use area. Approximately 500 average annual acres of marsh and swamp and 600 acres of marsh pond would be preserved.

Guideline 1.7(r): Adverse disruptions of coastal wildlife and fishery migratory patterns.

Response 1.7(r): Gaps in dike would allow for migration of aquatic species.

Guideline 1.7(s): Land loss, erosion, and subsidence.

Response 1.7(s): The project would function to reverse erosion.

Guideline 1.7(t): Increases in the potential for flood, hurricane, or other storm damage, or increases in the likelihood that damage would occur from such hazards.

Response 1.7(t): The rock dike would lessen the potential impact of storms on the Manchac WMA.

Guideline 1.7(u): Reductions in the long-term biological productivity of the coastal ecosystem.

Response 1.7(u): Long-term biological productivity would be enhanced.

5.0 GUIDELINES FOR SHORELINE MODIFICATION.

Guideline 5.3: Shoreline modification structures shall be lighted or marked in accordance with U.S. Coast Guard regulations, shall not interfere with navigation, and should foster fishing, other recreational opportunities, as well as public access.

Response 5.3: The rock dike construction would contain gaps, thus, only minimally interfering with public access. Fishing may be enhanced as a result of the diversity provided by gaps and contrasting natural shoreline, planted oystergrass, and rock dike.

Guideline 5.5: Piers, docks, and other harbor structures shall be designed and built, using best practical techniques to avoid obstruction of water circulation.

Response 5.5: Not applicable.

Guideline 5.6: Marinas, and similar commercial and recreational developments, shall to the maximum extent practicable not be located to result in adverse impacts on open productive oyster beds, or submersed grass beds.

Response 5.6: Not applicable.

Guideline 5.7: Neglected or abandoned shoreline modification structures, piers, docks, mooring, and other harbor structures shall be removed at the owner's expense, when appropriate.

Response 5.7: The rock dike would be maintained over a 100-year project life. Abandonment would not have a deleterious effect on the local environment.

Guideline 5.8: Shoreline stabilization structures shall not be built for the purpose of creating fill areas for development unless part of an approved surface alteration use.

Response 5.8: Acknowledged.

Guideline 5.9: Jetties, groins, breakwaters, and similar structures shall be planned, designed, and constructed to avoid to the maximum extent practicable downstream land loss and erosion.

Response 5.9: The rock dike would have no impact on land loss or erosion in other areas.

CONSISTENCY DETERMINATION

Based on this evaluation, the New Orleans District, U.S. Army Corps of Engineers, has determined that construction of the rock dike to preserve intermediate marsh and swamp on the southern shoreline of the Manchac Wildlife Management Area is consistent, to the maximum extent practicable, with the guidelines of the State of Louisiana's approved Coastal Zone Management Program.

APPENDIX D

**ENDANGERED SPECIES
COORDINATION**



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

April 11, 1985 F/SER23:PWR:cf

Cletis R. Wagahoff
Chief, Planning Division
Environmental Analysis Branch
New Orleans District, COE
P.O. Box 60267
New Orleans, LA 70160

Dear Mr. Wagahoff:

This responds to your March 26, 1985, letter regarding the additional proposed shoreline construction, associated with the Lake Pontchartrain and Vicinity Hurricane Protection Project, in St. Bernard Parish, near New Orleans, Louisiana. The additional work would consist of shoreline protection along Lake Borgne and the Mississippi River-Gulf Outlet. A list of endangered and threatened species under the NMFS jurisdiction was requested pursuant to Section 7 of the Endangered Species Act of 1973 (ESA).

We have reviewed the proposed project and have determined that no species of listed sea turtles or whales are likely to occur in the proposed project area. The shoreline along Lake Borgne is not known to have any sea turtle nesting activity. This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity. If you have any questions, please contact Mr. Paul Raymond, Fishery Biologist, at (813) 893-3366.

Sincerely yours,

Paul W. Raymond
Sor

Charles A. Oravetz, Chief
Protected Species Management Branch

cc:
FWS, Jackson, MS
F/M412
F/SER11





United States Department of the Interior

FISH AND WILDLIFE SERVICE

JACKSON MALL OFFICE CENTER
300 WOODROW WILSON AVENUE, SUITE XXX 316
JACKSON, MISSISSIPPI 39213

April 8, 1985

IN REPLY REFER TO:
Log No. 4-3-85-165

Mr. Cletis R. Wagahoff
U.S. Army, Corps of Engineers
Post Office Box 60267
New Orleans, LA 70160

Dear Mr. Wagahoff:

This responds to your letter of March 26, 1985, concerning the proposed shoreline protection along the Mississippi Gulf Outlet and Lake Borgne as part of the Lake Pontchartrain and Vicinity Hurricane Protection Project. We have reviewed the information you enclosed relative to the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

Our records indicate no endangered, threatened or proposed species, or their critical habitat occurring in the project area. Therefore, no further endangered species consultation will be required for this project, as currently described.

If you anticipate any changes in the scope or location of this project, please contact our office, telephone 601/960-4900, for further coordination.

We appreciate your participation in the efforts to enhance the existence of endangered species.

Sincerely yours,

Dennis B. Jordan
Field Supervisor
Endangered Species Field Office

cc: Department of Wildlife & Fisheries, New Orleans, LA
ES, FWS, Lafayette, LA



United States Department of the Interior

FISH AND WILDLIFE SERVICE

JACKSON MALL OFFICE CENTER

300 WOODROW WILSON AVENUE, SUITE 3185

JACKSON, MISSISSIPPI 39213

February 5, 1985

IN REPLY REFER TO:
Log No. 4-3-85-165

Mr. Cletis R. Wagahoff
Chief, Planning Division
U.S. Army, Corps of Engineers
Post Office Box 60267
New Orleans, LA 70160

Dear Mr. Wagahoff:

This is in response to your letter of January 3, 1985, requesting information on threatened and endangered species located in the Lake Pontchartrain and Vicinity Hurricane Protection project's proposed mitigation sites in Jefferson, Orleans, St. Bernard, and St. Charles Parishes near New Orleans, Louisiana.

The endangered bald eagle (Haliaeetus leucocephalus) is known to nest in the project vicinity. According to the information available to us, none of the present mitigation plans are expected to impact the bald eagle. There are no other listed species in the project area.

This concurs with our letter of July 23, 1984, indicating the bald eagle as the only endangered or threatened species in the project area.

We have forwarded your letter and enclosed document to our Ecological Services Field Station in Lafayette, Louisiana, for their review and a response to you.

Your continued cooperation on this matter is appreciated.

Sincerely yours,

Dennis B. Jordan
Field Supervisor
Endangered Species Field Station

cc: Department of Wildlife & Fisheries, New Orleans, LA
ES, FWS, Lafayette, LA



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9450 Koger Boulevard
St. Petersburg, FL 33702

January 16, 1985 F/SER23:PWR:cf

Cletis R. Wagahoff
Chief, Planning Division
Environmental Analysis Branch
New Orleans District, COE
P.O. Box 60267
New Orleans, LA 70160

Dear Mr. Wagahoff:

This responds to your January 3, 1985, letter regarding the proposed construction of the Lake Pontchartrain and Vicinity Hurricane Protection project located in St. Bernard, Jefferson, Orleans, and St. Charles parishes near New Orleans, Louisiana. A list of endangered and threatened species under the NMFS' jurisdiction was requested pursuant to Section 7 of the Endangered Species Act of 1973 (ESA).

We have reviewed the proposed project and have determined that no endangered/threatened species under our purview are likely to occur in the proposed project area. This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat determined that may be affected by the proposed activity. If you have any questions, please contact Mr. Paul Raymond at (813) 893-3366.

Sincerely yours,

Charles A. Oravetz (sr)
Charles A. Oravetz, Chief
Protected Species Management Branch

cc:
FWS, Jackson, MS





United States Department of the Interior

FISH AND WILDLIFE SERVICE

75 SPRING STREET, S.W.
ATLANTA, GEORGIA 30303

JAN 08 1985

Mr. Cletis R. Wagahoff
Chief, Planning Division
Department of the Army
Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160

Dear Mr. Wagahoff:

This acknowledges your letter of January 3, 1985 (received January 7, 1985), requesting information on threatened and/or endangered species located in the Lake Pontchartrain and Vicinity Hurricane Protection project's proposed mitigation sites in St. Bernard, Jefferson, Orleans, and St. Charles Parishes near New Orleans, Louisiana.

We have forwarded your letter and enclosed document to our Endangered Species Field Station, Jackson, Mississippi, for their review and a response to you. If you need further information or have questions in regard to this review, the Fish and Wildlife Service representative who will assist you is Mr. Dennis Jordan, Field Supervisor, Endangered Species Field Station, Jackson Mall Office Center, 300 Woodrow Wilson Avenue, Suite 316, Jackson, Mississippi 39213, telephone 601/960-4900.

Sincerely yours,

A handwritten signature in black ink, appearing to be "J. H. [unclear]", is written over the typed name.

