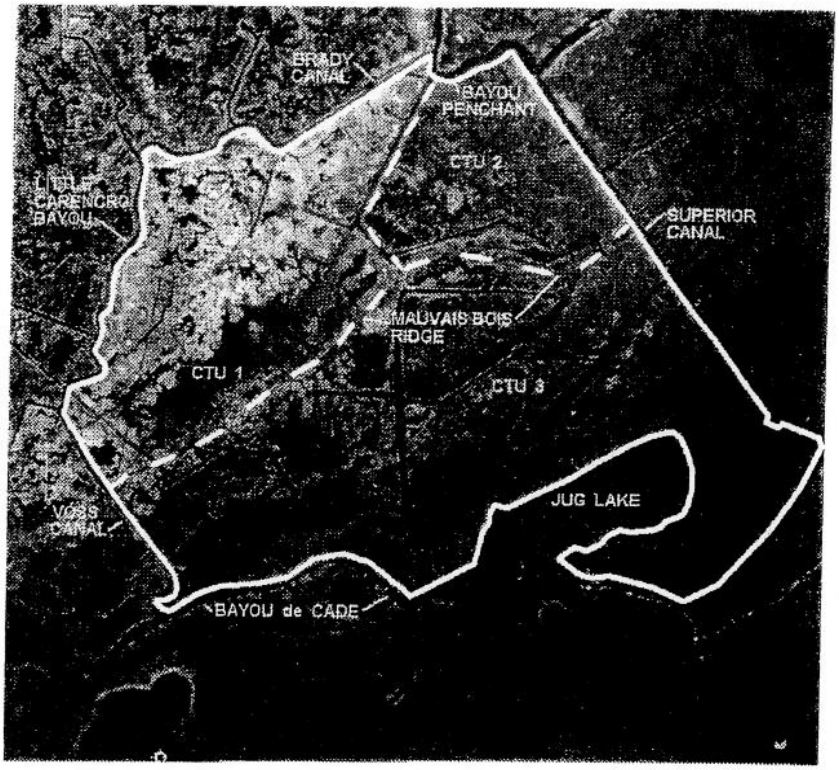
UNITED STATES
DEPARTMENT OF
AGRICULTURE

NATURAL RESOURCES
CONSERVATION SERVICE

FINAL
PROJECT PLAN
AND
ENVIRONMENTAL ASSESSMENT



BRADY CANAL HYDROLOGIC RESTORATION
PTE-26B
TERREBONNE PARISH, LOUISIANA

FEBRUARY 1996

COPY

JOINT PUBLIC NOTICE

July 22, 1996

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United States Army
Corps of Engineers
New Orleans District
Regulatory Functions Branch
Post Office Box 60267
New Orleans, Louisiana 70160-0267

(504) 862-2277
Project Manager
Mr. John Reddoch
Permit Application Number
SW(Terrebonne Parish Wetlands)1087

State of Louisiana
Department of Environmental Quality
Office of Water Resources
Water Pollution Control Division
Post Office Box 82215
Baton Rouge, Louisiana 70884-2215

(504) 765-0664
Project Manager
Ms. Linda Gauthier
WQC Application Number
WQC #960506-10

Interested parties are hereby notified that a permit application has been received by the New Orleans District of the U.S. Army Corps of Engineers pursuant to: [X] Section 10 of the Rivers and Harbors Act of March 3, 1899 (30 Stat. 1151; 33 USC 403); and/or [X] Section 404 of the Clean Water Act (86 Stat. 816; 33 USC 1344).

Application has also been made to the Louisiana Department of Environmental Quality, Office of Water Resources, for a Water Quality Certification (WQC) in accordance with statutory authority contained in Louisiana Revised Statutes of 1950, Title 30, Chapter 11, Part IV, Section 2074 A(3) and provisions of Section 401 of the Clean Water Act (P.L. 95-217).

DREDGING, STRUCTURES AND FILL FOR THE BRADY CANAL HYDROLOGIC RESTORATION PROJECT

NAME OF APPLICANT: LOUISIANA LAND & EXPLORATION AND FINA OIL AND CHEMICAL COMPANY, c/o USDA Natural Resources Conservation Service, 3737 Government Street, Alexandria, Louisiana 71302.

LOCATION OF WORK: In TERREBONNE PARISH, central to a point approximately 16 miles southwesterly from Houma, Louisiana, in an area bounded on the north by Bayou Penchant, Brady Canal and Little Carencro Bayou, on the south by Bayou DeCade and Turtle Bayou, on the east by Superior Canal and on the west by Little Carencro Bayou and Voss Canal, as shown on the attached drawings.

CHARACTER OF WORK: Dredge for material to maintain existing spoil embankments, to construct new embankments and to construct an access channel; modify five existing water control structures; and install and maintain rip-rap channel armor, a rock plug and a fixed-crest weir, in order to reduce erosion, encourage freshwater, sediment and nutrient influx and stabilize water levels within a 7,653 acre area of marsh and open water. Dredging operations will consist of the excavation of approximately 60,300 cubic yards of material to construct 15,000 linear feet of earthen embankment with a final crown elevation of +4.0 ft. National Geodetic Vertical Datum (N.G.V.D.). An additional 18,390 cubic yards of material would be excavated annually to maintain a +4.0 ft. N.G.V.D. elevation along 50,000 feet of existing spoil embankment and to maintain a +2.0 ft. N.G.V.D. elevation along 29,600 feet of overflow embankment. An estimated 36,500 cubic yards of material would be excavated to construct a 2,385 foot channel to maintain barge access. Material excavated from the channel would be deposited in open water to an elevation conducive to marsh establishment. Other structural measures include: Deposition of approximately 4,375 cubic yards of rip-rap to construct a rock plug; deposition of 2,805 cubic yards of rip-rap to prevent scouring of two existing channel openings; installation of a fixed-crest weir with a 70-foot wide by 8-foot deep

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barge bay; addition of flapgates and stoplogs to an existing bulkhead with boat bay; addition of variable-crest sections to three existing fixed-crest weirs and installation of sheetpiling to replace an existing fixed-crest weir. Water control structures would generally be allowed to function passively with flapgates down and weir elevations set at 0.5 feet below average marsh elevation. Active manipulation of structures may be employed on occasion due to storm events or as dictated by monitoring data. This project has been approved for funding under the Coastal Wetlands Planning, Protection and Restoration Act and is sponsored by the U.S.D.A. Natural Resources Conservation Service and the Louisiana Department of Natural Resources Coastal Restoration Division.

The comment period for the Department of the Army Permit and the Louisiana Department of Environmental Quality WQC will close 20 days from the date of this joint public notice. Written comments, including suggestions for modifications or objections to the proposed work, stating reasons thereof, are being solicited from anyone having interest in this permit and/or this WQC request and must be mailed so as to be received before or by the last day of the comment period. Letters concerning the Corps of Engineers permit application must reference the applicant's name and the Permit Application Number, and be mailed to the Corps of Engineers at the address above, **ATTENTION: REGULATORY FUNCTIONS BRANCH**. Similar letters concerning the Water Quality Certification must reference the applicant's name and the WQC Application number and be mailed to the Louisiana Department of Environmental Quality at the address above.

The application for this proposed project is on file with the Louisiana Department of Environmental Quality and may be examined during weekdays between 8:00 a.m. and 5:00 p.m. Copies may be obtained upon payment of costs of reproduction.

Corps of Engineers Permit Criteria

The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

The U.S. Army Corps of Engineers is soliciting comments from the public, Federal, state, and local agencies and officials, Indian Tribes, and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the U.S. Army Corps of Engineers to determine whether to make, modify, condition, or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

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No properties listed on the National Register of Historic Places are near the proposed work. The possibility exists that the proposed work may damage or destroy presently unknown archeological, scientific, prehistorical, historical sites, or data. Copies of this notice are being sent to the State Archeologist and the State Historic Preservation Officer.

Our initial finding is that the proposed work would neither affect any species listed as endangered by the U.S. Departments of Interior or Commerce, nor affect any habitat designated as critical to the survival and recovery of any endangered species.

If the proposed work involves deposits of dredged or fill material into navigable waters, the evaluation of the probable impacts will include the application of guidelines established by the Administrator of the Environmental Protection Agency. Also, a certification that the proposed activity will not violate applicable water quality standards will be required from the Department of Environmental Quality, Office of Water Resources before a permit is issued.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

You are requested to communicate the information contained in this notice to any other parties whom you deem likely to have interest in the matter.

The applicant has certified that the proposed activity described in the application complies with and will be conducted in a matter that is consistent with the Louisiana Coastal Resources Program. The Department of the Army Permit will not be issued unless the applicant received approval or a waiver of the Coastal Use Permit by the Department of Natural Resources.

Pete Serio

P.J. Serio
Chief, Western Evaluation Section
Regulatory Functions Branch

Attachments

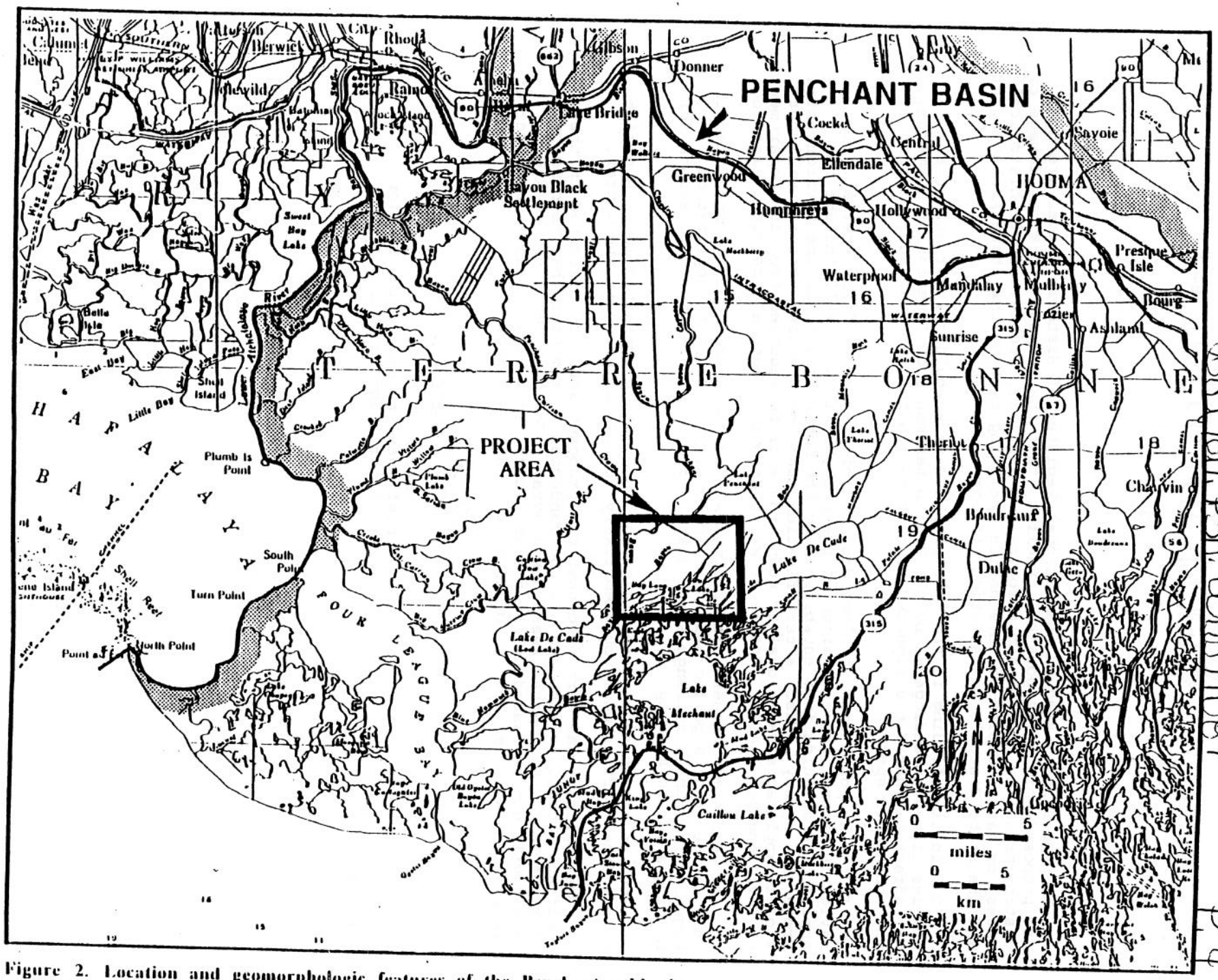

Figure 2. Location and geomorphologic features of the Penchant subbasin.

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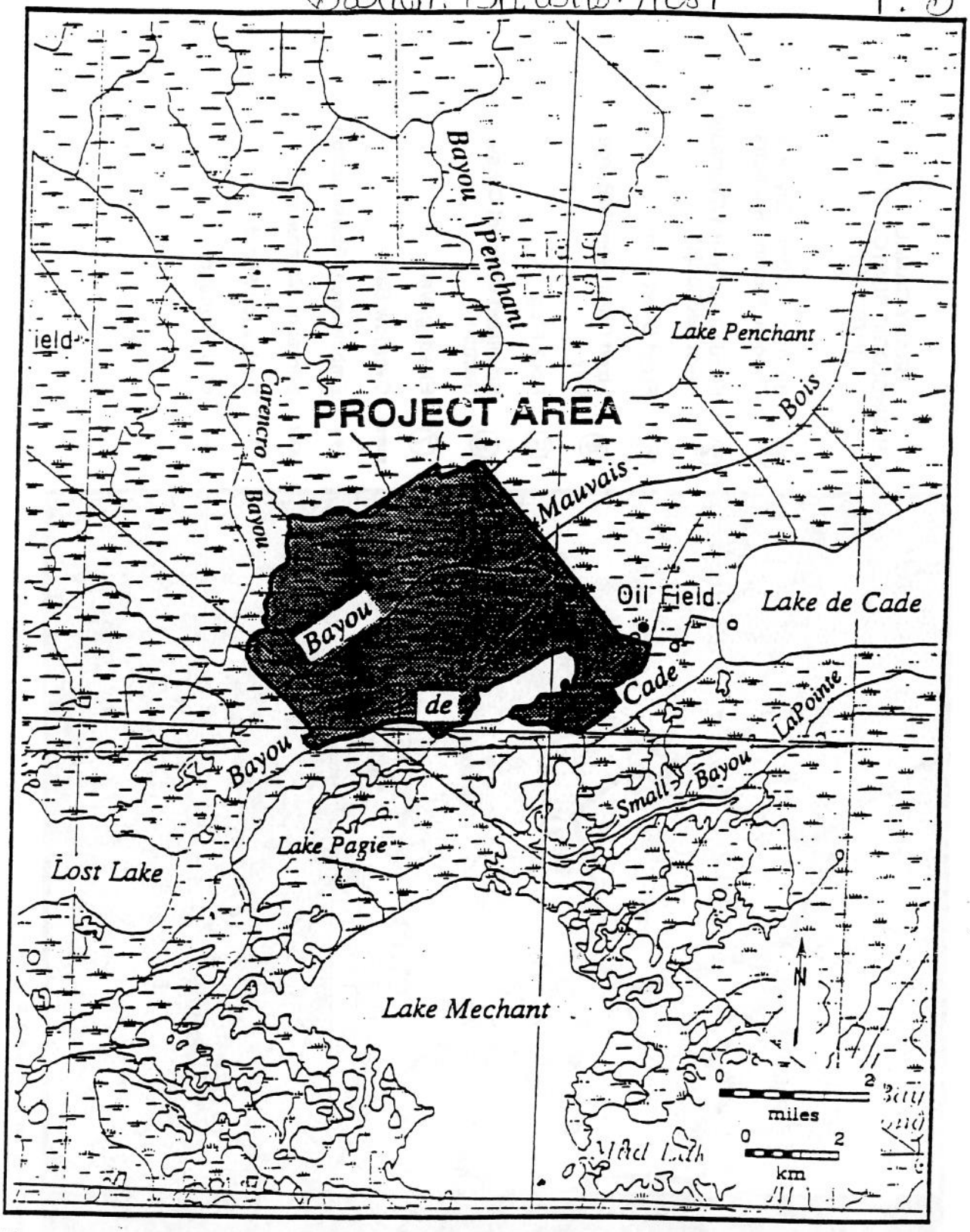
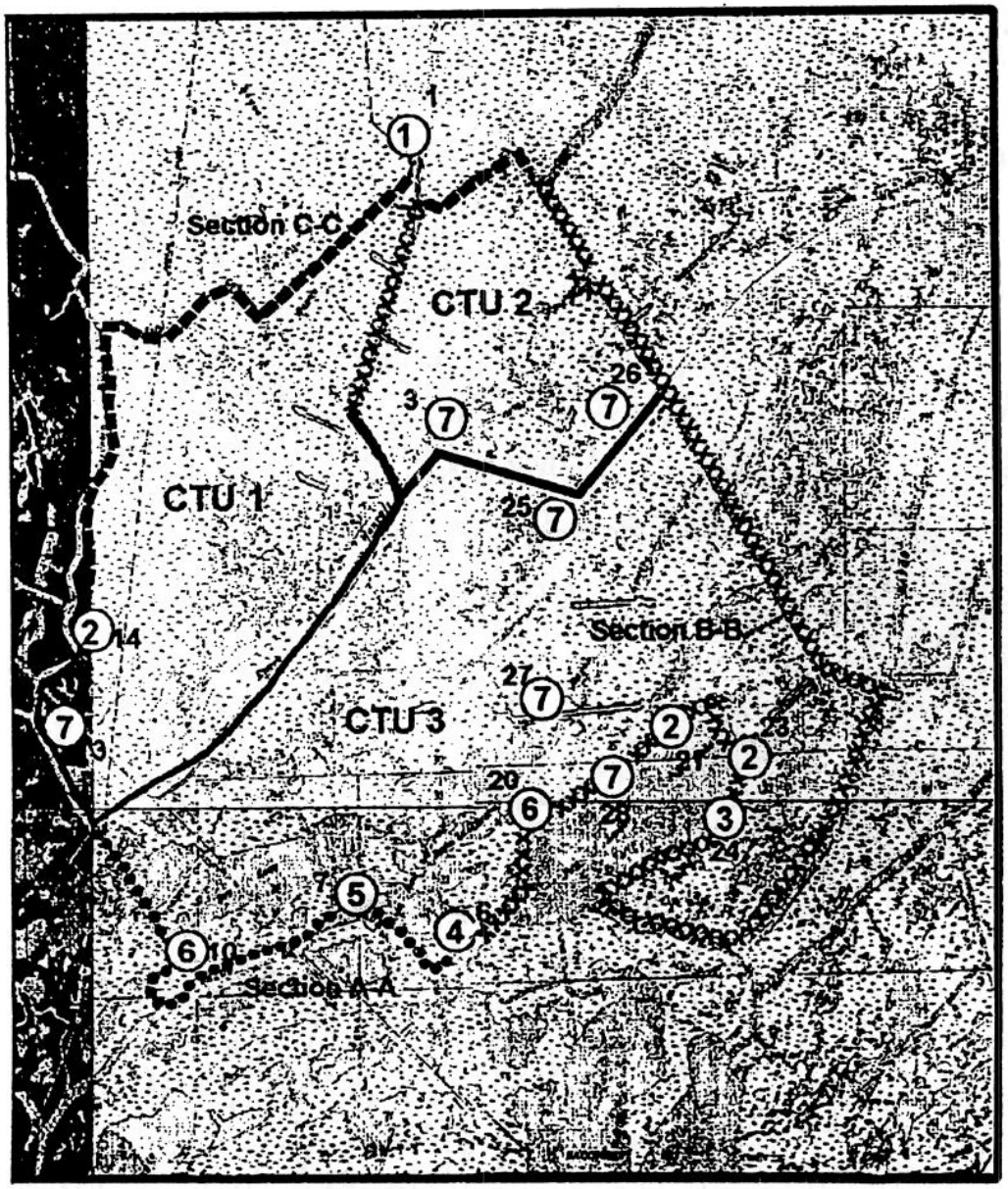


Figure 1. Location of the Brady Canal Hydrologic Restoration Project (PTE-26b).