Assistant Regional Director
Federal Assistance

APPENDIX E

IMPACTS SINCE 1984 FEIS

APPENDIX E

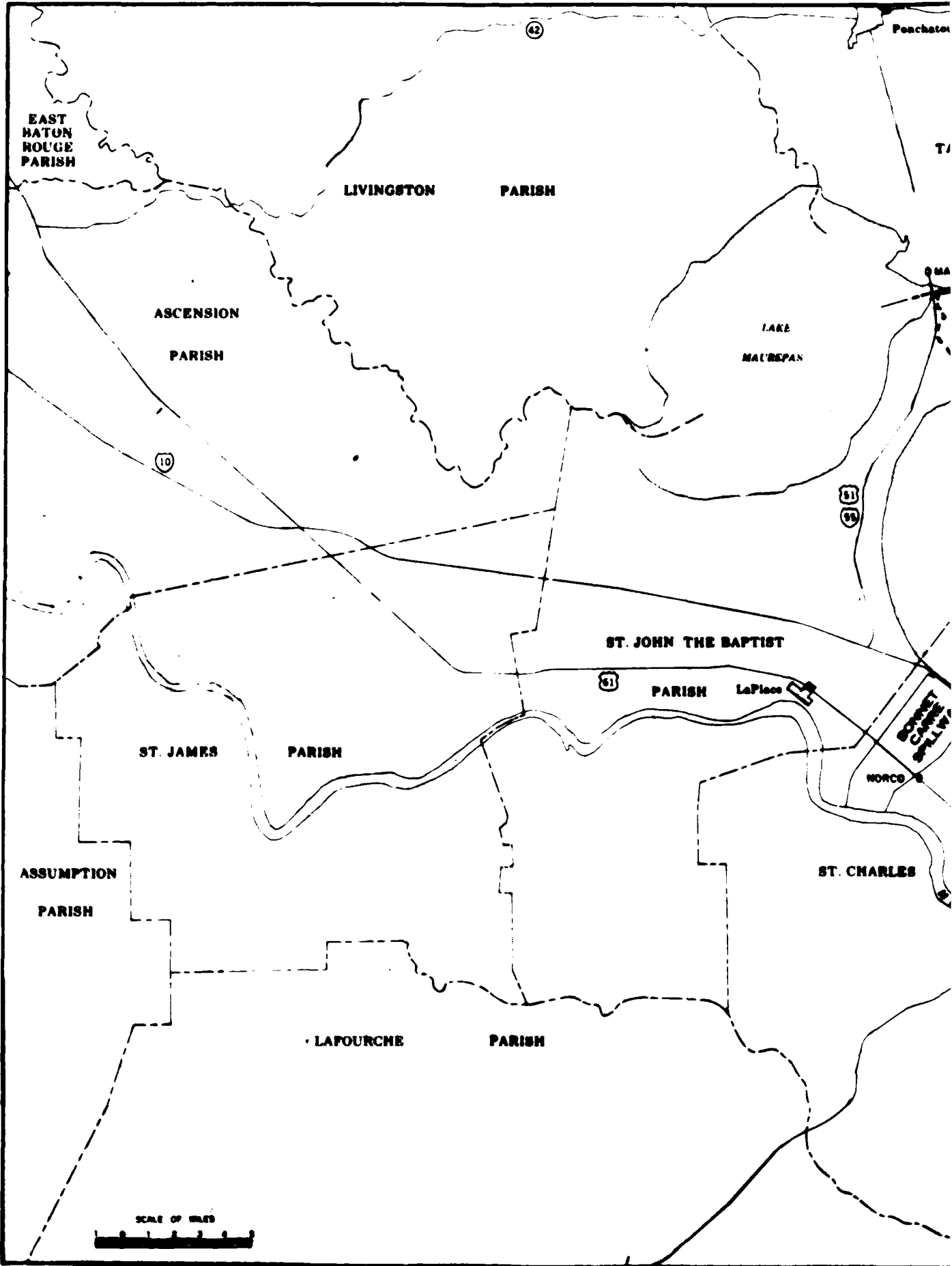
IMPACTS SINCE 1984 FEIS

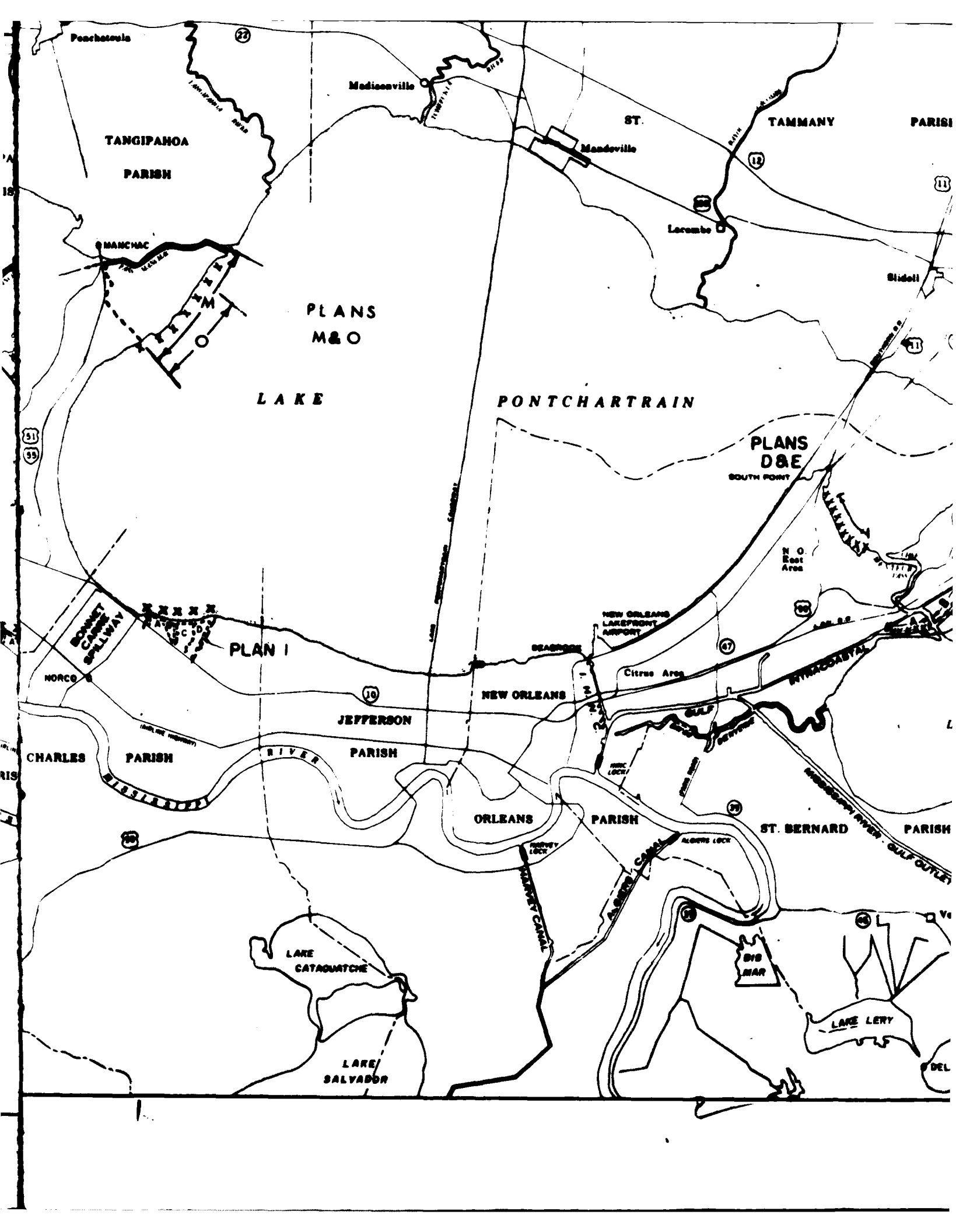
Additional impacts resulting from refinements in levee alignment and need for additional borrow areas since publication of the 1984 FEIS have been evaluated in several SIR's. The following acreages have been impacted:

HABITAT IMPACTED BY OBTAINING ALTERNATE BORROW OR LEVEE REALIGNMENT FOR HIGH LEVEL HURRICANE PROTECTION LEVEES SINCE 1984 FEIS

Habitat	Acres	General Location
Scrub Shrub/Disturbed Land	2,353	New Orleans East & Bonnet Carre' Spillway
Marsh	65	New Orleans East, Slidell
Swamp and Bottomland Hardwood	93	Chalmette
Upland	3	New Orleans East
Palustrine Forested Wetlands	20	New Orleans East
Marsh/Pond	14	New Orleans East
Wooded Old Field	10	St. Bernard

These are direct construction acres and have not been annualized. They are shown here to indicate that there are more impacts than discussed in the FEIS and the USFWS Coordination Act Report. As discussed in Section 8.4.1, with some types of analysis, it appears that the TSP overmitigates. These acres are shown to indicate that the over-mitigation is less than indicated.





Peachtree

22

Madisonville

ST.

TAMMANY

PARISH

TANGIPAHOA
PARISH

Mandeville

12

11

Lacombe

Slidell

11

MANCHAC

PLANS
M&O

LAKE

PONTCHARTRAIN

PLANS
D&E

SOUTH POINT

N. O.
East Area

BONNET
CARRÉ
SPILLWAY

PLAN I

NEW ORLEANS
LAKEFRONT
AIRPORT

SEABOARD

Citrus Area

90

97

NORCO

10

NEW ORLEANS

JEFFERSON

PARISH

CHARLES

PARISH

MISSISSIPPI RIVER

ORLEANS

PARISH

ST. BERNARD

PARISH

60

70

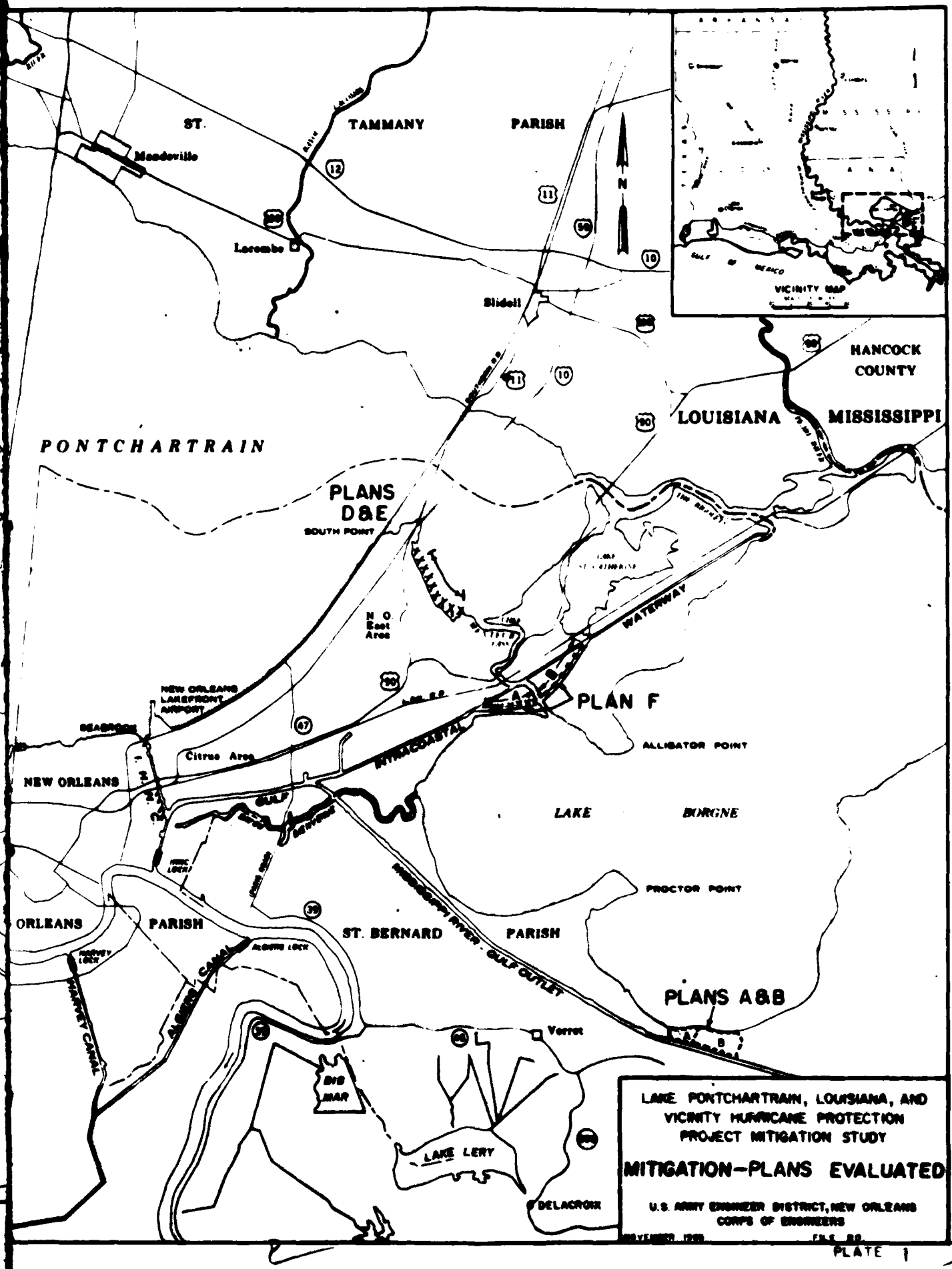
LAKE
CATAOUCHE

LAKE
SALVADOR

815
MAR

LAKE LERY

DEL

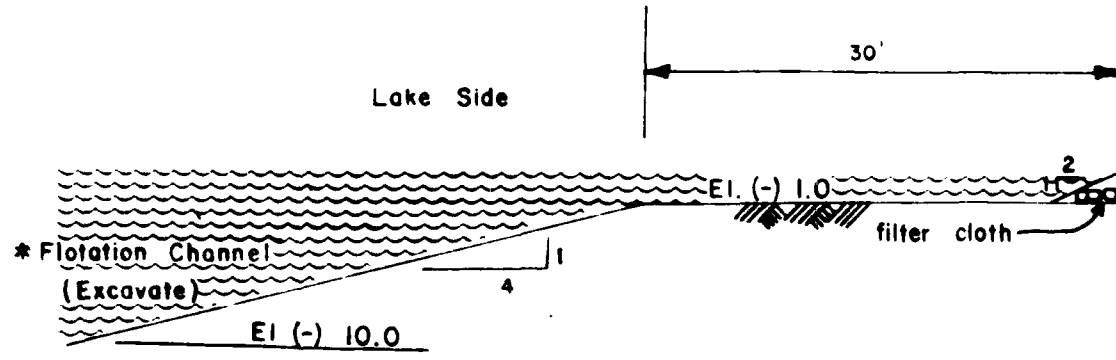
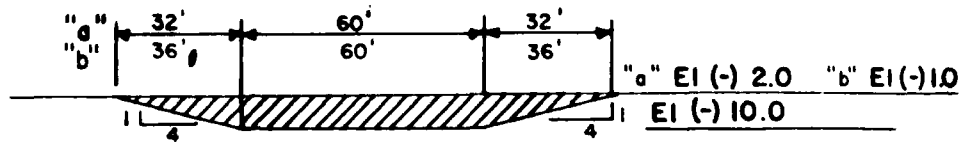


LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT MITIGATION STUDY

MITIGATION-PLANS EVALUATED

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

REVISED 1958 FILE NO.

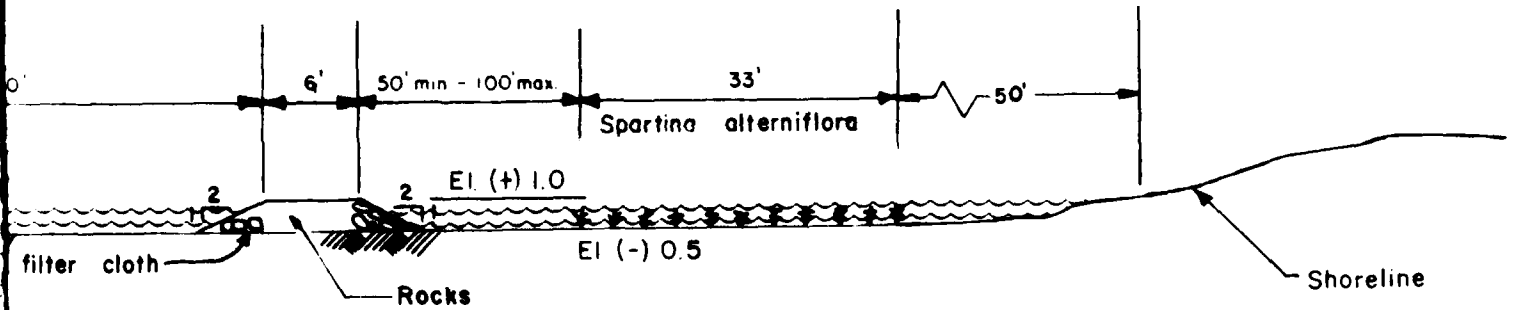


* See "b" dimensions above left

% Lighter by Weight	Limits of Stone weight (in lbs.)
100%	650 260
50%	280 130
15%	130 40

NOTES:
 Replace 100% of Upgrade vegetation
 Fertilize vegetatio
 Rockdike in 200'
 No replacement of

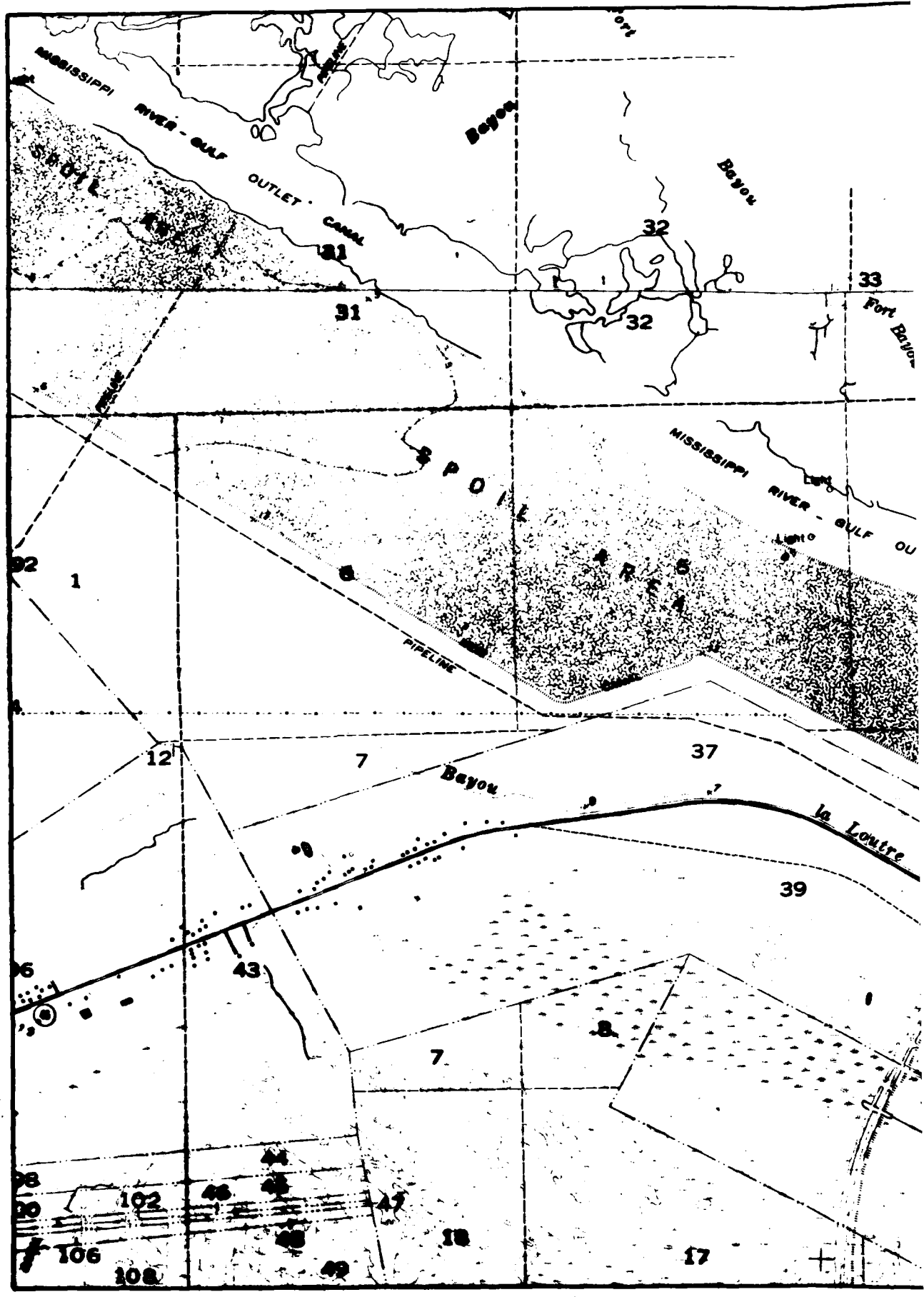
"b" El(-)1.0



NOTES:

- Replace 100% of rock every 20 yrs. Assume 100 yr. life
- Upgrade vegetation by replacing 25% every 10 yrs.
- Fertilize vegetation every 2 yrs.
- Rockdike in 200' lengths with 50' gaps between.
- No replacement of filter cloth.

LAKE PONTCHARTRAIN LOUISIANA AND
VICINITY HURRICANE PROTECTION PROJECT
MITIGATION STUDY
DESIGN FOR FORESHORE PROTECTION
DIKES WITH MARSH VEGETATION
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1985 FILE NO. H-2