See Drawings for Sections A-A, B-B, and C-C.

BRADY CANAL
HYDROLOGIC RESTORATION
(PTE-26B)

①	Bulkhead W/Boat Bay and Flapgate Stoplog Sections
②	Fixed Crest Weir W/Variable Crest Section(s)
③	Fixed Crest Weir
④	Fixed Crest Weir W/Barge Bay
⑤	Rock Plug
⑥	Stabilized Channel Cross-Section
⑦	Existing Weir
▬▬▬	Overflow Bank
•••	Embankment Construction
xxx	Shoreline Maintenance
1	Evaluation Site #
—	CTU Boundary

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Table 2: Existing Structures and Proposed Project Features Within the Brady Canal Hydrologic Restoration Project Area.

Evaluation Site	Channel		Existing Structure			Proposed Structure		
	Width (ft)	Depth (ft)	Type	Crest Elevation (ft BML)	Crest Width (ft)	Type	Crest Elevation (ft BML)	Crest Width (ft)
1	112	20	Timber Bulkhead	0.5	60	Bulkhead	0.5	120
			Boat Bay	-5.0	9	Boat Bay	-5.0	10
3			Var. Crest Weir	from 0 to -1.4	12	Flap Gates/Stoplog	from 0.5 to -5.0	12
6	285	8.4				Fixed Crest Weir	-0.5	145
						Barge Bay	-8.5	70
7	315	8				Rock Plug		
10	225	10.9				Channel Armor		
14	40	7.8	Fixed Crest Weir	-1.0	33	Fixed Crest Weir	-1.0	~~30~~ 30
						Var. Crest Section	from -1.0 to -6.0	6
20	160	9				Channel Armor		
21			Fixed Crest Weir	-1.0	48	Fixed Crest Weir	-1.0	30
						Var. Crest Sections	-1.0-6.0	18
22			Earthen Plug					
23			Fixed Crest Weir	-1.0	40	Fixed Crest Weir	-1.0	46
			Var. Crest Section		16	Var. Crest Section	from -1.0 to -6.0	12
24			Fixed Crest Weir			Fixed Crest Weir		
			Section 1	-1.0	30	Section 1	-1.0	30
			Section 2	-2.5	50	Section 2	-2.5	50
25			60" Pipe					
			Sluice gate					
			Flapgate					
26			Fixed Crest Weir	-0.5	16			
27			42" Pipe					
			V. crest weir inlet	from 0 to -3.5	6			
			Flapgate					
28			42" Pipe					
			V. crest weir inlet	from 0 to -3.5	6			
			Flapgate					

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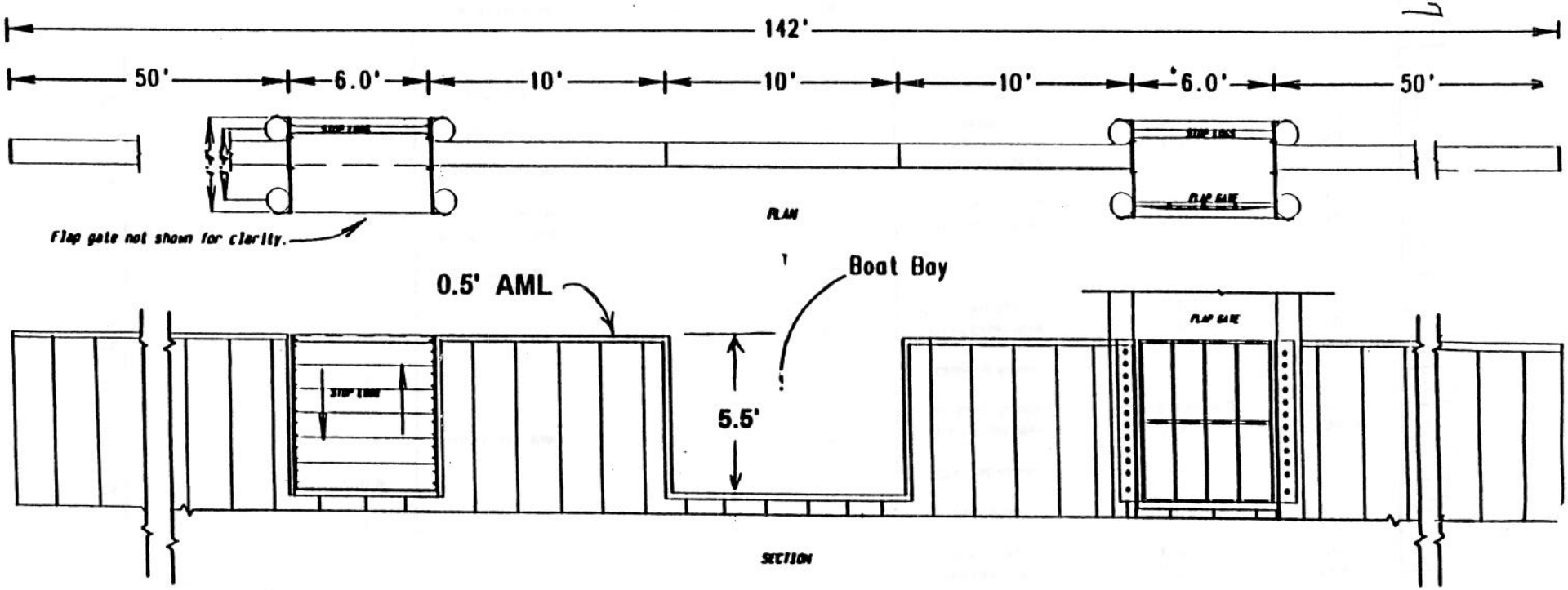
Typical Drawing

Weir w/Boat Bay & VC Sections w/Flap Gates



NOT TO SCALE

NOTE:
Dimension shown based upon planning surveys.

Brady Canal
Hydrologic Restoration
ES-1 Weir W/Boat Bay and
VC Sections w/Flap Gates
Terrebonne Parish, La.

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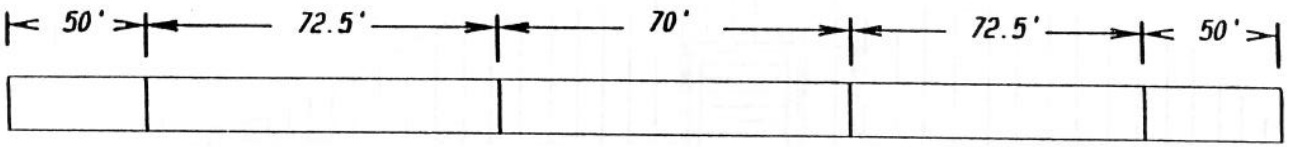
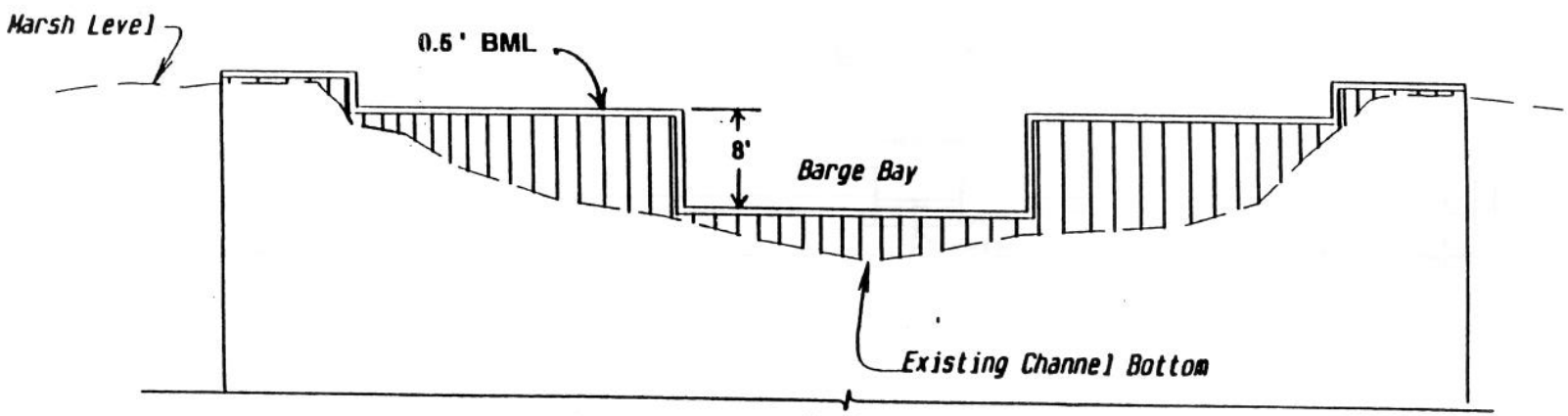
brady1

TYPICAL DRAWING

FIXED CREST WEIR WITH BARGE BAY



Plan View



Section

NOTE:
Dimensions shown based upon planning surveys.

Not to Scale

Brady Canal
Hydrologic Restoration
ES-6 Fixed Crest Weir W/Barge Bay
Terrebonne Parish, La.

SWTerr. Psh. Wtlo.) 1087

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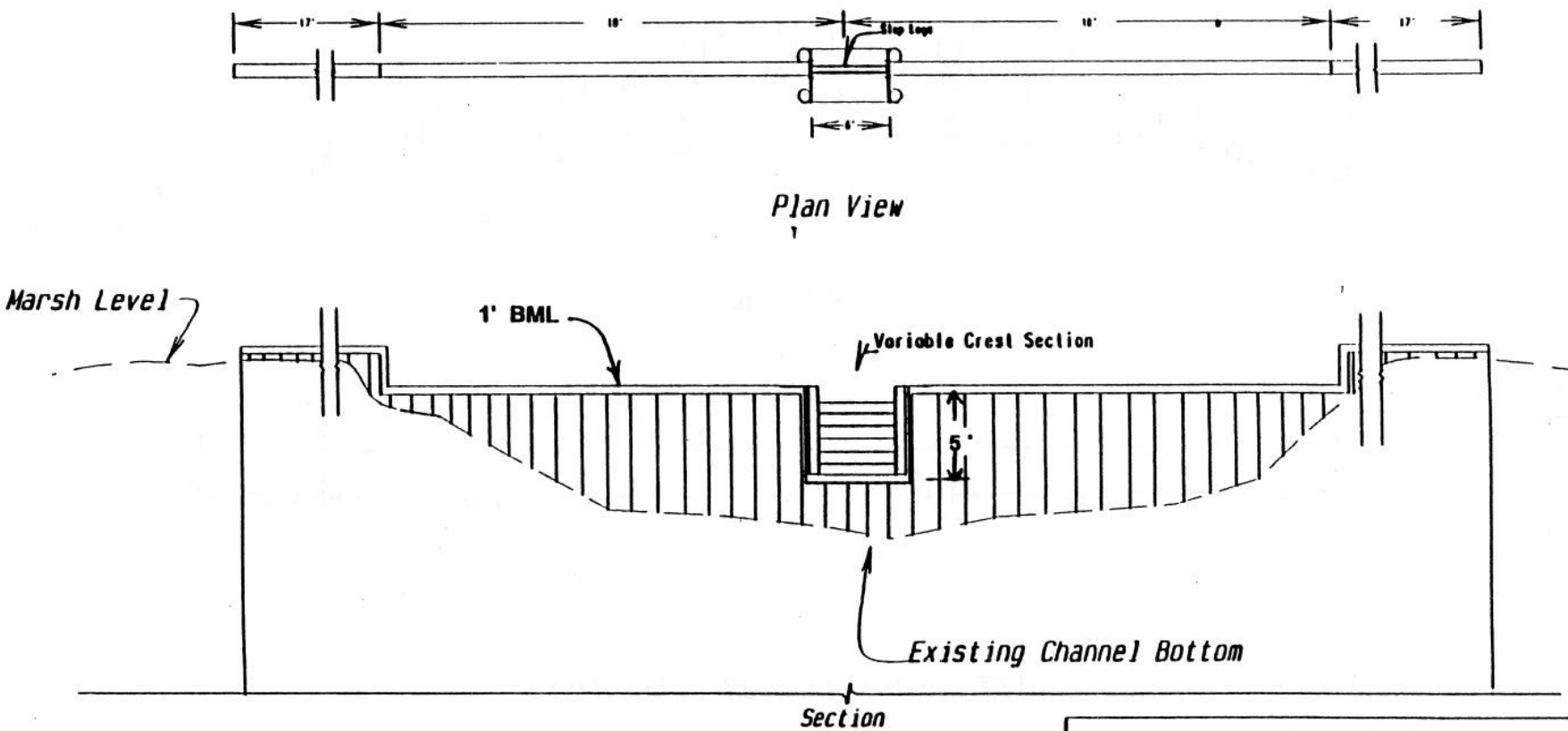
TYPICAL DRAWING

WEIR W/VARIABLE CREST SECTION



NOTE:
Dimensions shown based upon planning surveys.

Not to Scale

Brady Canal

Hydrologic Restoration

ES-14 Weir W/Variable Crest Sections

Terrebonne Parish, La.

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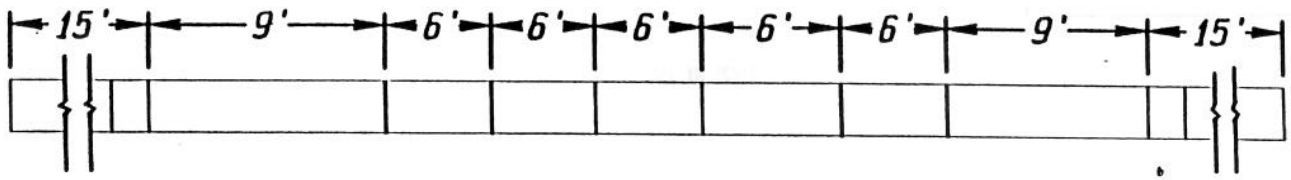
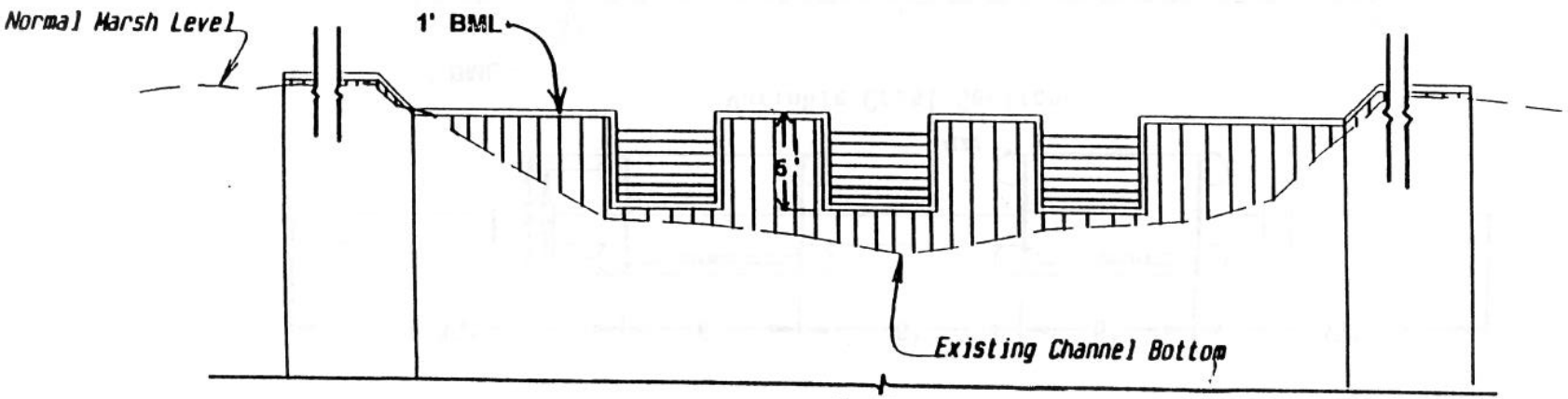
TYPICAL DRAWING

WEIR WITH VARIABLE CREST SECTIONS



Plan View



Section

NOTE:
Dimensions shown based upon planning surveys.

Not to Scale

Brady Canal

Hydrologic Restoration

ES-21 Weir W/Variable Crest Sections

Terrebonne Parish, La.

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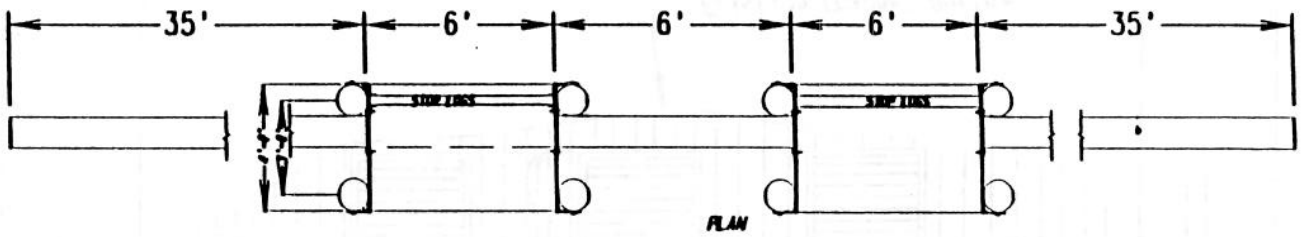
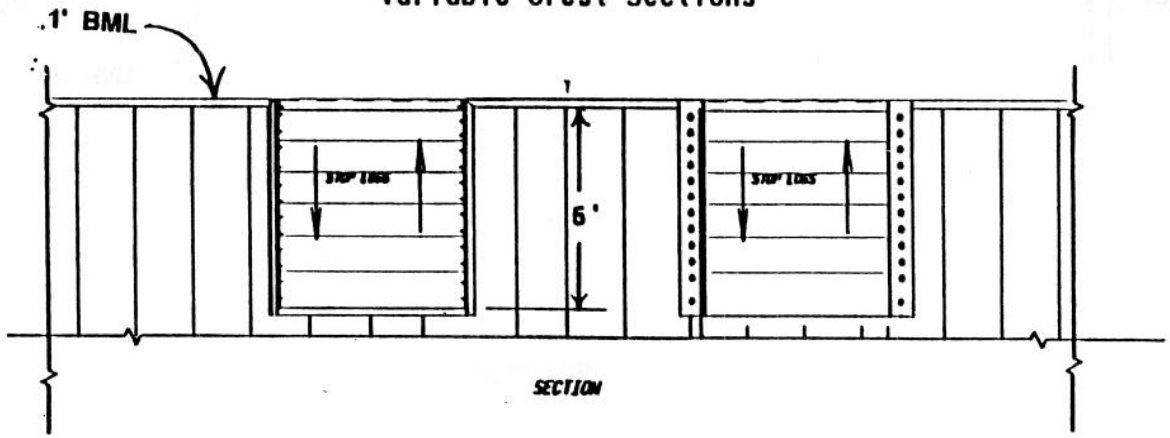
TYPICAL DRAWING
WEIR W/VARIABLE CREST SECTIONS



Variable Crest Sections



NOT TO SCALE

NOTE:

Dimensions shown based upon planning surveys.