33

Fort Bayou

33

T 135
T 145

Light

L A K E B O

Anguilla Lagoon
GULF OUTLET CANAL

Old Shell Beach

UNIT A

UNIT B

3

40

20

Gaging Station

Light

Shell Beach

MISSISSIPPI RIVER

Louise

Refinery

Water Tank
Alluvial City

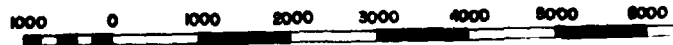
Yacowkey

Gaging Station

42

41

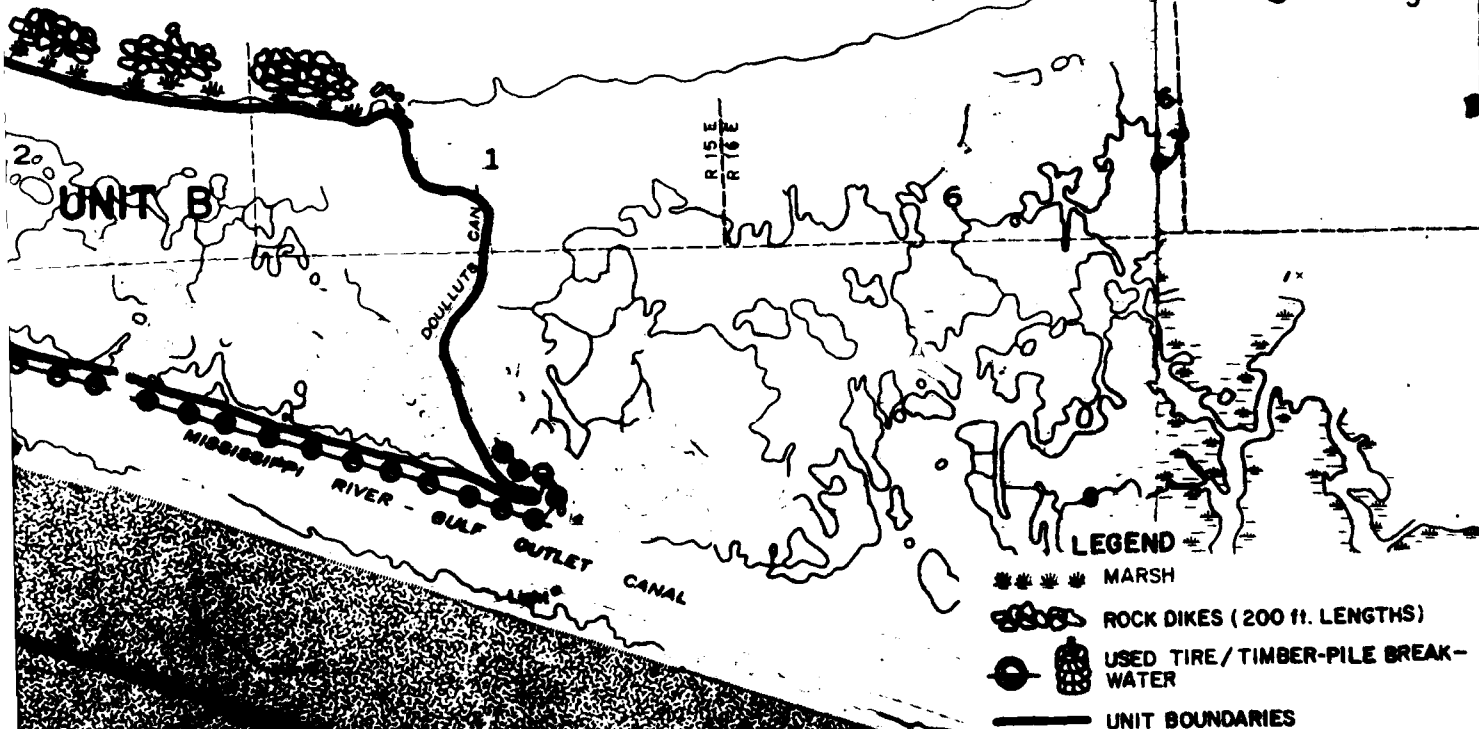
SCALE 1:24000



L

E B O R G N E

LAKE BORGNE



SCALE 1:24000

2000 3000 4000 5000 6000 7000 FEET

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, HURRICANE PROTECTION PROJECT

MITIGATION STUDY

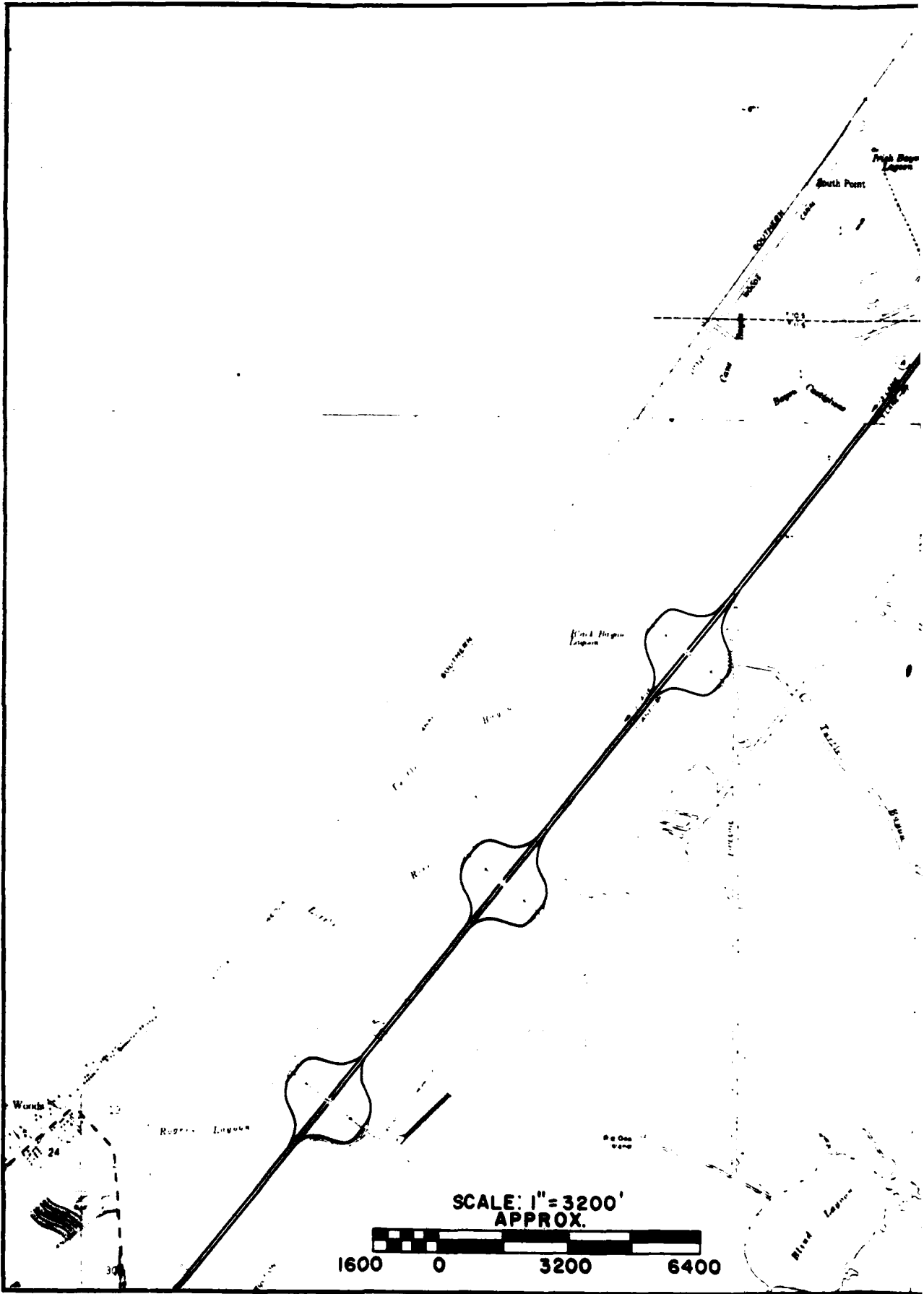
PLANS A AND B, ST. BERNARD EGRESS PROTECTION

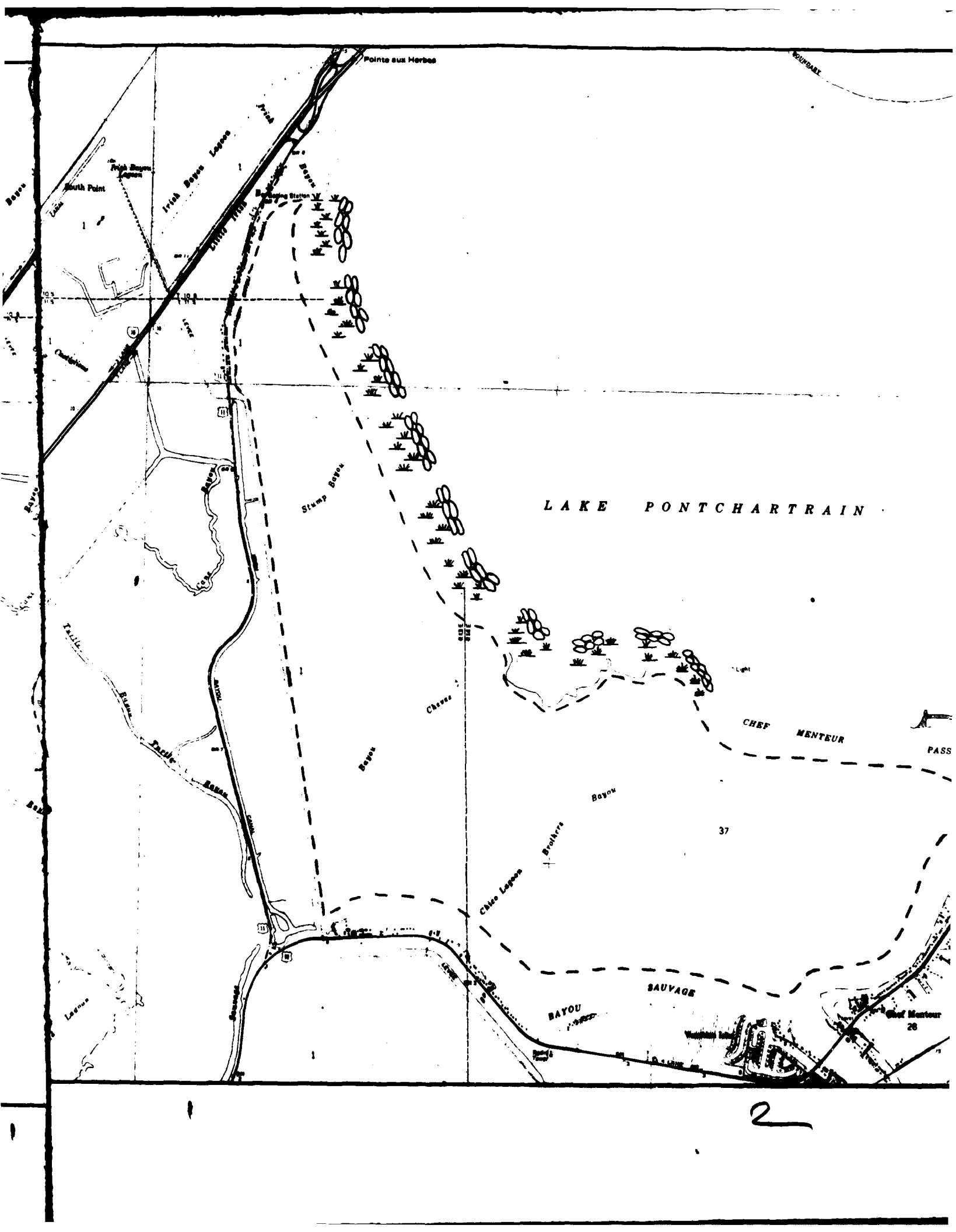
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS

NOVEMBER 1988 FILE NO.

PLATE 3

3





Pointe aux Herbes

BOUNDARY

South Point

Irish Bayou Lagoon

High Bayou Lagoon

Bayou Station

Stamp Bayou

Stamp Bayou

LAKE PONTCHARTRAIN

Chasse

CHEF MENTEUR

PASS

Bayou

37

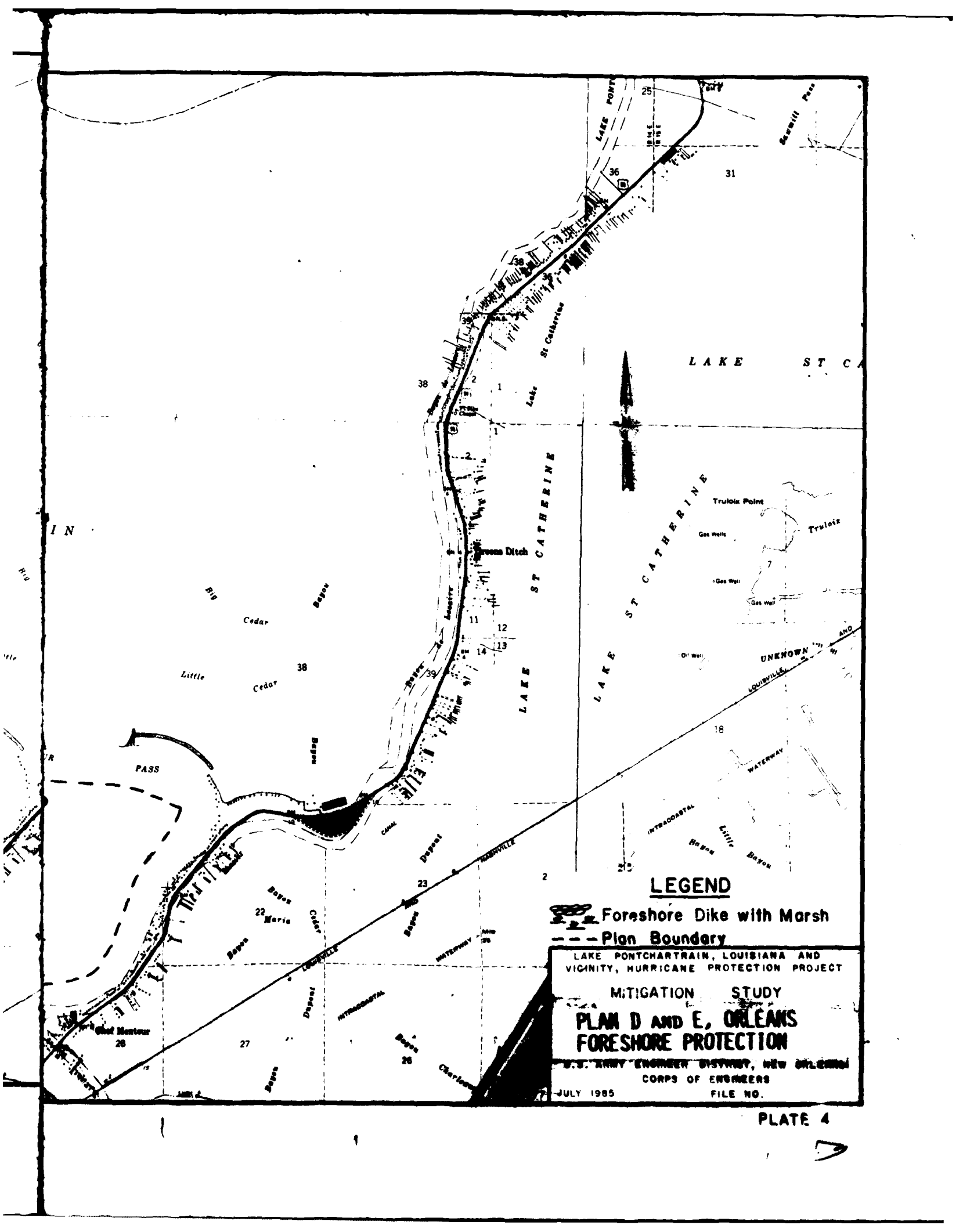
Chico Lagoon

BAYOU

SAUVAGE

Chef Menteur 26

2



LEGEND

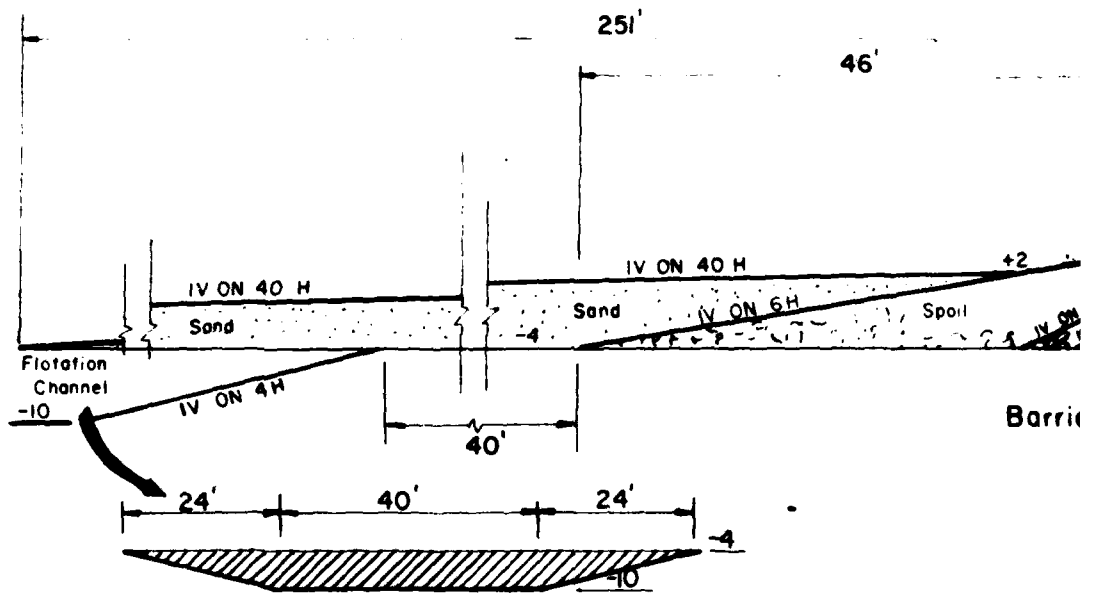
-  Foreshore Dike with Marsh
-  Plan Boundary

LAKE PONTCHARTRAIN, LOUISIANA AND VIGNITY, HURRICANE PROTECTION PROJECT

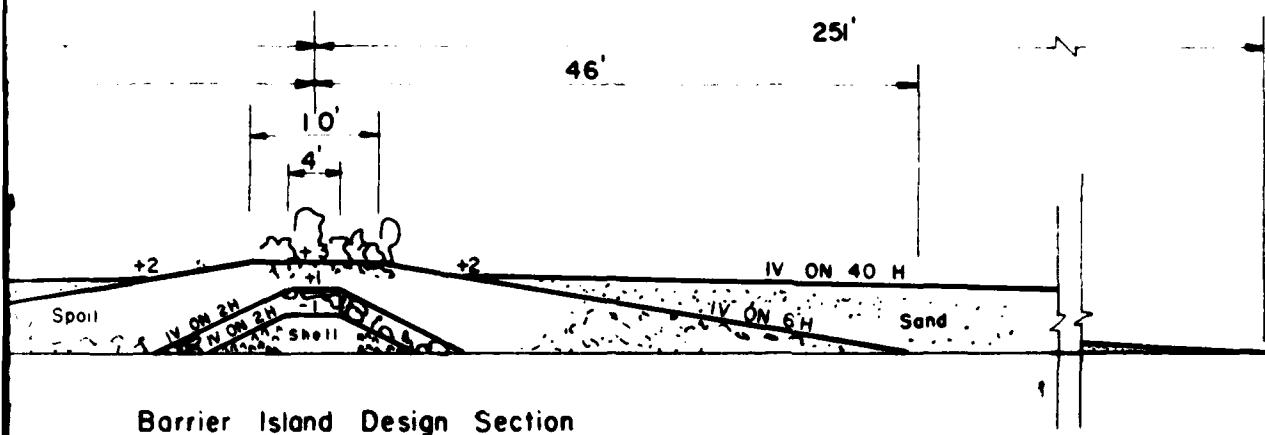
MITIGATION STUDY

PLAN D AND E, ORLEANS FORESHORE PROTECTION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1985 FILE NO.



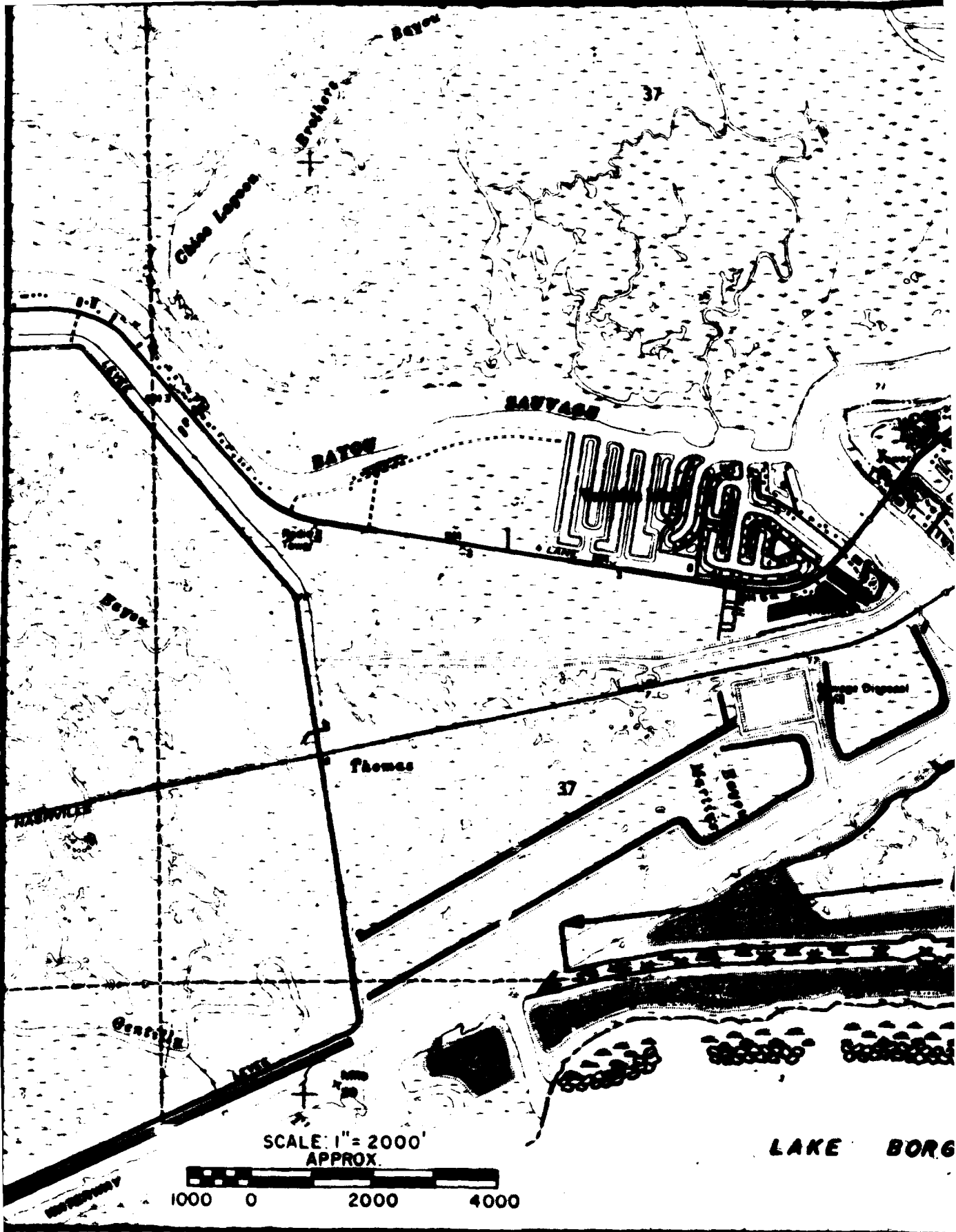
Flotation Channel Section



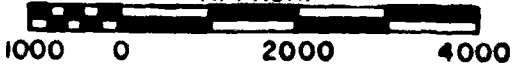
LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT MITIGATION STUDY
 DESIGN FOR
 ARTIFICIAL BARRIER ISLAND
 U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
 CORPS OF ENGINEERS