Brady Canal
Hydrologic Restoration
ES-23 Weir W/Variable Crest Sections
Terrebonne Parish, La.

Sw Terr. Psh. Wtlo.) 1087

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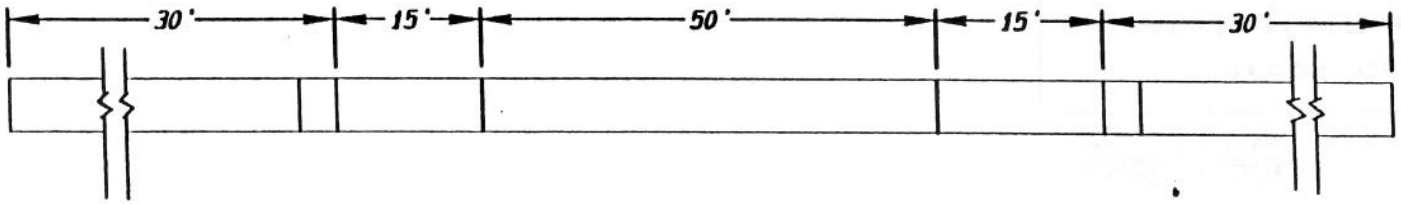
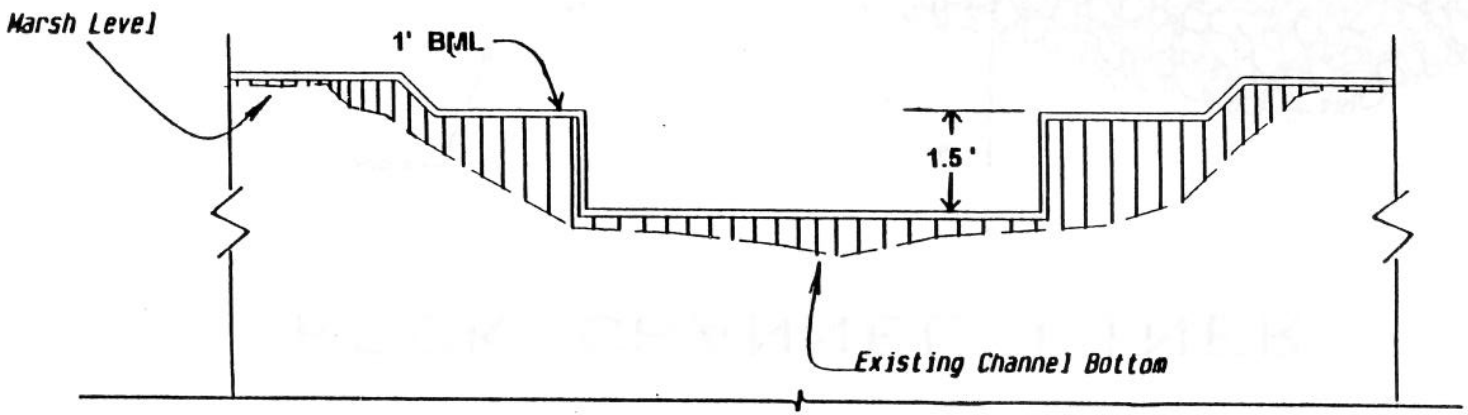
TYPICAL DRAWING

FIXED CREST WEIR



Plan View



Section

Not to Scale

NOTE:
Dimensions shown based upon planning surveys.

Brady Canal
Hydrologic Restoration
ES-24 Fixed Crest Weir

Terrebonne Parish, La.

SW Terr. Bsh. Wtb.) 1087

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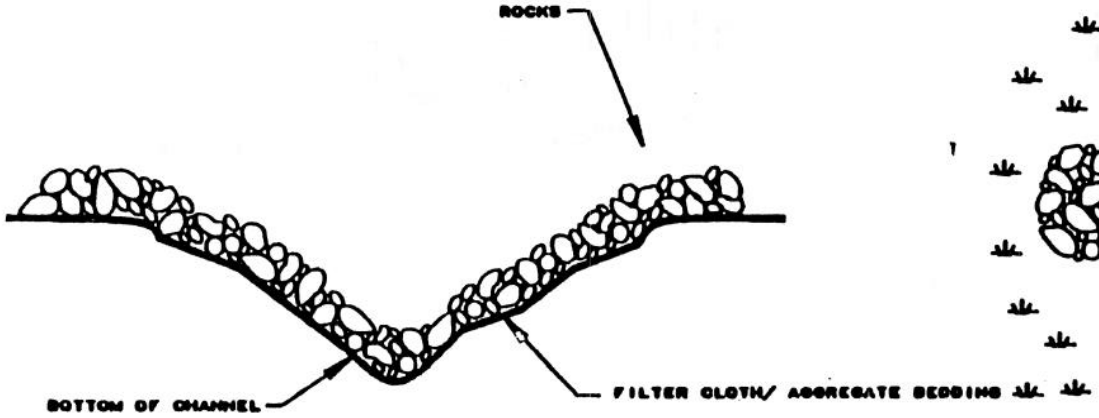
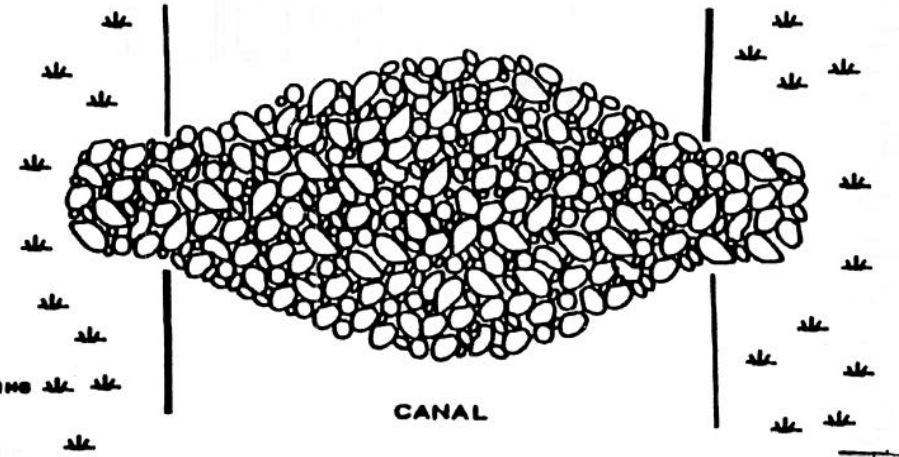
TYPICAL DRAWING

ROCK CHANNEL LINER



ELEVATION VIEW
NOT TO SCALE



PLAN VIEW
NOT TO SCALE

Brady Canal
Hydrologic Restoration
ES-10,20 Rock Channel Liner
Terrebonne Parish, La.
ES-10 1,440 cu.yds., ES-20 1,365 cu.yd.

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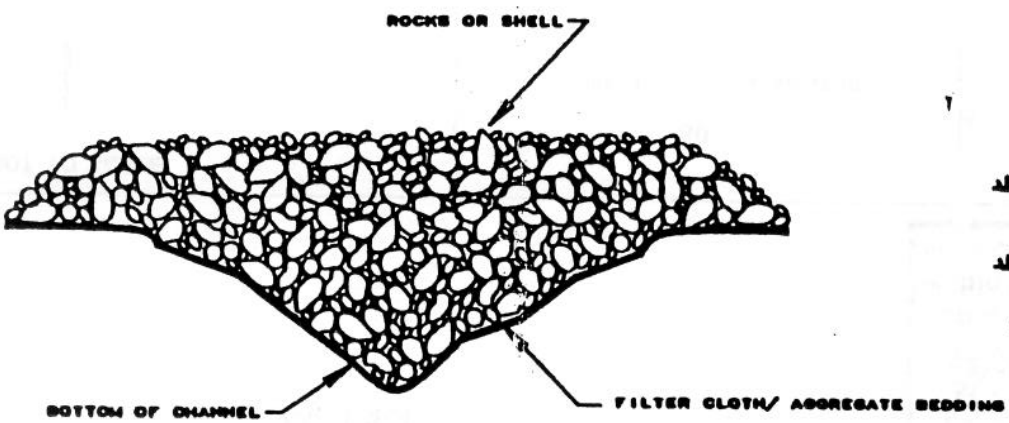
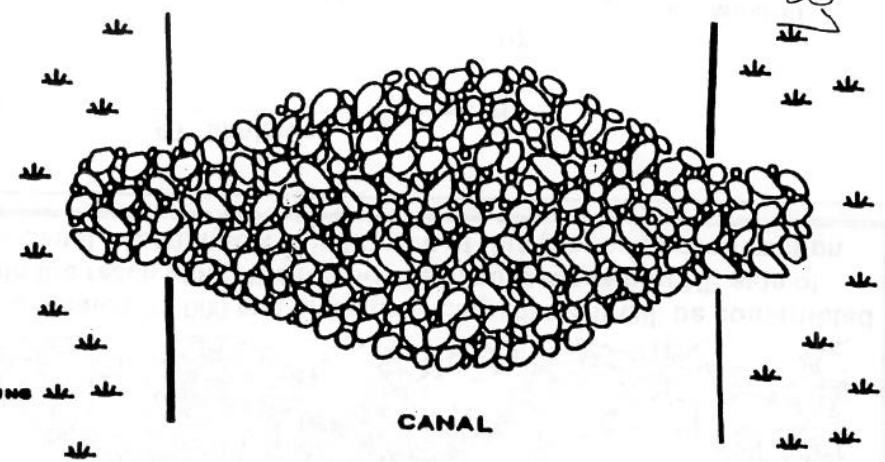
TYPICAL DRAWING
ROCK PLUG



ELEVATION VIEW
NOT TO SCALE



PLAN VIEW
NOT TO SCALE

Brady Canal
Hydrologic Restoration
ES-7 Rock Riprap Plug
4,375 cu. yd.
Terrebonne Parish, La.

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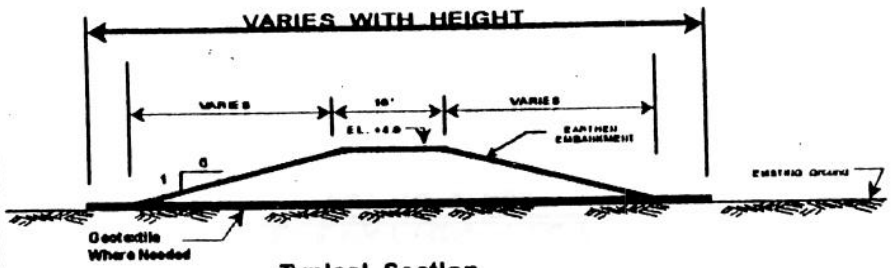
EARTHEN EMBANKMENT
SECTION A - A

Dist Tem Pgh. Wtb 1087

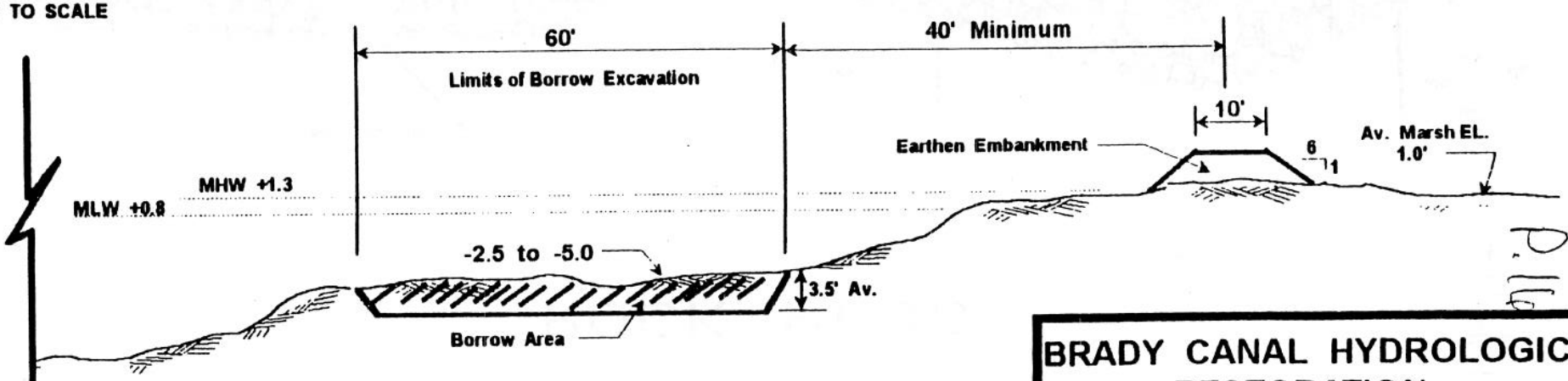


Typical Section

LOCATION MAP

Approximately 15,000 feet of Earthen Embankment will be constructed within the reach along the N side of Bayou DeCade and NE side of Voss Canal. Section A-A is indicative of this proposed construction.

NOT TO SCALE



Typical Profile

Notes:
1. All Elevations Shown in N.G.V.D.
2. Total Length of Earthen Embankment - 15,000 Feet.
3. Total Volume of Earthen Embankment Fill - 60,300 Cubic Yards.
4. Borrow Material to be Taken from Bayou DeCade and Voss Canal.

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BRADY CANAL HYDROLOGIC RESTORATION

DETAILS - EARTHEN EMBANKMENT
SECTION A - A

TERREBONNE PARISH, LA

SLW (Terr. Psh. Wtlo.) 11287

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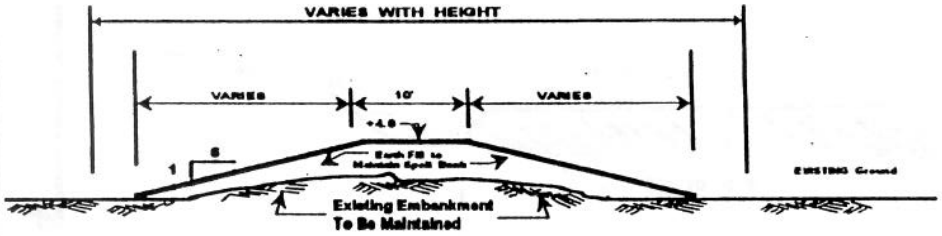
SPOIL BANK MAINTENANCE
SECTION B - B

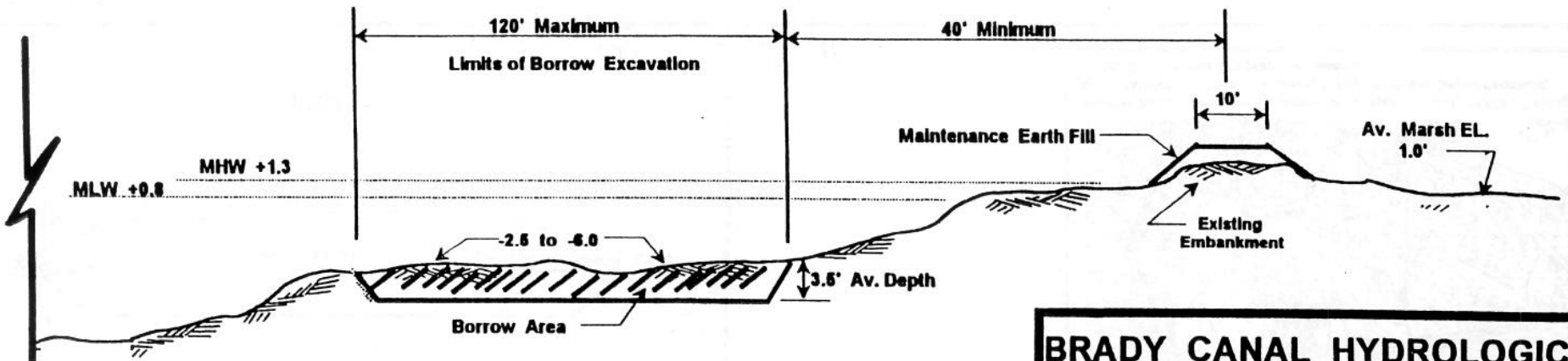


Typical Section

LOCATION MAP

Spoil Bank Maintenance is proposed for approximately 63,000 LF along Superior Canal, Turtle Bayou, Bayou DeCade, and Jug Lake. Section B-B depicts this proposed construction.

NOT TO SCALE



Typical Profile

Notes:
1. All Elevations Shown in N.G.V.D.
2. Total Length of Earthen Embankment to be Maintained- ~~44,000 Feet~~ 50,000 Feet This Length Does Not Include Lake Shore of Jug Lake. With Jug Lake Shoreline - Total Length Approximately ~~63,000 Feet~~. 69,000 Feet.
3. Estimated Annual Volume of Maintenance Earth Fill - ~~15,300 Cubic Yards~~. 16,800 cubic yards
4. Borrow Material to be Taken from Superior Canal, Bayou DeCade, Turtle Bayou, Jug Lake, and Voss Canal.

BRADY CANAL HYDROLOGIC RESTORATION

Spoil Bank Maintenance
Section B - B

TERREBONNE PARISH, LA

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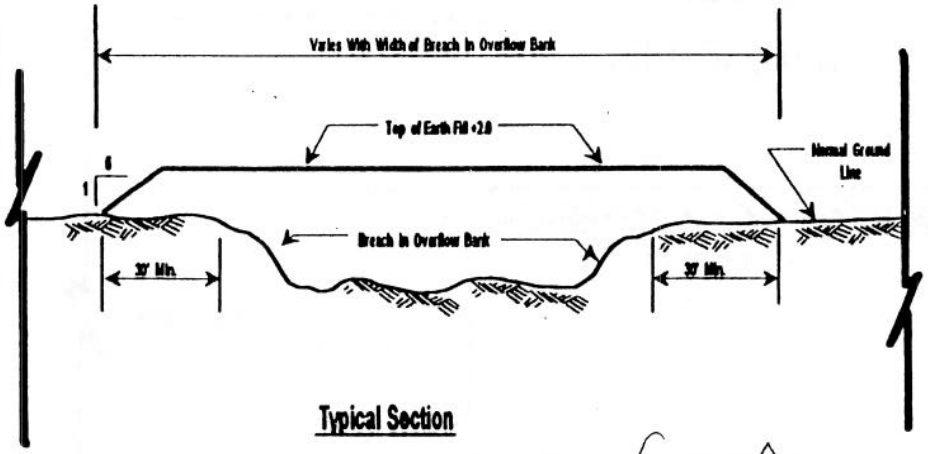
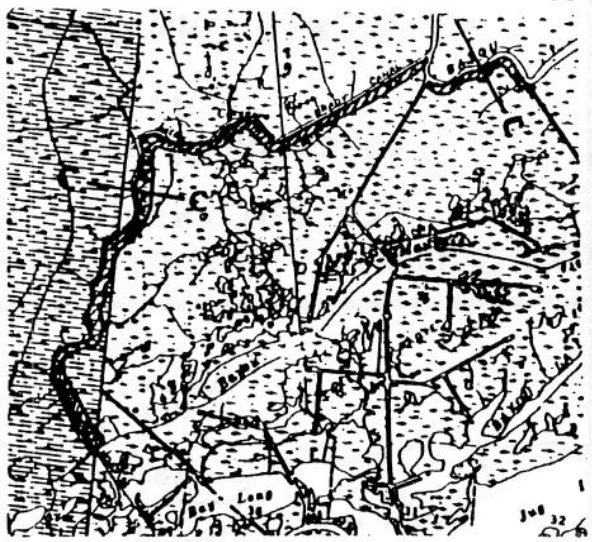
OVERFLOW BANK MAINTENANCE
SECTION C - C



Typical Section

Vicinity Map



Overflow Bank Maintenance is proposed for approximately 29,600 LF along Bayou Carencro, L. Bayou Carencro, Brady Canal, and Bayou Penchant. Section C - C depicts this proposed measure.