A

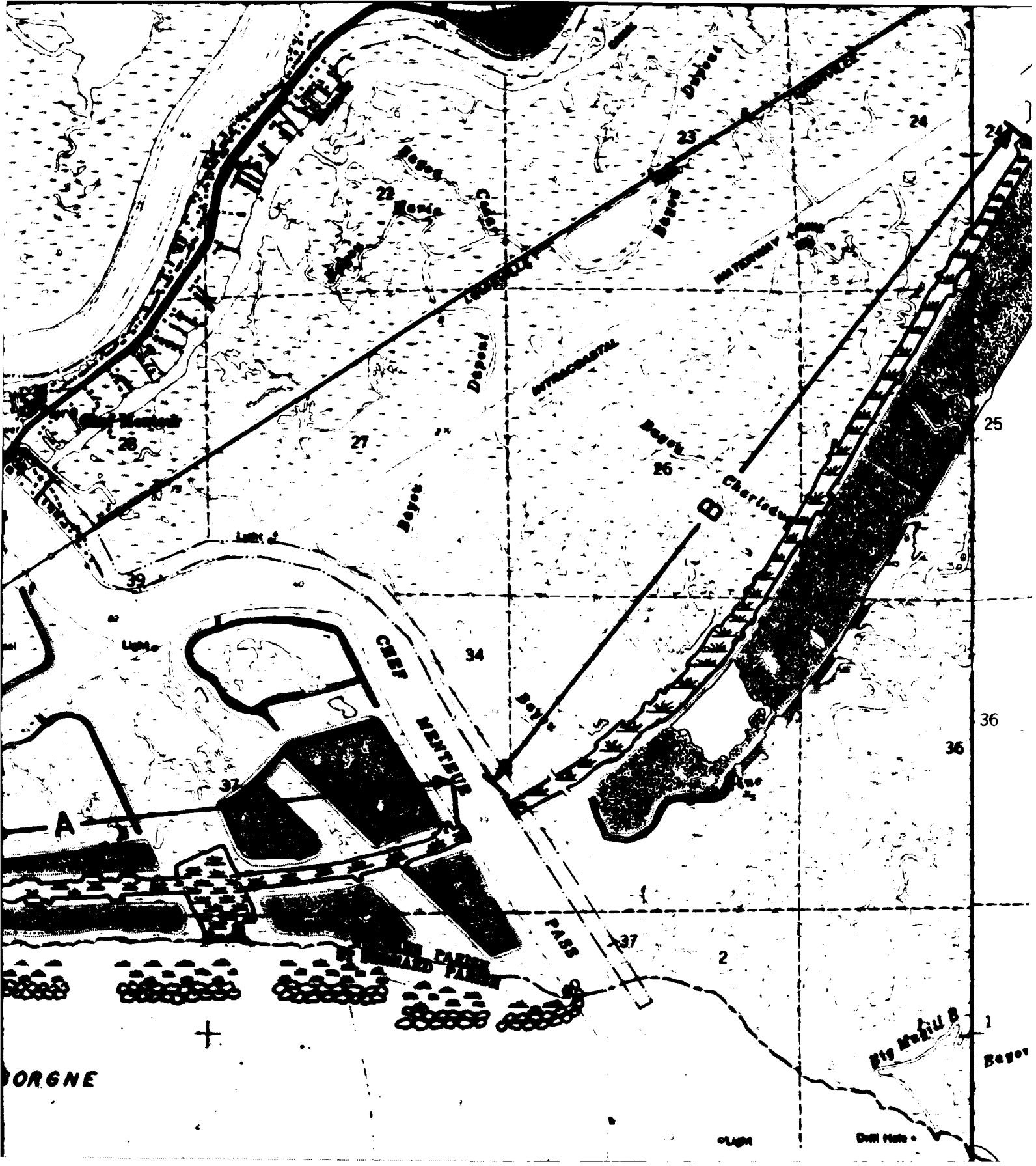
PLATE 5



SCALE: 1" = 2000'
APPROX.



LAKE BORG

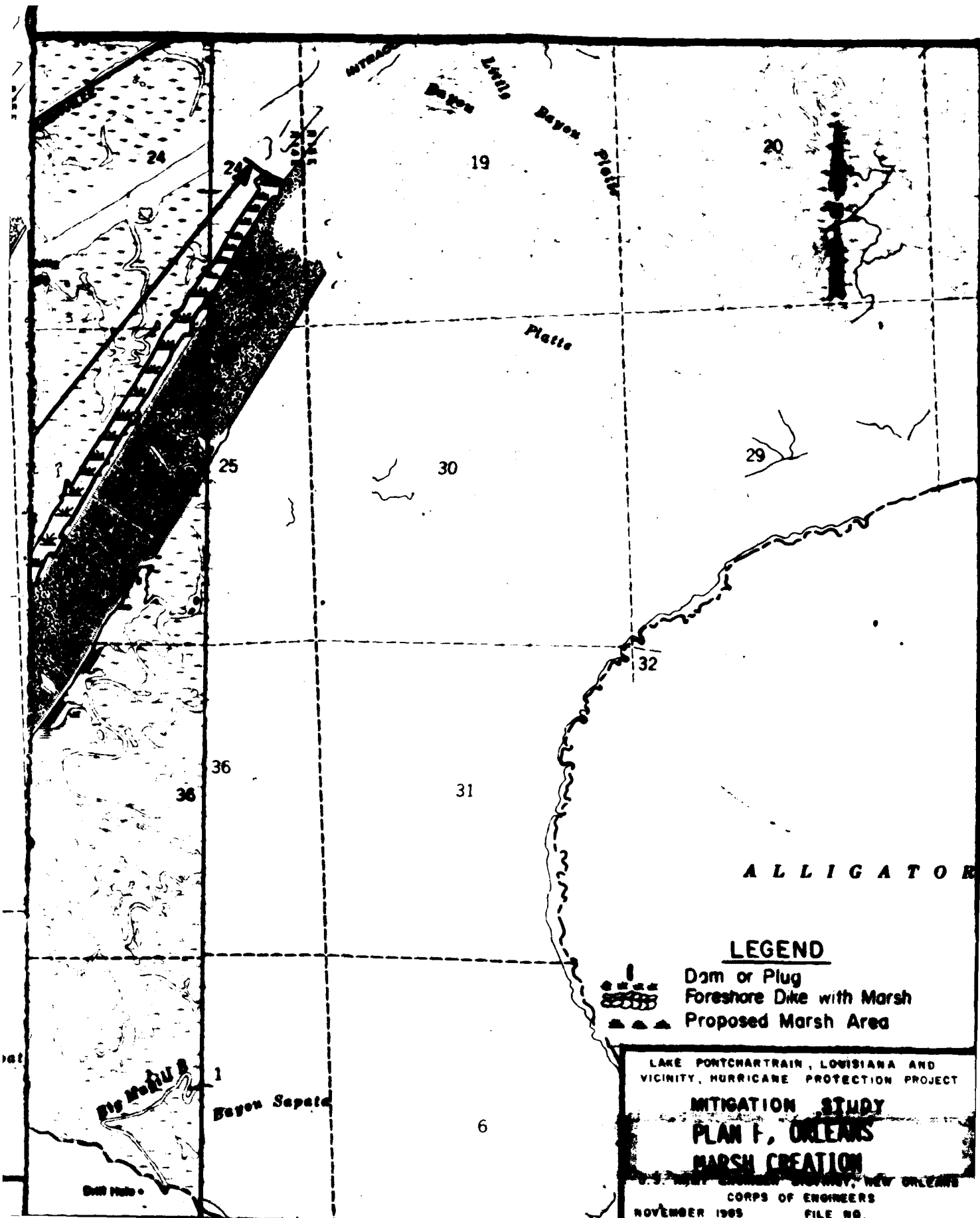


BORGNE

Big Mouth Bay




Light

Dull Hole



A L L I G A T O R

LEGEND

-  Dam or Plug
-  Foreshore Dike with Marsh
-  Proposed Marsh Area

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, HURRICANE PROTECTION PROJECT

**MITIGATION STUDY
PLAN F, ORLEANS
MARSH CREATION**

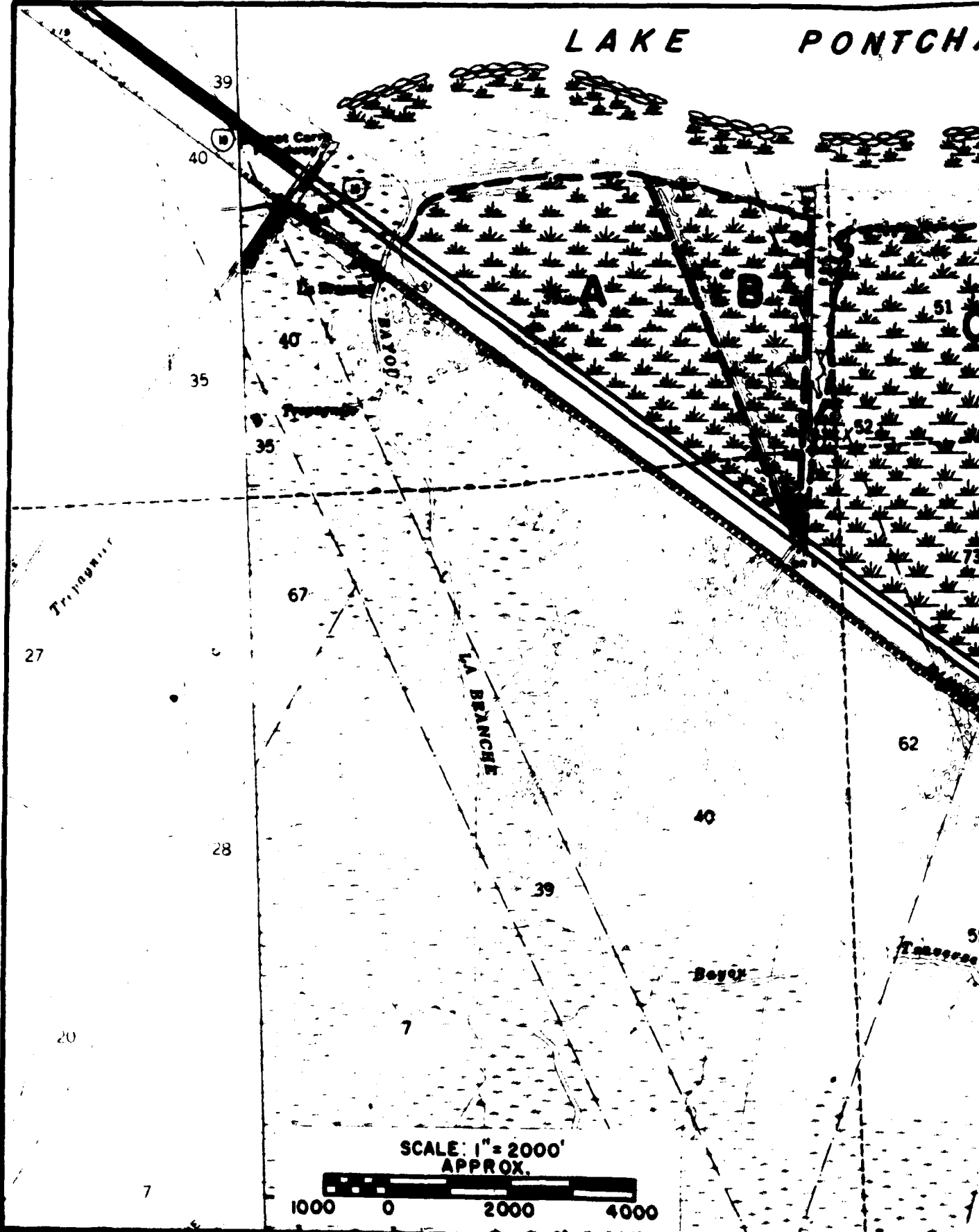
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS

CORPS OF ENGINEERS

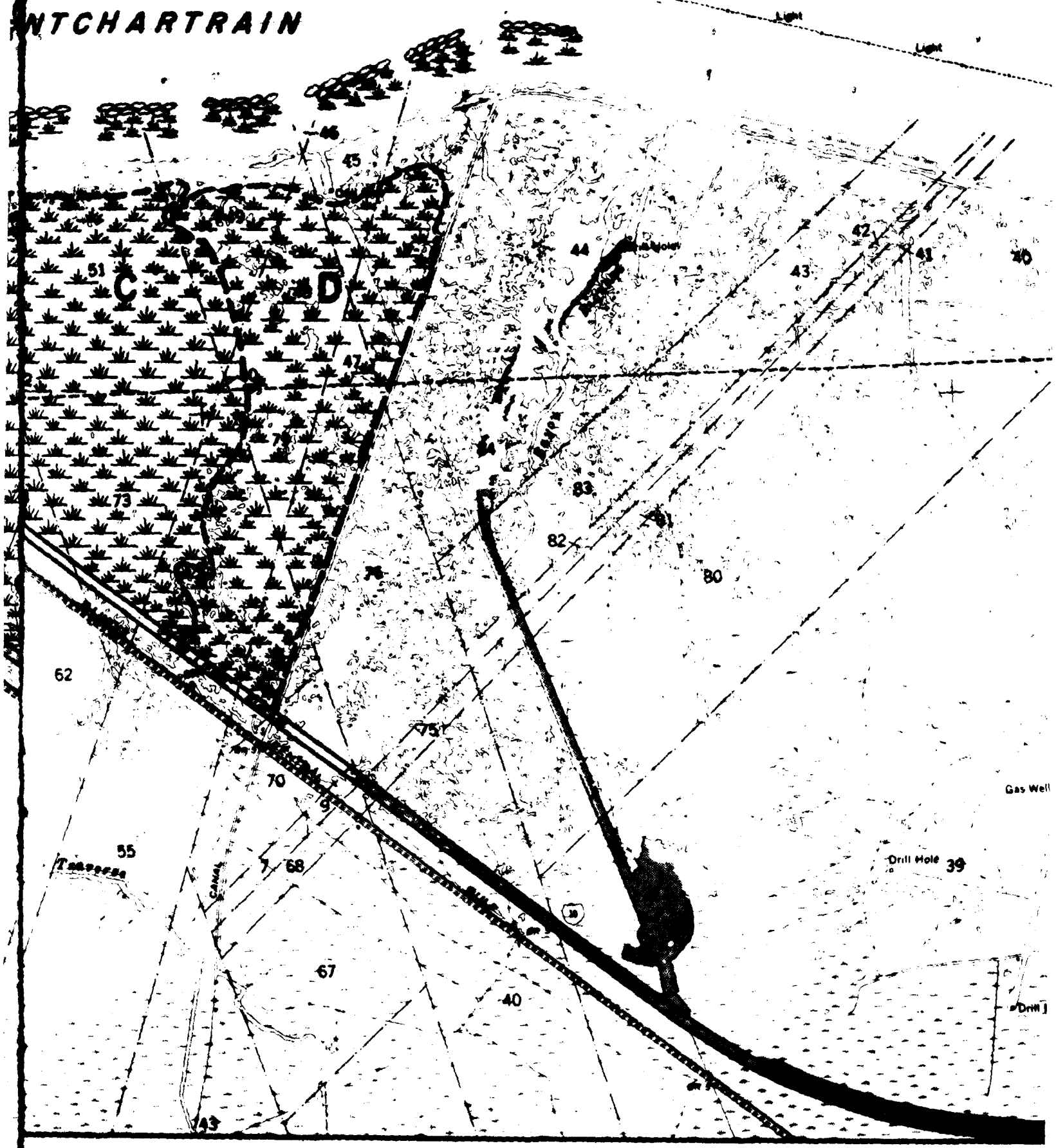
NOVEMBER 1985

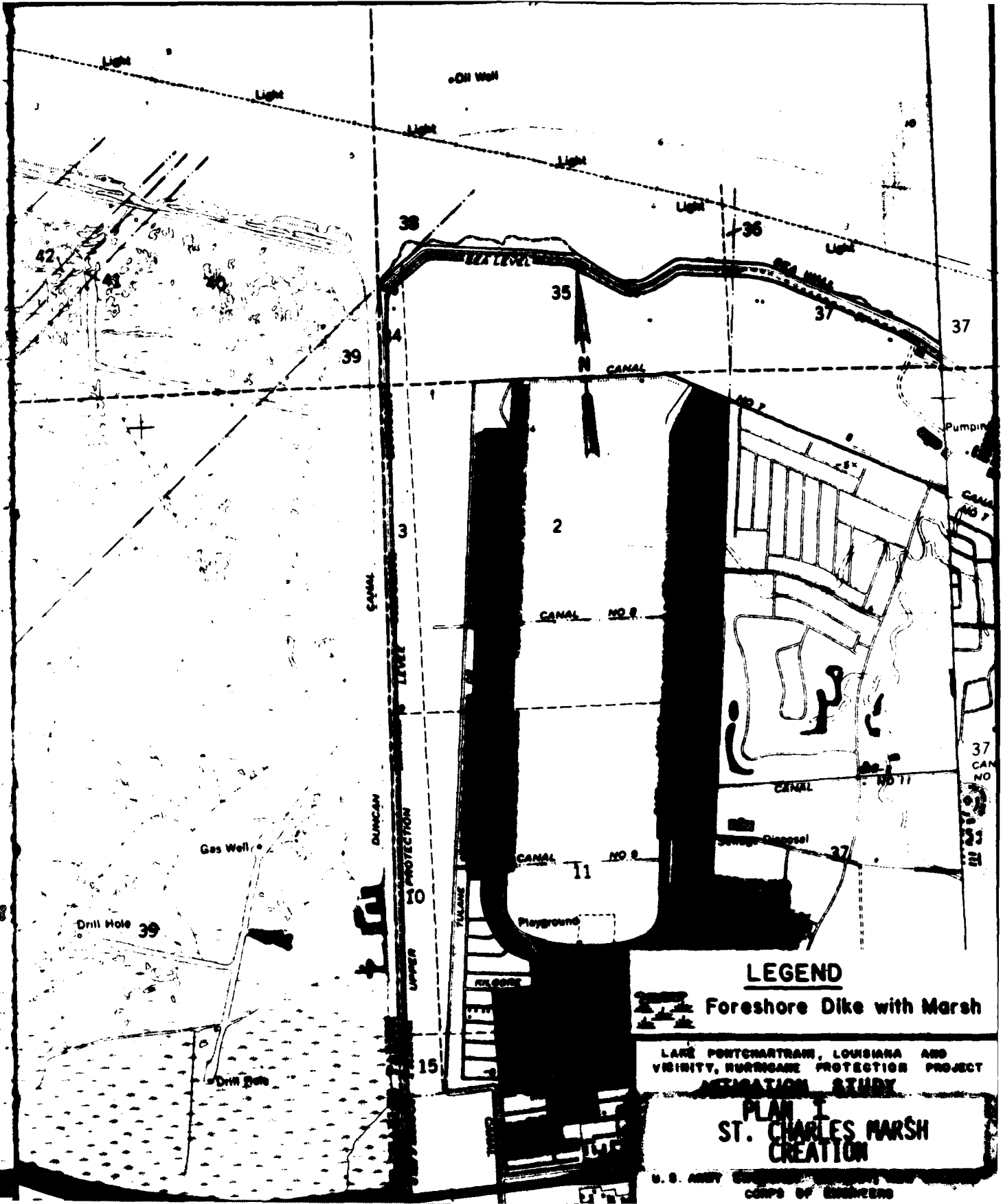
FILE NO.

LAKE PONTCH.