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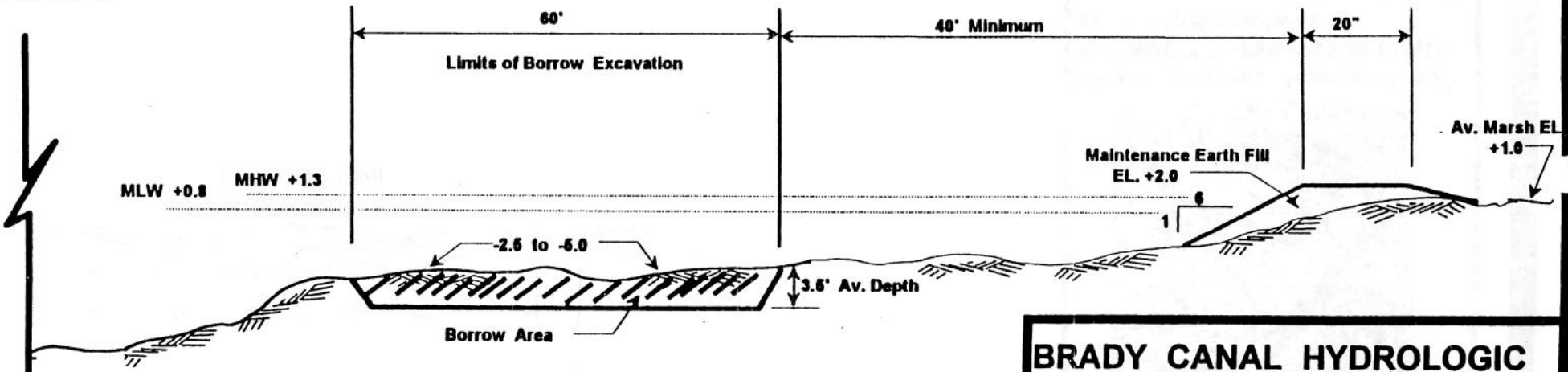

Typical Profile

Notes:
1. All Elevations Shown In NGVD
2. Total Length of Earthen Embankment to be Maintained- Approx. 29,600 Feet. Along Bayou Carencro, Little Bayou Carencro, Brady Canal, and Bayou Penchant..
3. Estimated Annual Volume of Maintenance Earth Fill for Overflow Banks - 1590 Cubic Yards Based on Repairing 300' of Bank per Year.
4. Borrow Material to be Taken from Adjacent Canal or Bayou.

BRADY CANAL HYDROLOGIC RESTORATION

Overflow Bank Maintenance

Section C - C

TERREBONNE PARISH, LA

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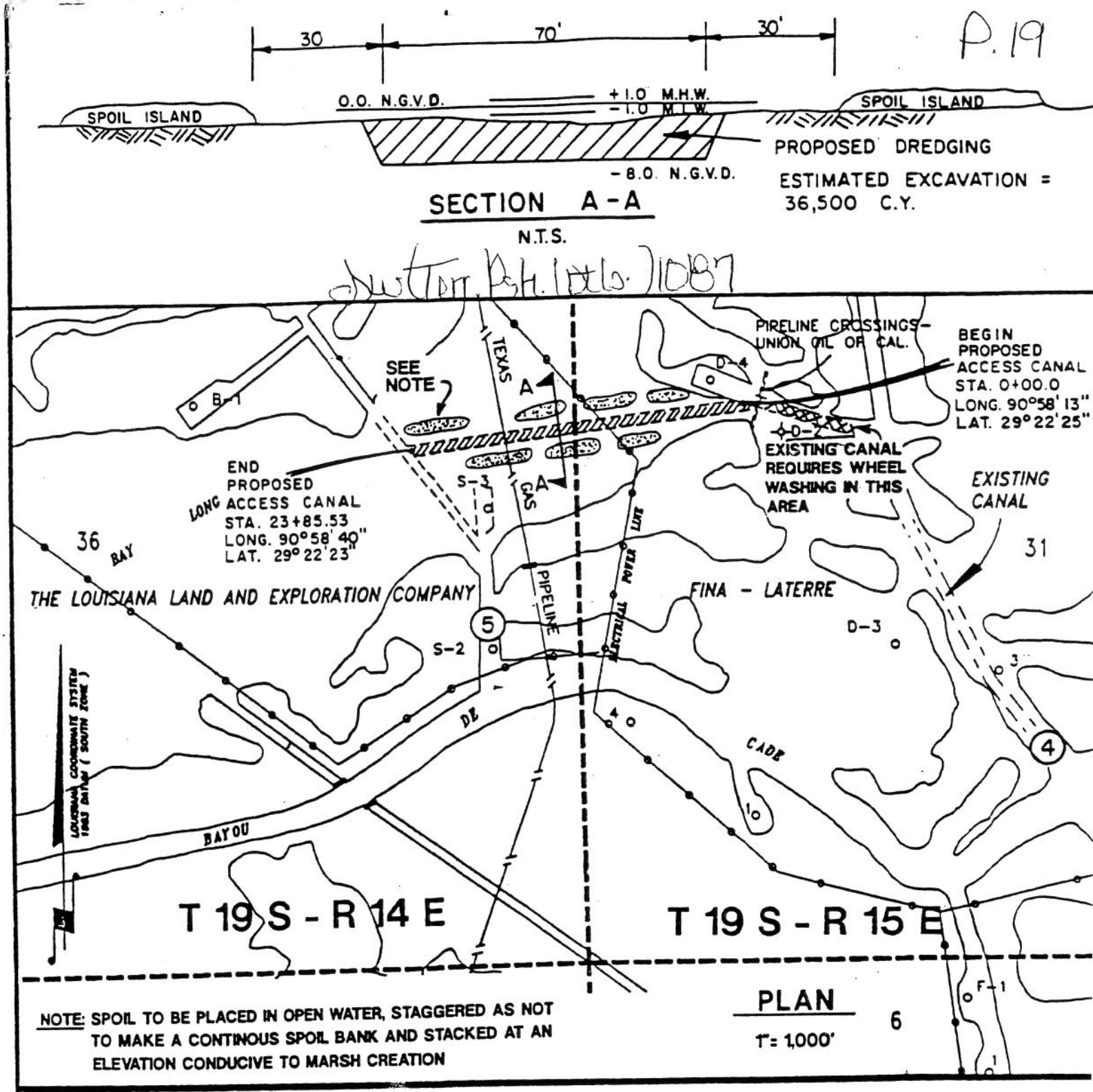

PROPOSED ACCESS CANAL TO BE DREDGED IN CONJUCTION WITH THE BRADY CANAL HYDROLOGIC RESTORATION PROJECT LOCATED IN SECTION 31, T19S - R15E AND SECTION 36, T19S - R14E, TERREBONNE PARISH, LA.

RECEIVED
USDA-SCS MAIL ROOM
JUL 18 11 25 AM '96

FINAL

PROJECT PLAN
AND
ENVIRONMENTAL ASSESSMENT

FOR

BRADY CANAL HYDROLOGIC RESTORATION

PTE-26b

TERREBONNE PARISH, LOUISIANA

Prepared by:

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BRADY CANAL HYDROLOGIC RESTORATION

PTE-26B

TERREBONNE PARISH, LOUISIANA

PROJECT PLAN AND ENVIRONMENTAL ASSESSMENT

JANUARY 1996

Abstract:

This Environmental Assessment (EA) describes the proposed structural measures and operational plan to reduce wetland loss in the Brady Canal area wetlands in Terrebonne Parish, Louisiana. The recommended plan consists of a bulkhead with a boat bay and two flapgated stoplog sections, a fixed crest weir with a barge bay, fixed crest weirs with variable crest sections (3), a fixed crest weir, 315 feet of rock plug (1), stabilized channel cross-sections (rock) (2), approximately 15,000 feet of shore and earthen embankment, and maintenance of all banklines surrounding the project area.

The project is anticipated to enhance 188 acres of fresh, intermediate, and brackish marsh through greater utilization of introduced freshwater and sediment, and improved hydrologic conditions. Land loss rates will be reduced and approximately 306 acres of emergent vegetation will be protected.

Local sponsors will provide 25 percent of the total funding. A potential negative impact anticipated as a result of the project is a possible reduction in estuarine organism access. This should be offset by the increased production of emergent vegetation, protection of emergent wetlands, and related production of detrital organics and food chain organisms.

This document has been prepared under authority of the Coastal Wetlands Planning, Protection, and Restoration Act of 28 November 1990, House Document 646, 101st Congress. It is intended to fulfill the requirements of the National Environmental Policy Act for the project to be funded under the authorization of Public Law 101-646.

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SUMMARY OF PLAN/EA

Project Name: Brady Canal Hydrologic Restoration (PTE-26b)

Parish: Terrebonne

State: Louisiana

Sponsor: U.S. Dept. of Ag., Natural Resources Conservation Service

Description of Recommended Plan:

The preferred plan will maintain and enhance existing marshes in the project area by reducing the rate of tidal water exchange and improving the utilization of introduced freshwater and sediment. The proposed project includes the replacement or maintenance of weirs, construction of a rock plug, stabilized channel cross-sections, and restoration and maintenance of channel banks. Freshwater and sediment introduction from adjacent channels is provided for through overbank flow and structures along the north, east, and west sides of the project area. Bank restoration and structures will be used along the southern boundary to reduce rates of tidal water exchange in order to prevent expansion of tidal channels into interior ponds and improve freshwater and sediment retention.

Resource Information:

Size of Project: 7,653 acres

Land Ownership: Private

Wetlands

Coastal Fresh Marsh
Coastal Intermediate Marsh
Coastal Brackish Marsh
Scrub/shrub

Threatened and Endangered Species

No known locations of threatened or endangered species exist within the project area.

Cultural Resources

Site # 16 TR 46
Site # 16 TR 113
Site # 16 TR 217

Problem Identification:

Human-induced hydrologic changes
Subsidence

Alternative Plans Considered:

No Action
Hydrologic Restoration

Project Purpose:

Reduce wetland loss rates, enhance existing emergent wetlands, and increase submerged aquatic vegetation.

Principle Project Measures:

Bulkhead with boat bay and two flapgated variable crest sections (1)
Fixed crest weir with barge bay (1)
Fixed crest weir with variable crest section(s) (3) (replacement of existing structures)
Fixed crest weir (1) (replacement of existing structures)
Rock plug (1) (315 feet)
Stabilized channel cross-section (rock) (2)
Earthen embankment (15,000 feet)
Maintenance of existing overflow bank (21,600 feet)
Maintenance of shore and earthen embankment
Maintenance of existing structures

Project Benefits:

Primary:

Enhance 188 acres of emergent marsh
Protect 306 acres of emergent marsh by reducing rate of wetland loss
Increase the areal extent of emergent and submerged aquatic vegetation within the 7,653-acre project area

Secondary:

Improve fish and wildlife habitats
Increase recreational opportunities for fish- and wildlife-related sports

Potential Adverse Impacts:

Reduce cross-sectional area of some of the access openings for marine organism
Disturb wetlands during construction of the shore and earthen embankment and structures

INTRODUCTION

The Brady Canal Hydrologic Restoration project (PTE-26b) is evaluated in the following document to identify potential project impacts associated with the proposed measures. This Plan/EA is prepared in accordance with the National Environmental Policy Act of 1969 (NEPA). The following sections contain discussions of the problems, alternatives, the preferred alternative and its impacts, resources, and public participation.

The 7,653-acre project area (Figure 1) is located in the Terrebonne Basin, within the Penchant subbasin, approximately 20 miles southwest of Houma, Louisiana. The Penchant subbasin (Figure 2) is experiencing marsh deterioration and land loss due to numerous factors. The proposed project has been designed to restore a favorable hydrologic regime to the area and provide shoreline rehabilitation along the southern project boundary. The project goal is to maintain and enhance existing marshes in the project area while continuing to provide for oil and gas operations and other resource uses.

AUTHORITY

The Coastal Wetlands Planning, Protection, and Restoration Act of 28 November 1990 (CWPPRA), House Document 646, 101st Congress (PL 101-646), provides for the use of federal funds for planning and implementing projects that create, protect and enhance vegetated wetlands. The proposed Brady Canal Hydrologic Restoration project (PTE-26b), is included on the third priority list submitted to Congress in 1993 by the Louisiana Coastal Wetlands Conservation Restoration Task Force. Construction is authorized to begin as soon as all applicable regulatory and other legal requirements are met and project plans are finalized.

PURPOSE AND NEED FOR PROPOSED ACTION

PROJECT SETTING

The Brady Canal Hydrologic Restoration project (PTE-26b) is located within the Bayou Penchant - Lake Penchant watershed. The 7,653-acre project area contains fresh, brackish, and intermediate marshes and is bounded by Bayou Penchant, Brady Canal, and Little Carencro Bayou to the north, Bayou de Cade and Turtle Bayou to the south, Superior Canal to the east, and Little Carencro Bayou and Voss Canal to the west. The Mauvais Bois Ridge bisects the area and provides for a hydrologic differentiation between the northern and southern sections of the project area. The approximate center of the project area is Latitude 29° 52' 30" North, and Longitude 91° 29'30" West.

The project area consists of approximately 4,613 acres of marsh, and 2,660 acres of open water, with the remaining areas classified as "other" habitats (Louisiana Department of Natural Resources, Coastal Restoration Division, unpublished GIS data). The fresh, brackish, and intermediate marshes of the project area are typically adapted to an average salinity of 0 to 3 parts per thousand (ppt).

PROBLEMS AND OPPORTUNITIES

The area is subject to an average 31 acres per-year rate of wetland loss (Dunbar et al. 1992). The conversion of emergent vegetation to open water is largely attributable to

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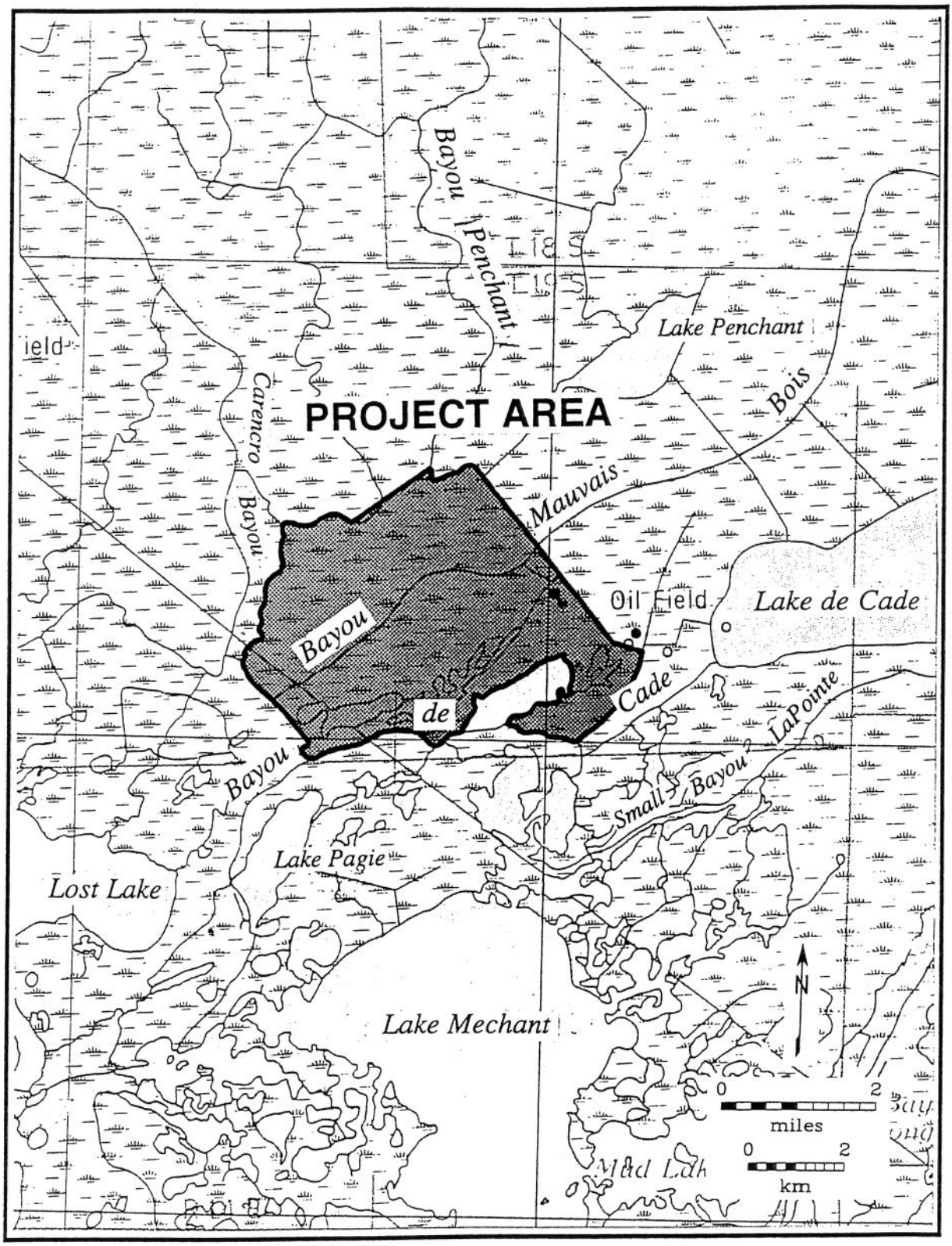

Figure 1. Location of the Brady Canal Hydrologic Restoration Project (PTE-26b).

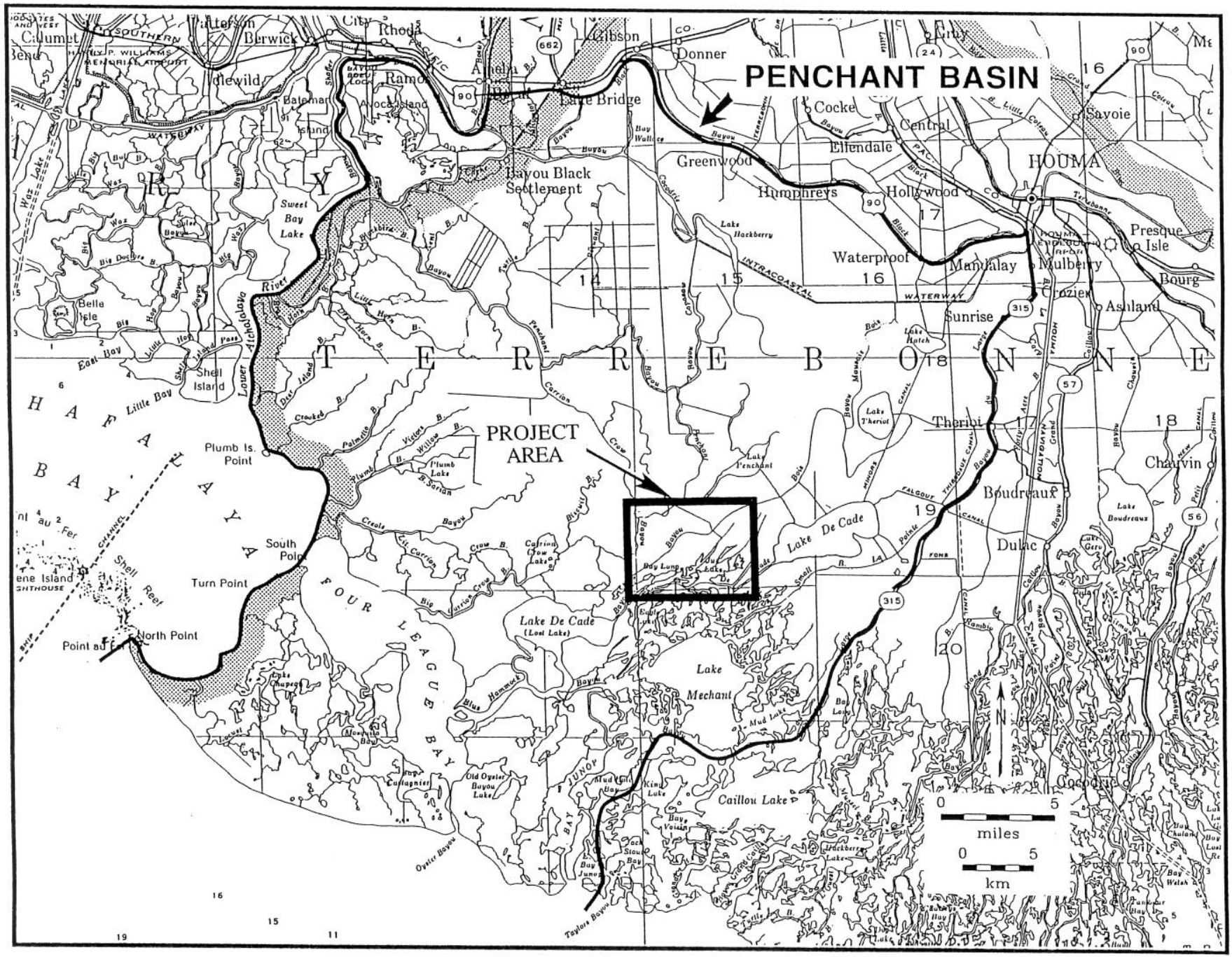

Figure 2. Location and geomorphologic features of the Penchant subbasin.

subsidence as well as human-induced hydrologic changes. Hydrologic changes include increased water levels as a result of relative subsidence; increased inundation related to the prograding delta system to the west; and increased rates of tidal water exchange associated with oil and gas canals, loss of natural bayou banks, and the loss of wetlands seaward of and within the project area. Within the present setting, all of these factors have an adverse effect on the highly organic soils and fresh to brackish vegetative communities.

A seasonal supply of sediment-laden fresh water from the Atchafalaya River allows enhancement of freshwater introduction and sediment retention into the project area. Natural and human-made landforms within the project area allow for management of water introduction and tidal water exchange. In combination, such management can provide for the amelioration of subsidence, erosion by tidal currents, and large rapid fluctuations of water levels and salinity, all of which contribute to marsh loss in the present setting.

PROJECT GOAL AND OBJECTIVES

The proposed project is to be implemented in order to maintain existing marshes in the project area. Marshes will be maintained by enhancing freshwater introduction and sediment retention within a highly fragmented transitional marsh along the western edge of the Mauvais Bois Ridge. The project will promote freshwater flow from Bayou Penchant into the marshes. Tidal water exchange rates will be decreased by reducing the channel cross-section of human-made and eroded natural channels. Channel banks will be restored to enhance sediment retention and prevent expansion of tidal channels into interior ponds.

SCOPE OF THE PROJECT PLAN/EA

SCOPING OF CONCERNS

Project concerns have been expressed by landowners in the area to the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS) during planning sessions for original marsh conservation projects in 1987. Although the importance of the concerns have increased in response to Hurricane Andrew's impact in 1992, the original concerns and desires still exist today, including maintenance and enhancement of existing vegetated wetlands, improved productivity, access for commercial and recreational fisheries, and continued oil and gas activities. These concerns vary in their importance among landowners, agencies, land users, and the public. NRCS formed an interdisciplinary team and solicited input from various agencies to consider all concerns in the evaluation and formulation of the project. Vegetated wetlands were considered the most important resource and given the highest priority.

FORECASTED CONDITIONS

Future conditions have been predicted through the CWPPRA Wetland Value Assessment (WVA) procedure with participation of all agencies involved in the CWPPRA process. The results can be found in the report prepared by the Coastal Wetlands Task Force for the third priority list (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993).

ENVIRONMENTAL SETTING AND EXISTING RESOURCES

PHYSICAL ENVIRONMENT

CLIMATE

Climatic conditions at the Brady Canal Hydrologic Restoration project (PTE-26b) area are governed by its proximity to the Gulf of Mexico and its wetland setting. The climate is categorized as humid subtropical with mild winters and hot, humid summers. More than a century of temperature and precipitation records (National Oceanic and Atmospheric Administration [NOAA] 1993) show an average summer temperature of 80.9 degrees Fahrenheit (°F), a winter average of 54.0 °F, and a mean annual temperature of 68.3 °F. Rainfall averages 62.91 inches per year with heaviest rainfall occurring in the summer months. Summer showers occur frequently and average monthly precipitation is highest in July.

Prevailing southerly winds during the summer months minimize the effects of high temperatures and produce conditions favorable for afternoon thunderstorms. During the winter months, the area is subjected alternately to the southerly flow of warm tropical air and the northerly flow of cold continental air for periods of varying lengths. The resulting frontal movements produce squalls and sudden drops in temperature, as well as significant changes in water levels in a short amount of time. Annual wind speed averages eight (8) to nine (9) miles per hour. Higher wind speeds occur during the passage of major storms and hurricanes. The latter have a major impact on the project area because of storm surges and associated inundation and erosion of the marshes. Tropical storms and hurricanes recur once or twice every three to seven years (USDA, SCS 1960).

GEOLOGY AND SOILS

Geologic Setting

The Brady Canal Hydrologic Restoration project area is located within the Penchant Basin of the Terrebonne deltaic complex in the south-central portion of the Mississippi River Delta Plain. The Penchant Basin occupies part of the overlapping area of the successively abandoned lobes of the Teche and Lafourche delta complexes and was formed between approximately 3,500 and 300 years B.P. (before present) (Wicker et al. 1980). The substrate is composed of Holocene deltaic sediments that overlie Pleistocene deposits at different depths up to 660 feet (Penland et al. 1989). The depth to the Pleistocene in the Brady Canal Hydrologic Restoration project area ranges from -225 to -275 feet (May et al. 1984). Compaction of these Holocene sediments, combined with structural movement related to geosynclinal setting and faulting, results in high rates of subsidence. Subsidence is offset only by the accumulation of organic materials and the introduction and retention of sediments. Recently, the project area has come under the influence of the active Atchafalaya delta complex that marks the western boundary of the Terrebonne basin.

The major physiographic features in the project area are a result of the geologic history and development of the most western portion of the Lafourche distributary system. The project area straddles the subsided natural levee ridges of one of the former Lafourche course's major distributary channels, Bayou Mauvais Bois, and extends into the adjacent interdistributary basins to the south and north. At one time, the Bayou Mauvais Bois distributary supplied the area with freshwater and sediments during annual river floods that offset the adverse effects of relative subsidence.

At present, the area is no longer adequately nourished by the sediment and water of the Mississippi River. Although the Atchafalaya River, a Mississippi River distributary, annually supplies freshwater and sediments to the Penchant Basin, distribution and retention are insufficient to offset the effects of subsidence and marine erosional processes. Consequently the area has become characterized by marsh erosion and deterioration, and dominated by tidal water exchange. Loss of physical integrity of the relatively firm and stable Mauvais Bois Ridge, and the natural levees of lesser channels, that form the skeletal framework for the fragile wetlands occupying the interdistributary basins, is resulting in rapid conversion of wetlands to open water.

Relative Sea Level Rise

Relative sea level rise, composed of subsidence and sea level rise, is a major contributing factor to wetland loss in the project area and is measured at approximately 1.29 centimeters or 0.51 inches per year (Penland et al. 1989). The rate of subsidence in the Terrebonne delta complex can be calculated by adjusting the relative sea level rise measurements with the eustatic correction factor (global sea level rise). The resulting subsidence rate in the Terrebonne Delta Plain, based on data from the same stations where relative sea level change was measured, and corrected for global sea level rise, is approximately 1.17 centimeters or 0.46 inches per year (Penland et al. 1989). This rate is considered the highest subsidence rate in coastal Louisiana. Because the most predominant factor controlling the rate of subsidence in the Mississippi River Delta Plain is the compaction of Holocene deposits, this high rate can be attributed to the thickness of the Holocene deposits in this area. The effect of subsidence is augmented by a global sea level rise of approximately 0.12 centimeters or 0.05 inches per year.

Distribution and Acreage of Soil Types

Soil types in the project area reflect both the geologic framework of distributary ridges and interdistributary basins, and the salinity variation from fresh to intermediate/brackish. The soils found in the project area have been recently mapped as Allemands, Bancker, Clovelly, Carlin, Kenner, Lafitte and Larose soils (NRCS 1994 - unpublished data). The Allemands and Clovelly soils constitute the majority of the soils in the project area. Figure 3 and Table 1 present the acreages and distribution of the soils within the project area respectively.

Approximately 40 percent of the soils are classified as soils associated with brackish marsh and occur predominantly south of the Bayou Mauvais Bois Ridge (e.g., Clovelly Muck Slightly Saline [CLA], Lafitte Muck [LFA], and Clovelly Muck Very Slightly Saline [CEA]). The largest area of fresh marsh soils south of the Bayou Mauvais Bois Ridge consists of Kenner Muck and occurs between the Bayou Mauvais Bois Ridge, Superior Canal, and Bayou La Loutre (Figure 3). Soils occurring north of the Bayou Mauvais Bois Ridge are predominantly fresh marsh soils (e.g., Allemands Muck [AEA] and Larose Muck [LRA]).

The distribution of soils in the project area clearly indicates the importance of the Mauvais Bois Ridge as a hydrologic boundary. Loss of physical integrity of the ridge and adjacent wetlands to the south provides for intrusion of saline waters into the project area and the gradual progression of fresh to brackish marsh because of increasing tidal influence along a network of canals and evolving channels.

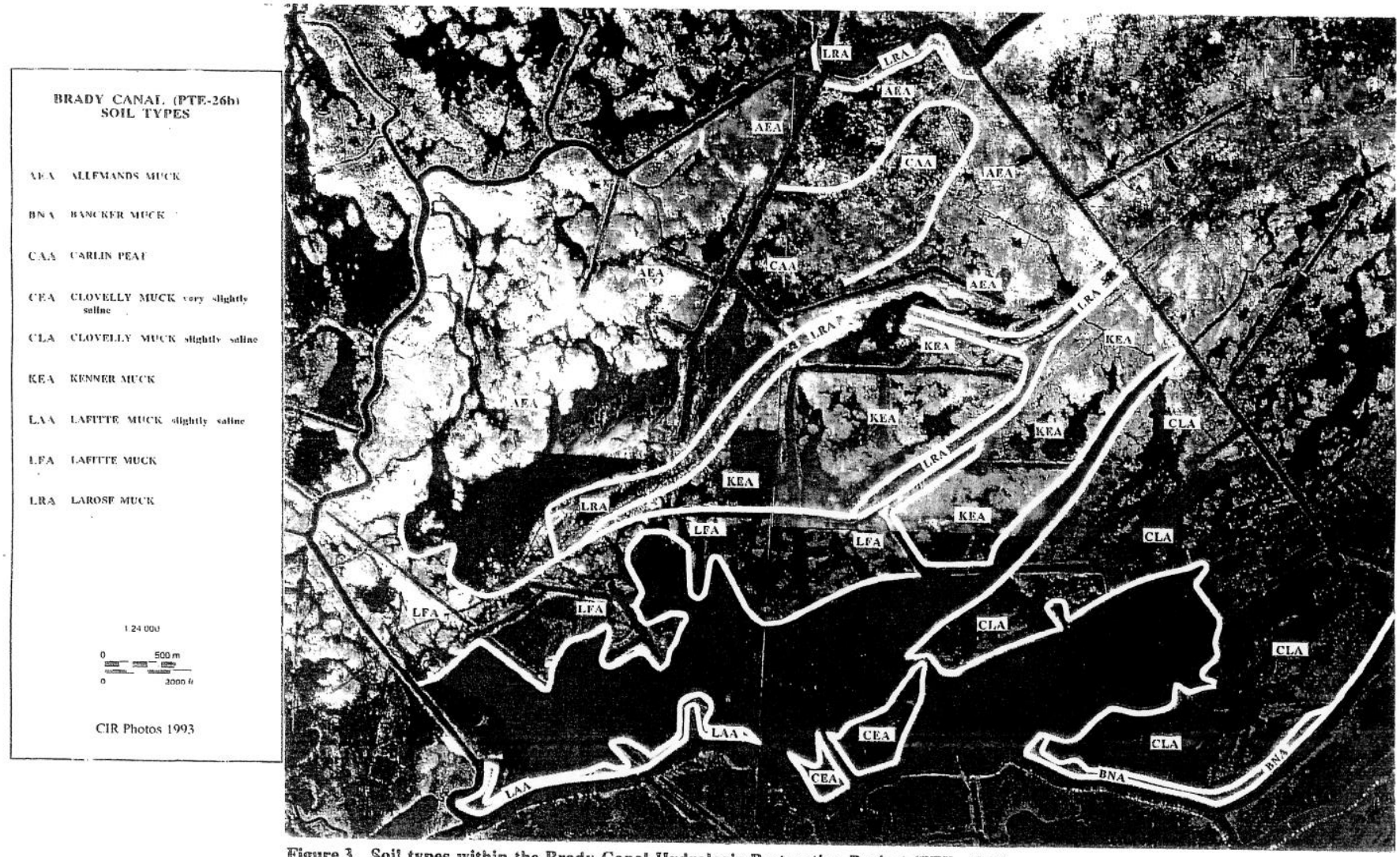

Figure 3. Soil types within the Brady Canal Hydrologic Restoration Project (PTE - 26b) area (NRCS 1994).

Table 1: Acreage and Proportionate Extent of the Soils in the Project Area (NRCS 1994 - unpublished data).

Map Symbol	Soil Name	Marsh Type(1)	Acres(2)	Percent of Total Soil
AEA	Allemands Muck	(F)	2,200	34.9
BNA	Bancker Muck	(B)	100	1.6
CAA	Carlin Peat	(FL)	350	5.6
CEA	Clovelly Muck Very Slightly Saline	(B)	100	1.6
CLA	Clovelly Muck Slightly Saline	(B)	1,400	22.2
KEA	Kenner Muck	(F)	950	15.1
LAA	Lafitte Muck Slightly Saline	(B)	50	0.8
LFA	Lafitte Muck	(B)	800	12.7
LRA	Larose Muck	(F)	350	5.5
	Total Land		**6,300**	**100.0**
	Water		1,600	
	TOTAL AREA		**7,900**	

(1) F = Freshwater Marsh Soils
B = Brackish Marsh Soils
FL = Flotant Marsh Soils

(2) Acreages reflect preliminary calculation of soil types based on the draft soil map compiled by NRCS (1994 - unpublished data).

Soil Types

The following sections provide general descriptions of the soils in the project area and the soil conditions under which they developed and exist. Soil profile sheets are enclosed as Appendix A.

Freshwater Marsh Soils

Allemands Muck

This level, very poorly drained, semifluid, organic soil is generally located in freshwater marshes that are flooded and/or ponded most of the time. This soil formed in moderately thick accumulations of decomposed herbaceous material and underlying clayey

alluvium. Elevation ranges from approximately one (1) foot above sea level to five (5) feet below sea level and slope is less than 0.5 percent.

Typically, the surface layer is a very dark grayish-brown, slightly acid or neutral muck, 23 inches thick. The underlying material, to a depth of 55 inches, is gray and dark gray, neutral and moderately alkaline clay and mucky clay.

This soil is flooded by freshwater to depths of six (6) to 12 inches most of the time. During storms, floodwaters are as deep as two (2) feet. The water table is commonly at or above the surface, but during periods of sustained north wind and low gulf tides, the water table is as much as six (6) inches below the soil surface. This soil has a low load bearing capacity. The permeability is rapid in the organic surface layer and very slow in the clayey underlying material. Total subsidence potential is high.

Kenner Muck

This level, very poorly drained, organic soil generally occurs in freshwater marshes which are ponded and/or flooded most of the time. The soils formed in herbaceous material. Elevations range from sea level to about one (1) or two (2) feet above sea level. Slope is less than 0.5 percent.

Typically, the Kenner soil surface layer is a dark brown and very dark grayish-brown, and slightly acid muck to a depth of about ten (10) inches. The underlying soil layers, to a depth of about 65 inches, are dark brown and very dark grayish-brown, neutral, and moderately alkaline muck. These layers have thin strata of clay. The underlying material, to a depth of about 70 inches, is very dark grayish-brown, mucky clay.

This Kenner soil is almost continuously flooded with several inches of freshwater. During storms, floodwaters are as deep as two (2) feet. During periods when the soil is not flooded, the seasonal high water table ranges from one (1) foot above the surface to 0.5 foot below the surface. This soil has low strength and poor trafficability. Permeability is moderately rapid in the organic layers and very slow in the clayey layers. Total subsidence potential is very high.

Larose Muck

This soil type consists of very poorly drained, very slowly permeable semifluid, mineral soils that formed in thin, herbaceous muck over clayey alluvium. This soil generally occurs in freshwater marshes that are ponded and/or flooded most of the time. Elevation ranges from sea level to about one (1) foot above sea level. Slope is less than 0.2 percent.

Typically, the surface layer consists of dark gray, very fluid clay about six (6) inches thick. The underlying material to a depth of about 60 inches is gray, very fluid clay in the upper part and greenish gray, slightly fluid clay in the lower part. In some places, the surface layer is muck.