NTCHARTRAIN





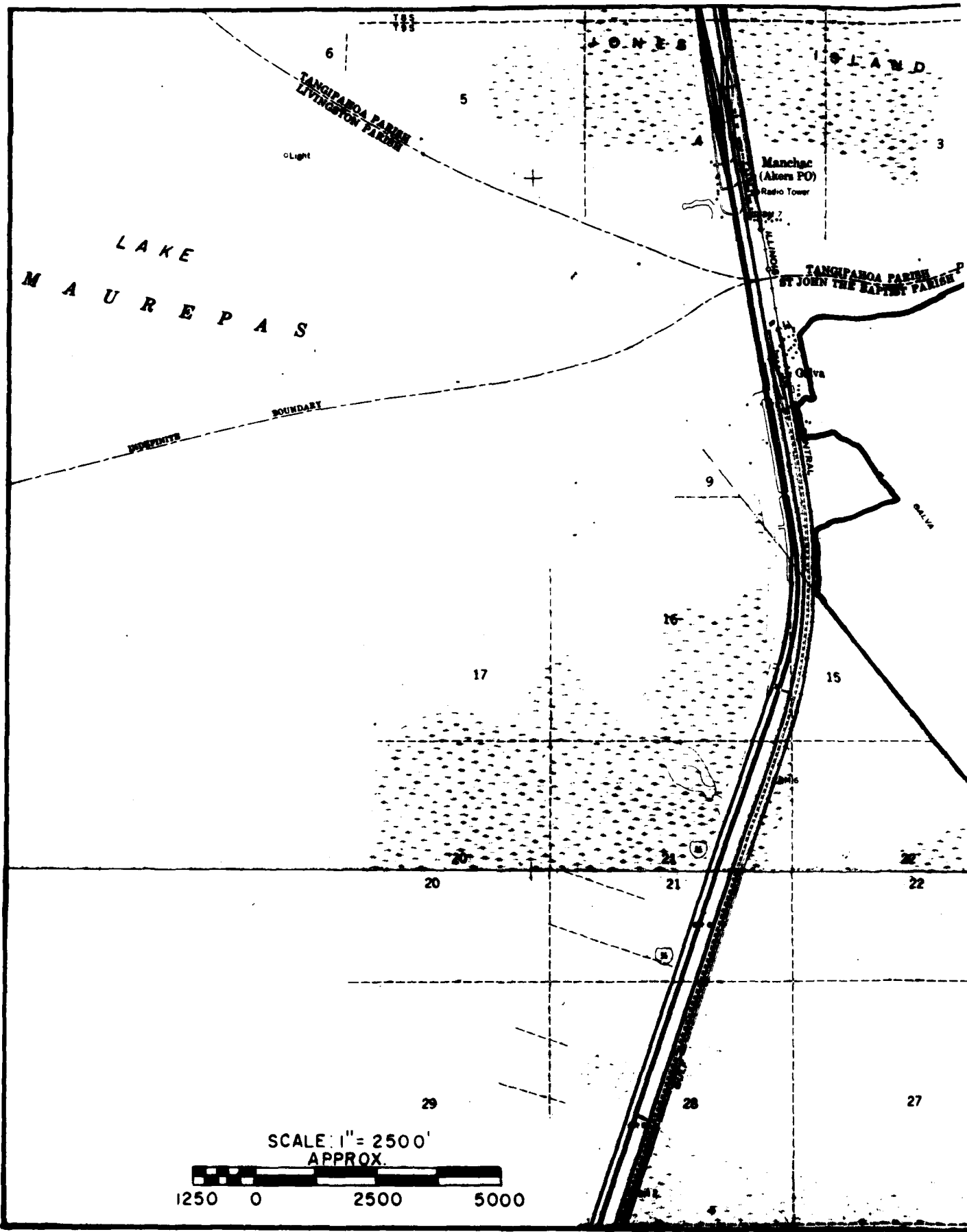
LEGEND

 **Foreshore Dike with Marsh**

LAKE PORTCHARTRAM, LOUISIANA AND
 VICINITY, HURRICANE PROTECTION PROJECT
 ACTIVATION STUDY

**PLAN I
 ST. CHARLES MARSH
 CREATION**

U. S. ARMY CORPS OF ENGINEERS

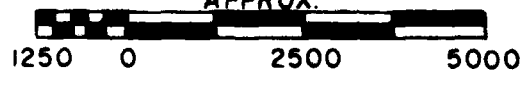


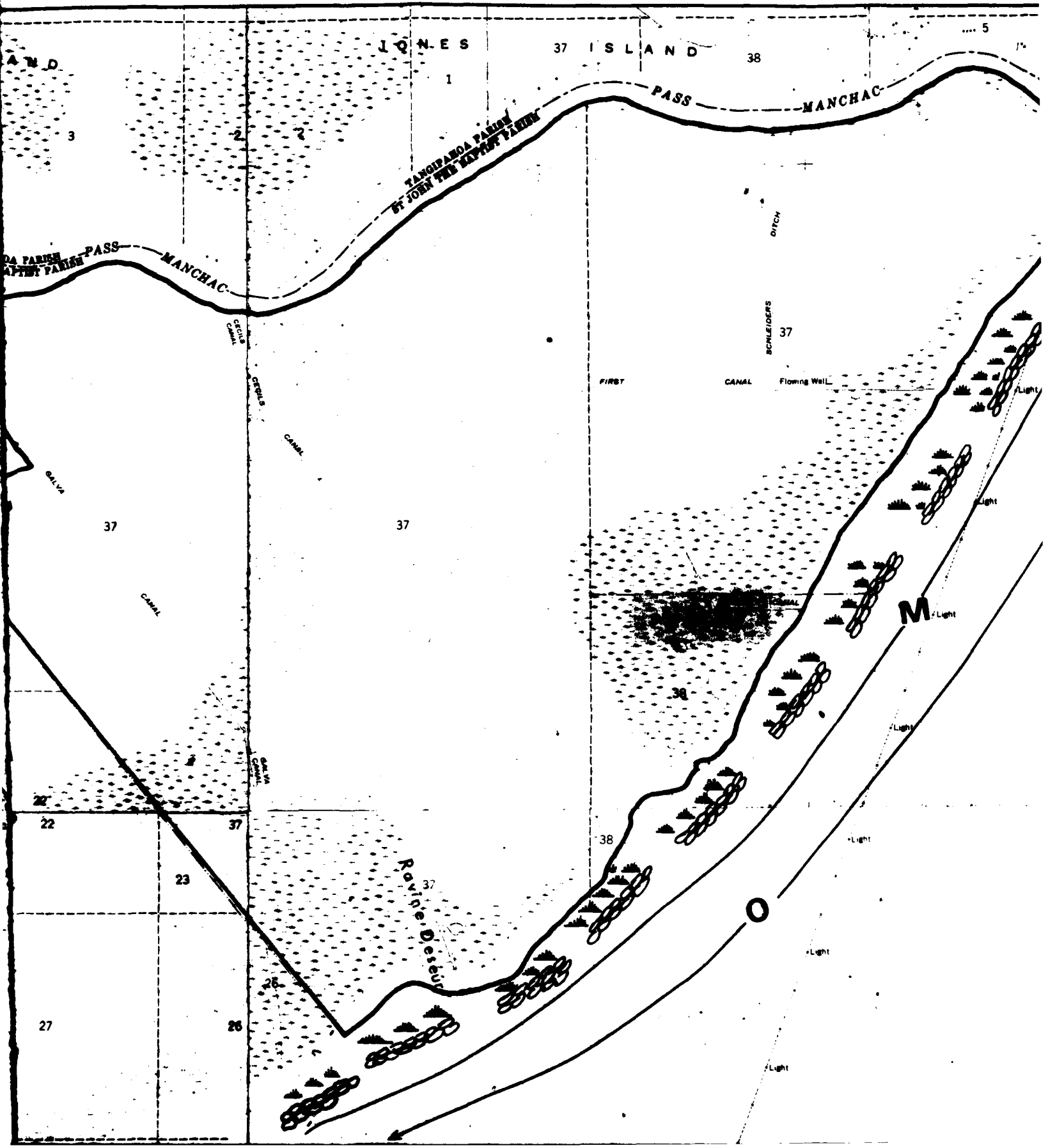
LAKE
MAUREPAS

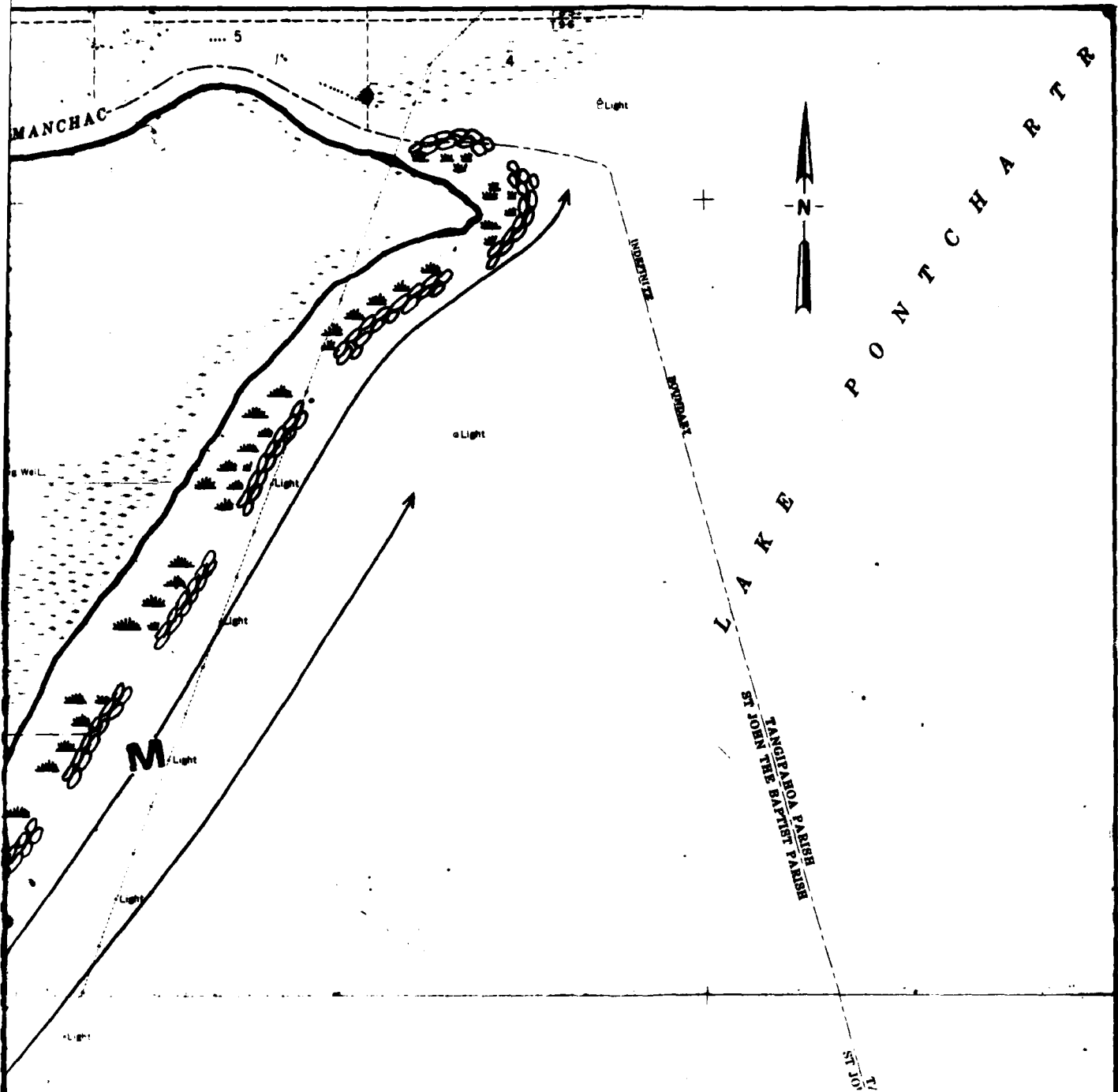
TANGIPAROA PARISH
LIVINGSTON TARIAN

TANGIPAROA PARISH
ST JOHN THE BAPTIST PARISH


SCALE: 1" = 2500'
APPROX.







LEGEND

 Foreshore Dike with Marsh

LAKE PONTCHARTRAIN, LOUISIANA AND VICINITY, HURRICANE PROTECTION PROJECT
 MITIGATION STUDY
**PLANS M & O MANCHAC
 FORESHORE PROTECTION
 (ENTIRE & SOUTH)**
 U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
 CORPS OF ENGINEERS
 JULY 1985 FILE NO

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FILM
8