This soil is flooded most of the time by freshwater, and it is saturated throughout the year. During non-flood periods, the seasonal high water table ranges from one (1) foot above the surface to 0.5 foot below the surface. Water and air move through this soil very slowly. This soil has moderate subsidence potential.

This level, very poorly drained, semifluid, mineral soil is generally located in brackish marshes that are ponded and/or flooded most of the time. Areas classified as Bancker Muck

are long and narrow, comprise several hundred acres, and generally parallel the natural waterways. Slope is less than 0.5 percent.

Brackish Marsh Soils

Bancker Muck

Typically, the surface layer is a very dark gray, moderately alkaline, semifluid muck about two (2) inches thick. Underlying this surface layer, to a depth of about 17 inches, is a dark gray, moderately alkaline, semifluid mucky clay soil layer. In general, below these top layers of muck and mucky clay is a layer of dark gray, moderately alkaline, semifluid clay to a depth of about 84 inches. In some places, however, the underlying material below a depth of about 40 inches is gray, semifluid fine sand or loamy sand.

This Bancker soil is flooded with several inches of saltwater most of the time. During storms, tides from the Gulf of Mexico cover this soil with two (2) or three (3) feet of water. During periods when the soil is not flooded, the water table ranges from one (1) foot above the surface to 0.5 foot below the surface. This soil has low strength and poor trafficability. The shrink-swell potential is very high. Permeability is very slow. The total subsidence potential is medium.

Clovelly Muck

This level, very poorly drained, very slowly permeable soil formed in moderately thick accumulations of herbaceous organic material overlying very fluid clayey river sediments. This soil generally occurs in brackish coastal marshes that are ponded or flooded most of the time. Elevation ranges from sea level to about one (1) foot above sea level.

Typically these organic soils have two layers. The surface layer ranges in depth from zero (0) to six (6) inches and is very dark grayish-brown in color. The underlying organic layer ranges from six (6) to 40 inches and is very dark brown. Both of these organic layers are classified as muck. These mucky organic layers have underlying mineral materials with depths ranging from 16 to 51 inches from the surface. The upper portion of the mineral layers are dark grayish clays followed by greenish gray clays.

The soil has low strength and poor trafficability. Permeability is rapid in the organic layers and very slow in the clayey layers. Total subsidence potential is very high if the organic and mineral layers are allowed to dry.

Lafitte Muck

This soil is a level, very poorly drained, semifluid organic soil which formed in decomposed herbaceous plant materials. Areas classified as Lafitte Muck are ponded or almost continuously flooded. The elevation ranges from sea level to about one (1) foot above sea level.

Typically, this organic soil has two layers. The surface layer ranges in depth from zero (0) to 12 inches and is dark brown in color. The underlying organic layer ranges in depth from 12 inches to 56 inches and is black in color. Both of these organic layers are classified as muck. These mucky organic layers have underlying mineral materials with depths ranging from 51 to 100 inches from the surface. The upper portion of the mineral layers are dark gray clays followed by dark gray silty clay loams.

Trafficability of this soil is low due to its low strength. The permeability is generally rapid in the organic surface layer and very slow in the lower mineral clayey layers. If the organic surface layers are allowed to dry, the subsidence potential is high with the organic material shrinking to about half of its original thickness with further subsidence occurring as a result of oxidation and compaction.

Flotant Marsh Soils

Carlin Peat

This is a level, very poorly drained peat soil that occurs in large areas of "floating" marshes. The surface layer is a very dark grayish-brown peat about 12 inches thick overlaying a very dark grayish-brown mucky peat. The fibrous peat surface layer floats on a layer of water. Thickness of water layers varies with the water level in adjacent bodies of water, resulting in a fluctuating surface elevation

This Carlin soil is strongly acid to neutral in the surface layer and grades to moderately alkaline in the lower layers. Permeability is rapid, but there is little movement of air because the water table is high. There is no internal drainage, and runoff is very slow. The water table is high, and trafficability is poor. Subsidence and increased acidity occur when this soil is drained. Dikes and drainage ditches are extremely difficult to construct and maintain because the organic material is not stable.

HYDROLOGY

Hydrologic Setting

The Brady Canal Hydrologic Restoration project lies within the Bayou Penchant - Lake Penchant Watershed area and is composed of fresh, intermediate, and brackish marsh. Hydrologic boundaries of the project area consist of Bayou Penchant, Brady Canal, and Little Carencro Bayou to the north; Bayou de Cade and Turtle Bayou to the south; Superior Canal to the east; and Little Bayou Carencro and Voss Canal to the west. The hydrologic conditions within the project area are affected by the hydrology of the entire Penchant Basin which has undergone major changes during the last century, resulting in a very complex hydrologic setting.

The natural hydrologic setting of the Penchant Basin is that of a predominantly freshwater basin confined by the natural levee ridges of Bayous Boeuf and Black to the north, and the Marmande and Mauvais Bois ridges to the southeast and east. The basin is open to the west and southwest where it connects with the Lower Atchafalaya River, Atchafalaya Bay, and Fourleague Bay. Historically, this provided for an estuarine system in which freshwater introduction and retention in the upper basin counteracted tidal water exchange with the bays and provided for low energy conditions, high accumulation of organic materials, and development of highly organic and fragile marsh soils.

The hydrologic conditions within the Penchant Basin have been modified over time by the construction of numerous canals, levees, local water management structures, and major public works projects. After leveeing of the Mississippi River, the largest projects affecting the hydrology in the basin were the construction of the Atchafalaya Basin Floodway; the Avoca Island levee along the Lower Atchafalaya River, the Gulf Intracoastal Waterway (GIWW), the Bayous Chene, Boeuf, and Black Project, the rock weir at the Wax Lake Outlet, and the Houma Navigation Canal.

The Atchafalaya River water historically contributed freshwater, sediment, and nutrients to the Penchant Basin through the diversion of flood waters into Bayou Cocodrie via Bayou Boeuf at Morgan City, and into Bayou Penchant via Bayou Shaefer and Bayou Chene. After construction of the Atchafalaya Basin Floodway and Bayou Boeuf Lock on the GIWW, contribution of Atchafalaya River water to the basin became limited to diversion of flood waters via Bayou Chene, the diversion point located furthest downstream. Additional downstream displacement of the diversion point followed with the construction of the Avoca Island Levee that accompanied construction of the Bayous Chene, Boeuf, and Black Project. These changes are believed to have initially diminished freshwater and sediment diversion to and freshwater retention in the Penchant Basin. Subsequent increases in Atchafalaya River stages appear, however, to have mitigated the effects of these changes as indicated by a shift toward fresher habitats in the Brady Canal area. The recent removal of the Wax Lake Outlet weir is expected to reduce the amount of fresh water flowing through the Lower Atchafalaya River. It is not yet known if this will reverse the freshening effects in the Brady Canal area.

Hydrologic conditions in the northern portion of the Penchant area, were greatly altered in the late 1940's when the GIWW was dredged. The GIWW extended the Atchafalaya River's influence to areas east of the Penchant basin and intercepted freshwater drainage from the areas to the north of the GIWW. Additional changes in the basin's hydrology resulted when the Houma Navigation Canal was excavated in the 1960's. This channel connects the Gulf of Mexico with the GIWW at the city of Houma, and with the project area via the Falgout Canal. The Houma Navigation Canal modified hydrologic conditions throughout the Terrebonne deltaic complex, particularly with regard to tidal water exchange and related salinities.

In addition to these large-scale projects that changed the basin's hydrology, numerous smaller canals were dredged from the 1800's to the mid-1900's. While these canals were dredged to improve drainage or accommodate small boat access, they also resulted in linking non-tidal or low-energy tidal areas to areas affected by tidal action. Examples of these canals include Minor's Canal, Hanson Canal, and Peoples Canal. In the 1940's to 1970's many canals were dredged by the oil and gas industry in the interior of the area for access and production. Some of these canals intersect the natural, complex, hydrologic network that had evolved with the formation of the Terrebonne delta complex. The resultant breaching of natural hydrologic barriers added a strong coastwise flow component to what was predominantly a southward water movement and accelerated the linkage of freshwater distribution channels to tidal channels, thereby reducing freshwater retention, accelerating tidal water exchange and related erosion of the predominantly very fragile organic soils of the interior marshes, and facilitating saltwater intrusion. Canal plugs, levees, and water control structures have been constructed, particularly in the adjacent Lake de Cade area, to ameliorate these adverse hydrologic changes.

Currently, within the project area, water movements are passively controlled with weirs and plugs. Figure 4 and Table 2 indicate the locations of the existing structures and planned project features. Project features are identified numerically according to NRCS Evaluation Site (ES) that were used for environmental characterization of the project area during the planning phases of the project. All of the fixed crest weirs shown on Figure 4, except at location ES 3, currently have timber fixed-crest weirs on them; ES 3 contains a variable crest weir. Project weirs will replace the old structures and add features which allow management flexibility if necessary. Plugs currently exist at several locations along canals. The hydrology is modified by the existing structures especially in Conservation Treatment Unit (CTU) 2. Loss of the banks along Bayou de Cade also have greatly affected the project area's hydrology.

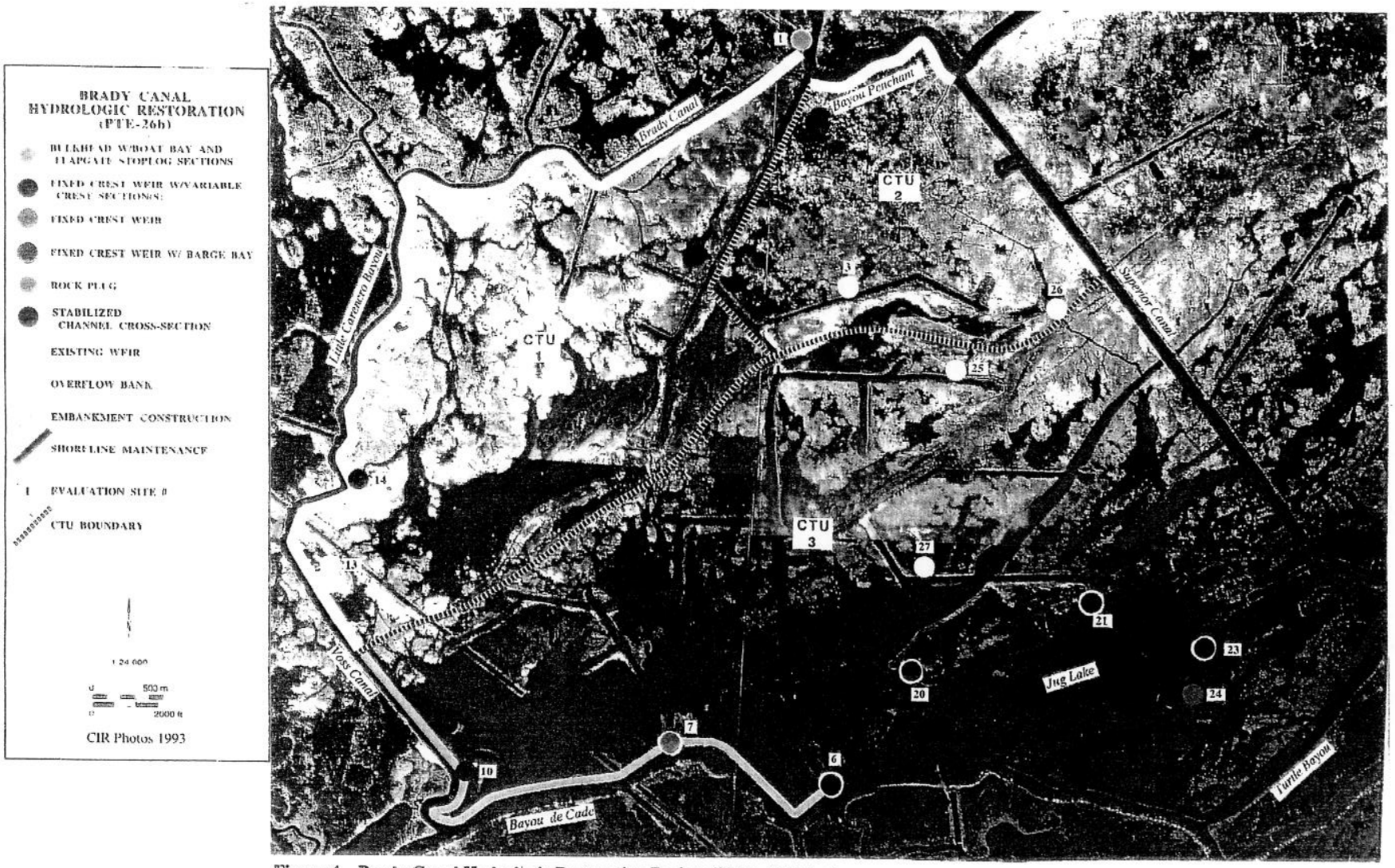

Figure 4. Brady Canal Hydrologic Restoration Project (PTE - 26b) features map.

Table 2: Existing Structures and Proposed Project Features Within the Brady Canal Hydrologic Restoration Project Area.

Evaluation Sites	Channel		Existing Structure			Proposed Structure		
	Width (ft)	Depth (ft)	Type	Crest Elevation (ft MML)	Crest Width (ft)	Type	Crest Elevation (ft MML)	Crest Width (ft)
1	112	20	**Fixed Crest Weir**	-0.5	60	**Bulkhead**	+0.5	120
			Boat Bay	-5.0	8	Boat Bay	-6.5	10
						Flap Gates/Stoplog	from -0.5 to -0.6	12
3			**Var. Crest Weir**	to -1.4	12			
6	285	8.4				**Fixed Crest Weir**	-0.5	145
						Barge Bay	-8.5	70
7	315	8				**Rock Plug**	?.?	8
10	225	10.9				**Channel Armor**		
14	40	7.8	**Fixed Crest Weir**	-1.0	33	**Fixed Crest Weir**	-1.0	36
						Var. Crest Section	from -1.0 to -6.0	6
20	160	9				**Channel Armor**		
21			**Fixed Crest Weir**	-1.0	48	**Fixed Crest Weir**	1.0	30
						Var. Crest Sections	1.0-6.0	18
22			**Earthen Plug**					
23			**Fixed Crest Weir**	-1.0	40	**Fixed Crest Weir**	-1.0	46
			Var. Crest Section		16	Var. Crest Section	from -1.0 to -6.0	12
24			**Fixed Crest Weir**	-2.0	80	**Fixed Crest Weir**		
						Section 1	-1.0	30
						Section 2	-2.5	50
25			**60" Pipe**					
			Sluice gate					
			Flapgate					
26			**Fixed Crest Weir**		16			
27			**42" Pipe**					
			V. crest weir inlet		6			
			Flapgate					

Water and Sediment Introduction

Freshwater and sediment introduction into the Penchant Basin, north of the Bayou Mauvais Bois-Marmande Ridges, are largely governed by the Lower Atchafalaya River. During high water stages of the river, water flows north through the Avoca Island Cutoff and eastward into Bayou Penchant, and into the GIWW toward the Houma Navigation Canal. Water and sediments from the Atchafalaya River are distributed further into the interior of the basin through an extensive network of canals and bayous. Sediment distribution is additionally facilitated by overbank flow from these canals and bayous when water levels are elevated as a result of high Atchafalaya River discharges. Elevated water levels during high Atchafalaya River discharges also are contributed to by the enclosed nature of the upper and middle Penchant Basin, and by periods of sustained onshore winds. Lesser sediment contributions into this part of the basin are provided indirectly through tidal water exchange via Atchafalaya Bay and Fourleague Bay.

Water circulation in the Penchant Basin south of Bayou Penchant and the Bayou Mauvais Bois-Marmande Ridges, is strongly influenced by tidal conditions. Tidal exchange rates appear to have been substantially increased as a result of the numerous hydrologic alterations in these areas, especially the loss of wetlands in the lower zone. In parts of the basin, water levels during the winter months may fluctuate as much as two (2) to three (3) feet in a matter of hours as the tide changes. This high rate of tidal water exchange tends to keep sediment particles suspended, reduce sediment retention by marsh vegetation, and minimize the sediment utilization required to maintain the system relative to the effects of sea level rise and subsidence.

The hydrology of the Brady Canal Hydrologic Restoration project area mirrors that of the surrounding basin. The area north of the Mauvais Bois Ridge still reflects to some extent the historically low energy conditions of the flotant marshes that make up much of the upper and middle Penchant Basin. To the south of the Mauvais Bois Ridge, the area has become increasingly tidally influenced as a result of wetland loss. In the northern portion of the project area, freshwater and sediment introduction are still provided to a large extent through overbank flow from Bayou Penchant, Little Carencro Bayou, and Brady Canal. This condition is prevalent especially in the northeastern portion of the project area where the eastern section of the Mauvais Bois Ridge appears to be an adequate barrier to retard the outflow of freshwater. The northwestern portion of the project area, however, has become increasingly subject to throughflow. Deterioration of the western segment of the Mauvais Bois Ridge and the loss of wetlands to the south of the ridge increasingly allow water, introduced through overbank flow and via an oil field canal, to flow through the area at increased velocities and with reduced utilization of water and sediment.

In the southern portion of the project area, freshwater and sediment utilization has diminished to an even greater extent. After crossing the ridge, water discharges into broken marsh and shallow open water area, and subsequently through natural and human-made channels into Bayou de Cade along the southern boundary. The rapid removal of freshwater and sediment results from the combination of largely unimpeded throughflow and tide-driven water movement. The area has been changed from a low energy system to one that is driven by tidal exchange with decreased retention of freshwater and sediments. Tidal influences derive from the connection of Bayou de Cade eastward with the Falgout and Houma Navigation Canals, and westward with Lake Mechant and Fourleague Bay. Tidal water movement has been further intensified by the recent wetland losses in the Raccourci area to the south and the resultant loss of hydrologic separation of the Brady Canal Hydrologic Restoration project area from Lake Mechant. An increase in water exchange rates and salinity fluctuations are believed to have been a major contributor to rapid wetland loss in this area,

especially within the southeast portion of the project area east of Jug Lake, and to the progression of loss into the area north of the Mauvais Bois Ridge.

Salinity

The fresh water input from the Atchafalaya River into the Brady Canal Hydrologic Restoration project area is responsible for maintaining relatively low levels of salinity throughout the project area. Salinity data are available for different time periods north and south of the Bayou Mauvais Bois Ridge. Between 1983 and 1985, Tenneco-LaTerre monitored salinities from the intersection of Superior Canal and Bayou Penchant - to the north of the Bayou Mauvais Bois Ridge. Their records show that most of the salinity readings did not exceed one (1) part per thousand (ppt) for the period of record. Exceptions to these salinity readings occurred in the months of September, October, and November for all three years. However, salinities never exceeded 3-4 ppt.

South of the Bayou Mauvais Bois Ridge, salinity data are available from a marsh management study being conducted by the National Biological Survey. Soil salinities are being measured at Bayou La Loutre and average salinities are available for different time periods between 1992 and 1994. The data indicate that for the majority of the recordings, average soil salinities did not exceed one (1) ppt. Average salinities exceeded two (2) ppt between July of 1992 and February of 1993.

Although available salinity data for the project area does not reflect a major difference between the environments north and south of the Bayou Mauvais Bois Ridge, the soils data, vegetative characteristics, and hydrologic regimes of these two areas do seem to indicate a higher salinity south of the ridge.

Water Levels

Water levels in coastal marshes are affected by tidal cycles and weather conditions (rainfall, frontal passages, storms, seasonality, etc.). Storm events such as hurricanes typically increase the natural water depth over the marshes for short periods. Flooding events will also contribute to greater than normal water level fluctuations in the coastal areas and have the potential of adversely impacting coastal marshes. From a long-term perspective, water levels are also affected by relative sea level rise. Sea level rise is contributing to a relatively slow but constant, long-term increase in water levels and imperceptible salt water intrusion throughout the coastal areas, thereby adversely impacting marshes.

Although historic water level measurements for the Brady Canal Hydrologic Restoration project area are not readily available, an overview of hurricane disturbances and flooding events that affected the central Louisiana coast depicts a general history of some major water level fluctuations in the Brady Canal region. Four major hurricanes have impacted the general project area in the last three decades: Hilda (September 1964), Betsy (September 1965), Juan (October 1985), and Andrew (August 1992). Storm surges associated with these hurricanes typically increased the water levels and brought salt water far into the interior marshes (Stone et al. 1993). Hurricane Andrew resulted in water depths of 2 to 3 feet over the marsh in the area of the project.

In addition to the introduction of higher water levels due to invasion of saline gulf waters during storm events, flooding from the Atchafalaya River has been noted to increase natural water depths in the project area, thereby adversely impacting the marshes. Excessive spring flooding due to high waters from the Atchafalaya River was reported in the mid-1970's.

Recent water level measurements within the Brady Canal Hydrologic Restoration project area are available from a tide gage used in a marsh management study being conducted by the National Biological Survey and from water level data recorded by Fina LaTerre, Inc. The National Biological Survey station is located in an area of broken marsh between Jug Lake and Bayou La Loutre; readings (January 1993 to December 1994) were normalized by taking an average marsh elevation (AME) at a number of locations within the vicinity of the gage. The Fina LaTerre, Inc. water level data were taken at two locations north of the Mauvais Bois Ridge and covered the periods 1983 - 1985 and 1989 - 1994.

Water levels recorded by Fina La Terre, Inc. at two gages located at the intersection of the Brady Canal and Bayou Penchant during the period of October, 1993, to September, 1994, are presented in Figure 5. The gages are located respectively on the Gulf (back) side and land (front) side of the weir with boat bay that currently exists in the Brady Canal at its intersection with Bayou Penchant. The record illustrates the seasonal trend of water levels related to the combination of Gulf water levels and Atchafalaya River discharge. The Atchafalaya River discharges result in sustained high water levels during the spring season, sometimes extending into early summer. Reduced Gulf water levels are responsible for low water levels during the winter season. Comparison of the two gage records also illustrates the hydraulic head that exists across the project area during the high water period. The gages furthermore illustrate the change in water level variability across the project area as related to dominance of tidal effects on the Gulf side of the Mauvais Bois ridge.

Correlation of water level data with daily rainfall from the Houma reporting station indicates that local precipitation has a relatively minor impact on water levels for the period of record. Tidal influence from gulf waters and possibly the river-water introduction from the north into the project area, as indicated by higher water levels in the spring, appear to have a more consistent impact on water levels than the rainfall.

WETLAND LOSS

Rates of Loss

Land loss data compiled by Dunbar et al. (1992) indicate that during the period from 1932 to 1990, about 1819 acres of land were converted to open water in the Brady Canal Hydrologic Restoration project area (Table 3). Approximately 52 percent of the land loss in the project area occurred over a 16 year time period between 1958 and 1974. Although the data indicate that the second highest total land loss occurred between 1932 and 1958 (477 acres), the average loss per year for this time period is only approximately 18 acres per year, i.e., the lowest for the period of record. In contrast, the average acres lost per year from 1983 to 1990 appears to indicate a renewed increase in land loss rates for the project area (31 acres per year).

Cause for Deterioration

Marsh deterioration in the project area is the result of both natural processes and human activities. Land loss rates vary depending on the relative magnitude of the causative factors and the geologic/geomorphological conditions of the area. In order to assess the relative importance of natural and human induced land loss in the project area, the land loss rates compiled by Dunbar et al. (1992) were further analyzed as shown in Table 4. However, because of mapping methodologies, wetland loss caused indirectly by human activities could not be broken out and is included with the loss caused by natural processes. Examples of indirect impacts of human activities include unintentional impoundment of wetlands by canal spoil banks and widening of canal banks as a result of erosion.

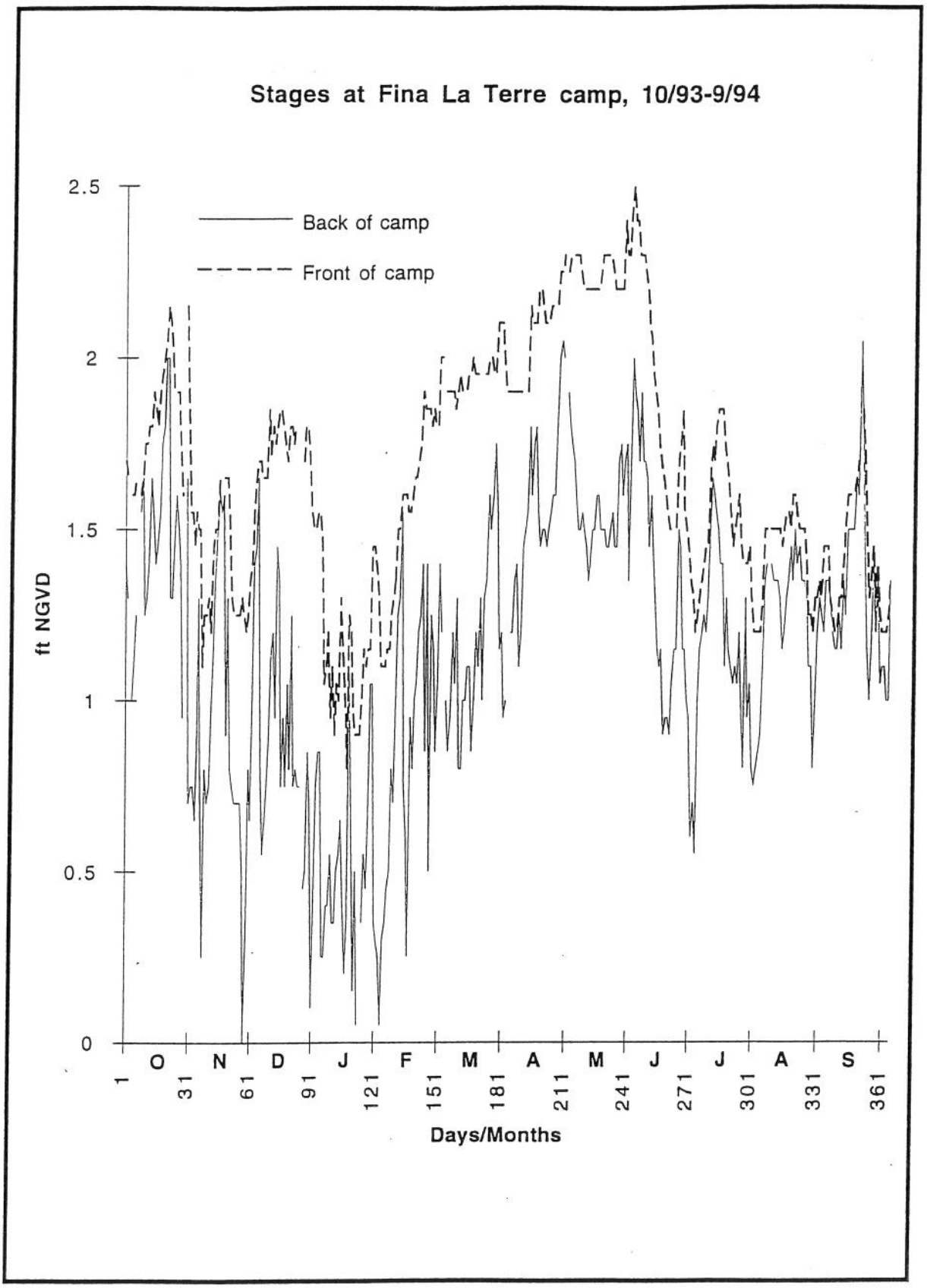

Figure 5. Water levels at the Brady Canal weir (ES-1) during the 1994 water year.

Table 3: Land Loss Rates for the Brady Canal Hydrologic Restoration Project Area (Data from Dunbar et al. 1992).

Time Period	Total Loss (Acres)	Total Loss per Time Period (%)	Average Loss per Year (acres)	Percent Loss Per Year
1932 - 1958	476.9	26.22	18.34	1.01
1958 - 1974	944.7	51.95	59.04	3.25
1974 - 1983	176.8	9.72	19.64	1.08
1983 - 1990	220.2	12.11	31.46	1.73
TOTAL	1,818.6	100.00		

Table 4: Land Loss Rates Attributed to Natural Processes and Human Activities for the Brady Canal Hydrologic Restoration Project Area (Data from Dunbar et al. 1992).

Time Period	Total Loss (Acres)	Total Loss per Time Period (%)	Average Loss per Year (acres)	Percent Loss Per Year
Natural				
1932 - 1958	399.4	28.40	15.36	1.09
1958 - 1974	645.3	45.89	40.33	2.87
1974 - 1983	141.3	10.05	15.70	1.12
1983 - 1990	220.2	15.66	31.46	2.24
TOTAL	1,406.2	100.00		
Human Activities				
1932 - 1958	77.5	18.79	2.98	0.72
1958 - 1974	299.4	72.60	18.71	4.54
1974 - 1983	35.5	8.61	3.94	0.96
1983 - 1990	0.0	0.00	0.00	0.00
TOTAL	412.4	100.00		

Between 1932 and 1990, 23 percent, or 412 acres, of the total land loss in the project area is attributed to human activities (Table 4). The greatest loss from this cause (299 acres or 73 percent) occurred between 1958 and 1974 which corresponds to the period when the major canal networks were excavated in the project area. The second highest land loss rate attributed to human activities occurred between 1974 and 1983 when an average of 4 acres per year was lost. According to Dunbar et al. (1992) no land was lost due to human activities between 1983 and 1990.

Natural processes causing erosion (e.g., subsidence, saltwater intrusion, tidal scour, etc.) were responsible for 77 percent, or 1,406 acres, of the total land loss in the project area between 1932 and 1990 (Table 4). The land loss rate attributed to natural causes was highest between 1958 and 1974 (40 acres per year) and between 1983 and 1990 (31 acres per year). The rate of land loss attributed to both natural processes and human activities was lowest for the 1932-1958 time period.

Land loss data in the project area indicate that losses were greatest in the southwest quadrant, or Bay Long portion, of the project area. Those losses occurred mainly during the 1958 to 1974 period, the same period when human-induced losses were greatest. The southeast quadrant, or Jug Lake portion, experienced the second highest land loss; the losses occurred steadily over the 58 year evaluation period.

Land losses were lowest in the project area's northeast quadrant which has been under management for a number of years. Water exchange in this area is primarily through overbank flow and the area is partially protected from excessive tidal action by the Mauvais Bois Ridge and by structural control of water exchange through the ridge.

Land loss in the northwest quadrant has been moderate and has occurred largely between 1932 and 1958, prior to extensive canal excavation and increased flooding from the Atchafalaya River. The area was exposed to greater tidal exchange when the Voss Canal breached the Mauvais Bois Ridge. Land loss has continued over time.

The trend of highest land loss in the southern portion of the project area continued after 1990 as indicated by Figures 6 and 7. Comparison of this pre- and post-hurricane aerial imagery, taken in December of 1990 and January of 1993, respectively, indicates the increased wetland loss and deterioration of the Mauvais Bois Ridge as a result of and following Hurricane Andrew in 1992. Continued deterioration of this ridge and progression of tidal effects northward will threaten the integrity of the marshes north of the ridge. The almost total erosion of the Bayou de Cade bankline between Jug Lake and the Voss Canal after Hurricane Andrew has created greater exposure of the Mauvais Bois Ridge to tidal and wave energy, further increasing the deterioration of the ridge and accelerating scour in the northern portions of the project area.

The data clearly show that marsh deterioration is affecting the overall physical integrity of the Brady Canal Hydrologic Restoration project area. Although no direct land losses due to human activities are now occurring, indirect losses attributable to past activities conducted locally as well as regionally are still occurring in conjunction with losses due to natural processes. The overall marsh deterioration apparent in the project area indicates a need for management practices that control and reduce these losses.

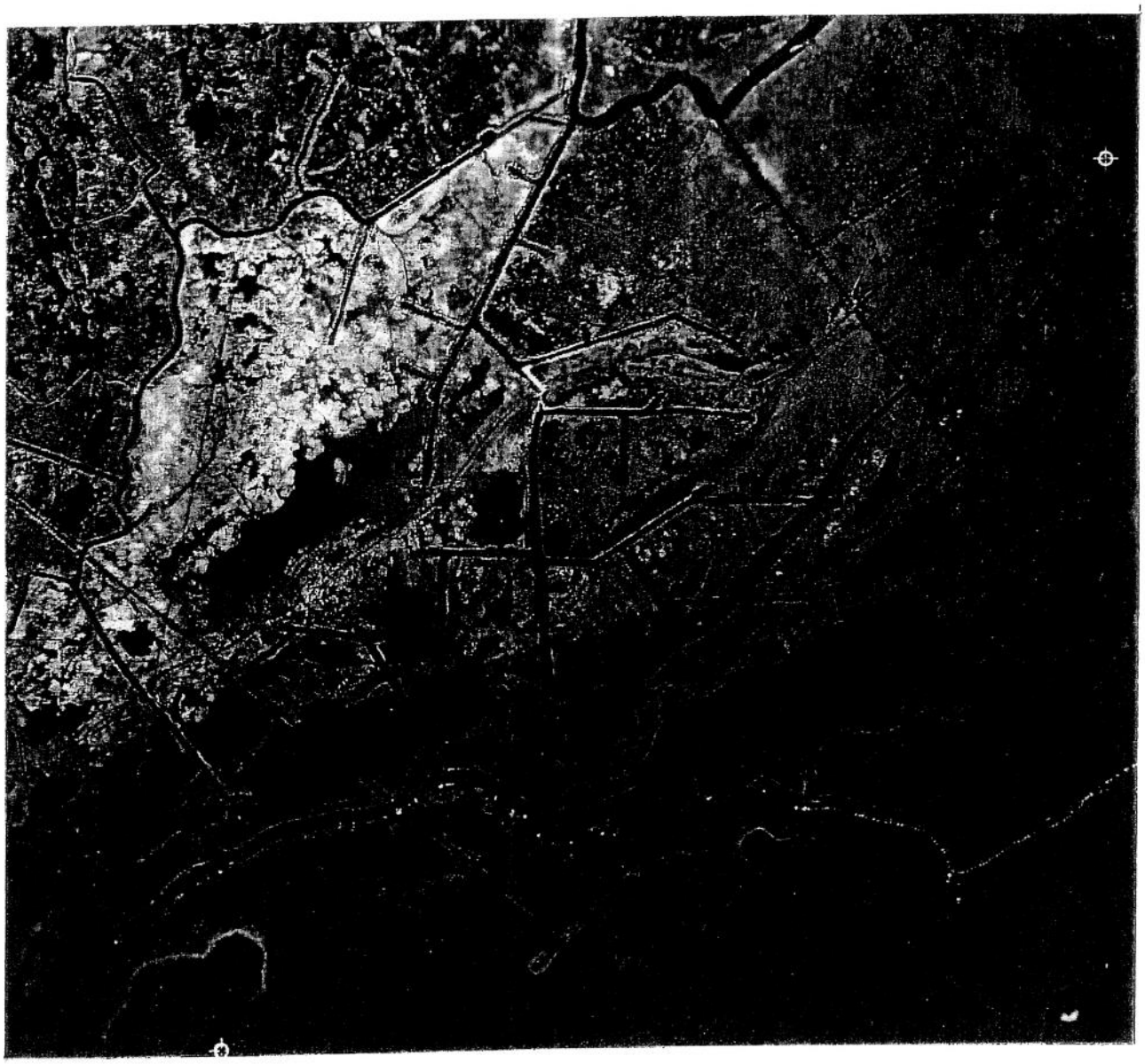

Figure 6. Color Infra-red Photography of the Brady Canal Hydrologic Restoration Project (PTE - 26b) taken in December, 1990.

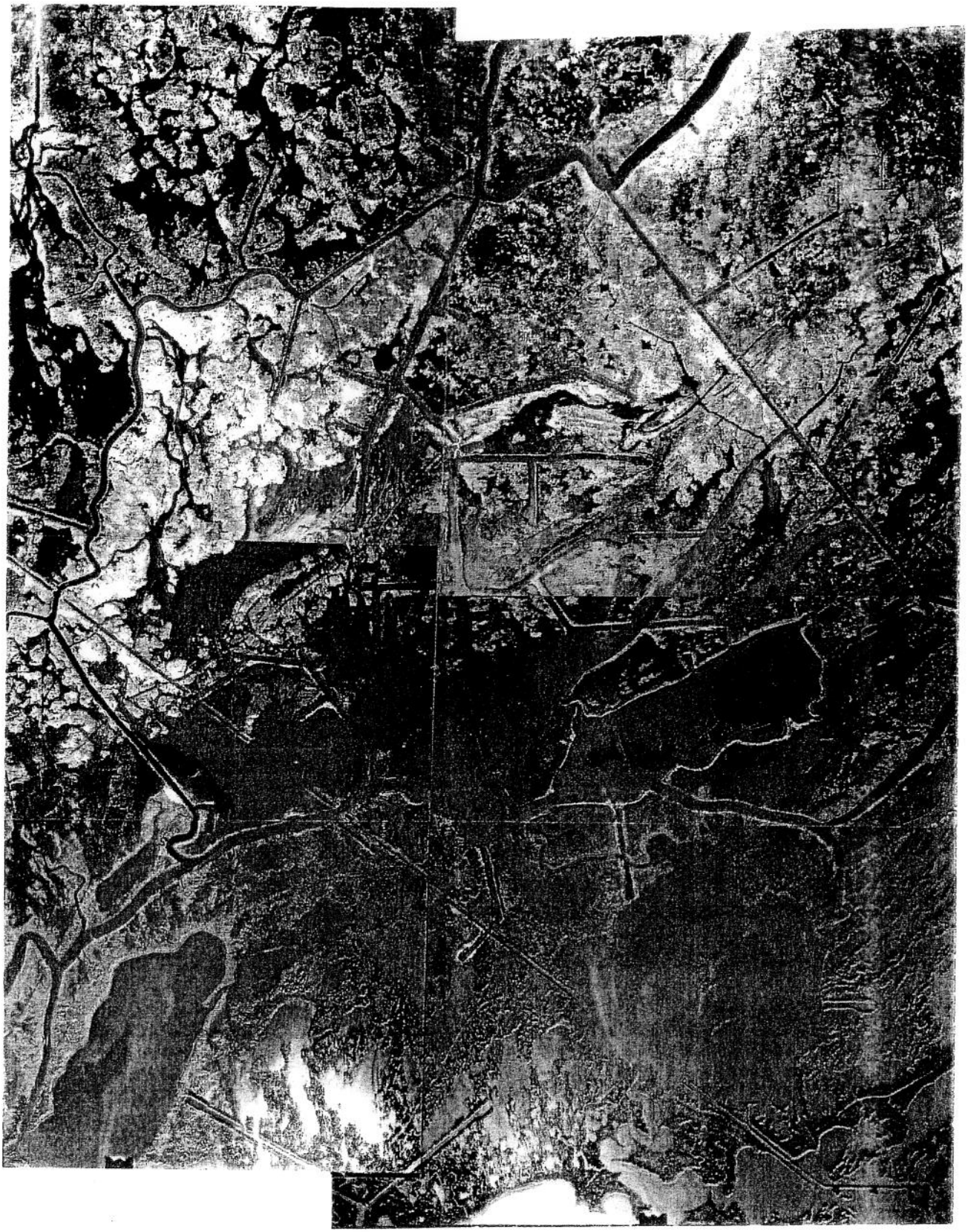

Figure 7. Color Infra-red Photography of the Brady Canal Hydrologic Restoration Project (PTE - 26b) Taken in January, 1993.

BIOLOGICAL ENVIRONMENT

VEGETATIVE COMMUNITIES AND HABITATS

Historically, the increasing influence of the Atchafalaya River had enhanced the establishment of freshwater marsh species within the Brady Canal Hydrologic Restoration project area (Figure 8). The vegetation in the project area was classified as brackish, intermediate and fresh in 1968 (Chabreck et al. 1968), and as intermediate and brackish in 1978 (Chabreck and Linscombe 1978). Currently, the project area consists of fresh and intermediate marshes, with a small remnant of brackish marsh in the southern portion along Bayou de Cade (Chabreck and Linscombe 1988), and interspersed spoil deposits which are characterized by black willow (*Salix nigra*) and other wetland species depending upon their elevation. The portion of the project area located north of the Mauvais Bois Ridge is classified as fresh and the area south of the ridge as intermediate to brackish (Chabreck and Linscombe 1988). Changes in vegetative communities within the project area reflect a change from saline marshes to fresh marsh environments, due to the increased influence of the Atchafalaya River.

Conservation Treatment Unit 1 (Figure 4) is classified as a fresh marsh and is dominated by bulltongue (*Sagittaria lancifolia*), Bagscale (*Sacciolepis striata*), and False loosestrife (*Ludwigia leptocarpa*), with pennywort (*Hydrocotyle sp.*), spikerush (*Eleocharis sp.*) and other species contributing to the vegetative community. Field observations of flotant formation in some interior ponds indicates that some shallow open areas, still isolated from canals and bayous, are converting to emergent marsh. Water hyacinths (*Eichhornia crassipes*) form large mats in open water areas thereby providing a substrate for other species to colonize.

Conservation Treatment Unit 2 is classified as a fresh marsh and is dominated by duck potato (*Sagittaria latifolia*), water hyacinth, and bulltongue. This area appears to be a healthy flotant marsh with a diverse plant community and very little expansion of open water areas. The small shallow ponds are covered with submerged aquatic vegetation (SAV). Species present include: white waterlily (*Nymphaea odorata*), bladderwort (*Utricularia sp.*), salvinia (*Salvinia rotundifolia*), milfoil (*Myriophyllum heterophyllum*), coontail (*Ceratophyllum demersum*), and duckweed (*Lemna sp.*). Flotant formation within interior ponds as described above, is greatest within this unit.

Conservation Treatment Unit 3 consists of the area south of the Mauvais Bois Ridge. This unit contains intermediate and brackish marsh. The intermediate marsh is dominated by a different vegetative community than CTU 1 and CTU 2. Dominant species in the area are marshhay cordgrass (*Spartina patens*), false loosestrife, bulltongue, and Olney bulrush (*Scirpus olneyi*). Additional species found include: eastern baccharis (*Baccharis halimifolia*), smartweed (*Polygonum sp.*), waterhyssop (*Bacopa sp.*), pennywort, and bagscale. Submerged aquatic vegetation is not as common in this unit as in the other units. Only the smaller ponds which are still isolated from canals and channels are covered with SAV. The common species are coontail, milfoil, and water stargrass (*Heteranthera dubia*). Brackish marsh is found in a small portion of CTU 3. The dominant plant is marshhay cordgrass. Water hyacinths do not cover the large expanses of open water in CTU 3. This area shows the largest amount of vegetation loss in the project area.

FISHERIES RESOURCES

The project area represents a transition zone between freshwater fishery habitats and estuarine fishery habitats. The area's hydrology is dominated by freshwater flows from Bayou Penchant and tidal influences from the south. The fisheries of the neighboring Lake Penchant and factors affecting them were studied in 1984 and 1985 (Allen, et al. 1986). Although the

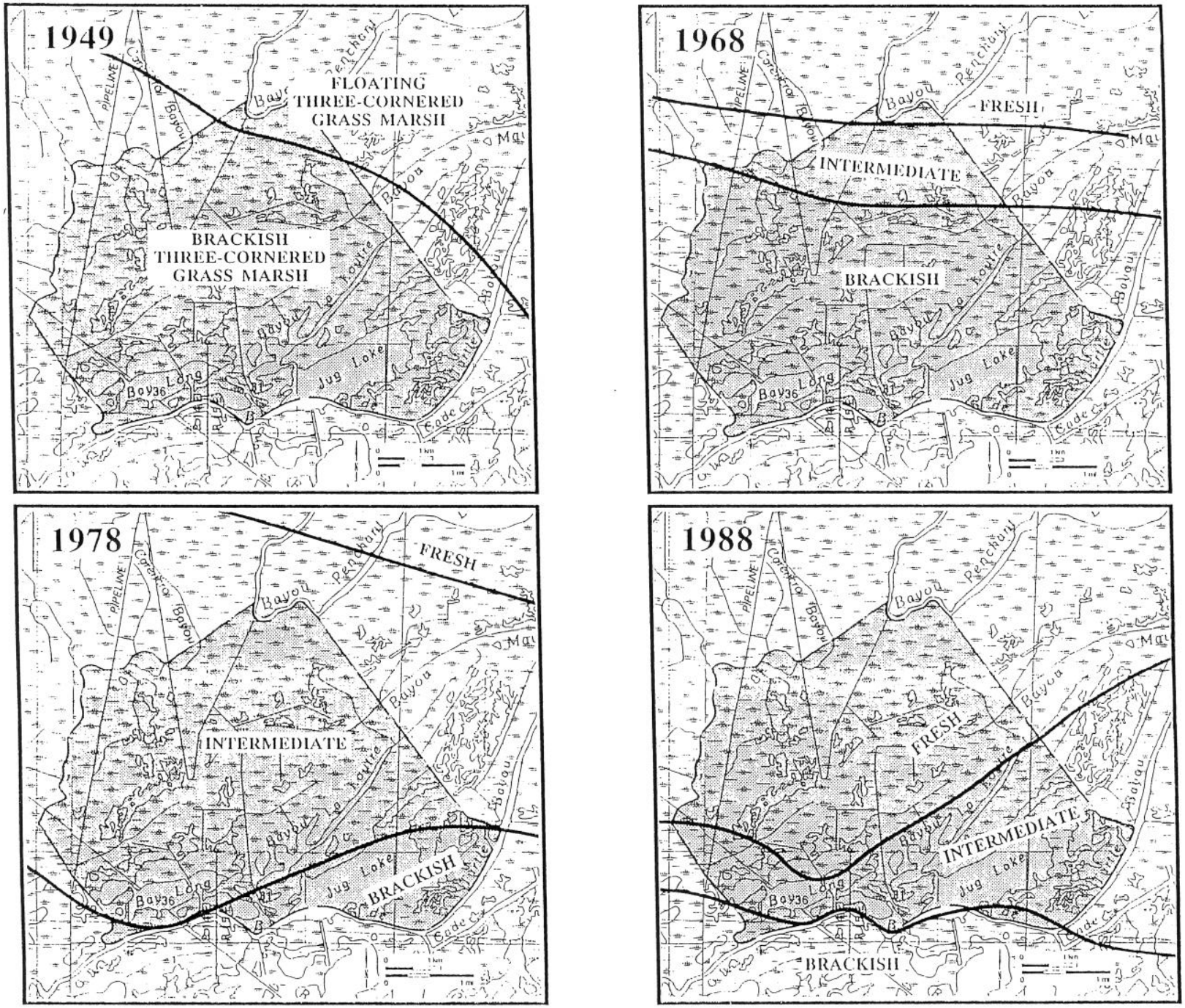

Figure 8. Typical vegetation communities within the project area in A) 1949 , B) 1968, C) 1978, and D) 1988 (O'Neil 1949, Chabreck et al. 1968, Chabreck and Linscombe 1978, Chabreck and Linscombe 1988).

tidal effects in the project area are slightly more pronounced than in Lake Penchant, the fish community in the northern portion of the project area (north of Mauvais Bois Ridge) is expected to be similar to that of Lake Penchant, whereas the southern portion of the project area is believed to be more estuarine in character. The latter is most pronounced in the late summer and fall, when the Atchafalaya River influence on the Bayou Penchant watershed is typically low. The Mauvais Bois Ridge, located between Lake Penchant and Lake de Cade, limits the potential estuarine influence on the fish communities in the northern portion of the project area.

Sampling stations of Allen, et al. (1986) included the confluences of Bayou Penchant and Peoples (Liners) Canal with Lake Penchant. Similar habitats and conditions presented in their study are expected to exist within the project area. Allen et al. (1986) collected 31 freshwater species and 11 estuarine/marine species of fish. The most abundant freshwater species were spotted gar (*Lepisosteus oculatus*), yellow bass (*Morone mississippiensis*), skipjack herring (*Alosa chrysochloris*), blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus*), largemouth bass (*Micropterus salmoides*), and redear sunfish (*Lepomis microlophus*). Spotted and longnose gar (*L. osseus*), skipjack herring, yellow bass, and common carp (*Cyprinus carpio*) dominated the freshwater fish catches by weight. The most abundant estuarine/marine species were threadfin shad (*Dorosoma petenense*), gizzard shad (*D. cepedianum*), and gulf menhaden (*Brevoortia patronus*) while weight was dominated by alligator gar (*Lepisosteus spatula*), and gizzard shad. The project area wetlands also provide habitat for blue crab (*Callinectes sapidus*) and shrimp. During field investigations, crab trap floats were observed in deeper waters of the lower portion of the project area. These wetlands provide nursery habitat for brown (*Penaeus aztecus*) and white shrimp (*P. setiferus*) when water salinities are suitable. The shrimp are harvested in nearby estuarine waters such as Lake de Cade, Lake Raccourci, and Lake Mechant as they migrate to the Gulf.

WILDLIFE RESOURCES

Emergent marshes and marsh ponds in the project area provide habitats for numerous wildlife species including reptiles, amphibians, birds, and mammals. Depending upon seasonal changes, these habitats can provide food, cover, and reproductive needs during various stages of each species' life cycle. Waterfowl, furbearers, and alligators (*Alligator mississippiensis*) are some of the more economically important species.

Waterfowl utilize the fresh and intermediate marshes of coastal Louisiana more than other habitats along the coast (Palmisano 1973, Chabreck et al. 1989). Gadwall (*Anas strepera*), northern pintail (*Anas acuta*), American green-winged teal (*Anas crecca carolinensis*), blue-winged teal (*Anas discors*), and American widgeon (*Anas americana*) winter extensively in habitats found within the project area. Mottled ducks (*Anas fulvigula*) also utilize these areas for breeding during the summer months.

Furbearers common in these habitats include nutria (*Myocastor coypus*) and muskrat (*Ondatra zibethicus*). Fresh marsh supports the highest densities of nutria with densities decreasing as salinities increase (Linscombe and Kinler 1984). Populations of nutria in the area are controlled through trapping and a shooting program. High populations of nutria can cause damage to marshes through herbivory, to the extent that marsh surfaces are denuded of vegetation and soil erosion may occur through tidal scour.

Muskrats are most abundant within brackish marshes and populations decrease as salinities decrease (O'Neil 1949, Palmisano 1973). The muskrat population in the project area has declined over time. This decline has been associated with a decrease of Olney bulrush stands, which is a preferred food source. Both are believed to relate to a decrease in salinities and an increase in water levels.

Alligators are common in fresh and intermediate marsh habitats (McNease and Joanen 1978). Populations have been high enough in the project area to support a seasonal harvest since 1979.

THREATENED AND ENDANGERED SPECIES

No known location of threatened or endangered species exists within the project area (Louisiana Department of Wildlife and Fisheries, Natural Heritage Program 1992). Also, the project area is not within any designated critical habitats. While sea turtles have been reported in the upper reaches of Terrebonne Bay, these are considered rare events and their occurrence is not expected within the project area because of the predominance of emergent vegetation. A bald eagle (*Hailieolucus leucocephalus*) nest is approximately one half mile from the eastern project boundary along the Mauvais Bois Ridge. Alligators are also listed as threatened due to similarity of appearance.

SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

LAND USE AND MANAGEMENT

All of the lands located within the project area are in private ownership. The remote location and setting allow surface access only by boat or float plane. Development within the project area consists primarily of oil and gas related activities. The exploration, production, and transportation of oil and gas has been facilitated by the development of a support infrastructure comprised of access canals, well slips, oil and gas wells, production facilities, storage and staging facilities, and pipelines. Recreational camp development within the project area is minimal. Approximately six camps are located along the perimeter and one camp is located in the interior portion of the project area. Three marsh conservation projects are presently in effect within the project area (See Existing and Planned Projects, page 31).

OIL AND GAS ACTIVITIES

All production facilities within the project area are currently served by a single mineral exploration and production company, UNOCAL Exploration Co. Three canal systems allow access to oil and gas wells within the project area. Two of the canal systems are used to access the wells on the two properties south of the Mauvais Bois Ridge. However, a single, common access route could be utilized.

A tentative agreement between the two landowners has been reached to close one of the access canals and use the other as a common access route for well locations on both properties. Realization of this agreement will depend on connecting the two canal systems and possibly lowering an existing 16-inch pipeline. The landowners intend to ensure that future oil and gas development will be conducted with adequate consideration of the hydrologic integrity of the project area.

COMMERCIAL FISHING RESOURCES

Commercial fisheries within coastal areas of Louisiana are a major economic industry, and are based upon estuarine-dependent fish populations. Landings of brown and white shrimp, and blue crabs in the Terrebonne, Timbalier, Atchafalaya, and Teche areas were valued at approximately 66.5 million dollars in 1989 (NMFS, unpublished data). Fisheries of spotted seatrout, menhaden, mullet and other species account for additional economic production.

The project area's vegetated wetlands and shallow ponds provide essential habitats for these species during different stages of each species' life cycle (Table 5). Biological productivity of the deltaic estuaries of the Mississippi River Deltaic Plain is related to delta evolution and associated growth and decline of emergent wetland habitats (Gagliano and van Beek, 1975). Because the marshes in the project area are generally considered to be in the degradational phase of the delta cycle, the fisheries support function of the project area is likely to decline in the near future. Prolonged maintenance of the emergent vegetation in the project area and increased influence of the Atchafalaya River would prolong the deltaic cycle and the current commercial fisheries related functions.

Presently, light commercial fishing is practiced in the bayous and lakes within and surrounding the project area. Catfish and garfish are harvested north of the Mauvais Bois Ridge while shrimp and crab are harvested in the Bayou de Cade area south of the ridge. There are no oyster leases in the project area.

COMMERCIAL WILDLIFE RESOURCES

Commercial use of various wildlife species within the project area has been documented as early as 1923. Trapping has been the main commercial activity. Annual values of commercial harvests of furbearers in the Mississippi River Deltaic Plain's fresh and intermediate marshes from 1977-78 through 1982-83 totaled approximately 6.1 million dollars (Linscombe and Kinler 1984). Leases for hunting have provided income to landowners in the project area since 1958.

Alligator harvests provide additional revenue from the project area. One of the landowners has harvested an average of 80 alligators/yr since the season was opened in 1979 (J. Woodard, Fina LaTerre, pers. commun., 1995). Also, harvesting of alligator eggs provides additional revenues. Statewide, alligator harvests in 1990 generated approximately 13.4 million dollars.

RECREATIONAL RESOURCES

The landowners issue hunting leases to private clubs and/or individuals for specified portions of their tracts within the project area. Holders of these hunting leases primarily target deer, rabbits, and/or waterfowl for hunting. The lessees also enjoy sport fishing within the project area. Sport fishermen comprise the largest of the non-lease holding user groups that recreate within the project area. In addition, some recreational shrimp trawling and crabbing has occurred within the southern portion of the project area.

HISTORICAL AND ARCHAEOLOGICAL RESOURCES

The project area is situated in a region of coastal Louisiana known for its wealth of archaeological and historical sites (McIntire 1958; Neuman 1977; Weinstein and Gagliano 1985; Weinstein and Kelley 1992). The natural levees of Turtle Bayou and Bayou de Cade, along with distributary channels emanating from these bayous, provided firm ground upon which both prehistoric and early historic occupants of the region are known to have settled. The surrounding marshes provided an environment for hunting, trapping, and fishing, and today could harbor the remains of small, ephemeral, resource-extraction sites and camps. Similarly, water bodies in the area could contain the remains of watercraft used by both prehistoric and historic peoples to gain access to the marsh.

A review of the archaeological records and site files housed at the Division of Archaeology, Louisiana Department of Culture, Recreation and Tourism, indicates that there are eight known archaeological sites located within or immediately adjacent to the Brady Canal

Table 5: Summary of Life History and Habitat Data for Commercially valuable nekton (from Wicker et al. 1982).

SPECIES	REPRODUCTION	POSTLARVAE	JUVENILES	SUB-ADULT	ADULTS
Brown Shrimp	September-June Gulf of Mexico, 16-60 fathoms	February-April (12-25 mmSL) Lower estuary, tidal passes, bays, sounds	March-June(25-90 mmSL) Upper estuary, nursery grounds shallow marsh, shorelines, bayous,10-20 ppt, 20-3-°C	May-November (90-140) Mid-lower estuary, staging grounds, bayous, lakes, bays, sounds, Gulf of Mexico	All year (140 mmSL) Gulf of Mexico
White Shrimp	March-November Gulf of Mexico, 4-17 fathoms	July-August Lower estuary, tidal passes, bays, sounds	June - September Upper estuary, nursery grounds, shallow marsh, shorelines, 0.5-10 ppt, 20-3-°C	August-December (90-140) Mid-lower estuary, staging grounds, bayous, lakes, bays, sounds, Gulf of Mexico	All year Gulf of Mexico
Blue Crab	Mating: May-September Estuarine waters less than 20 ppt Spawning: June-August Lower estuary, bays sounds, Gulf of Mexico, greater than 21 ppt	February-November Lower estuary, tidal passes, bays, sounds	December-March Upper estuary, nursery grounds, shallow marsh, shorelines, 0.5-10 ppt	All year Throughout estuary	All year Throughout estuary
American Oyster	May-October Reef waters greater than 10 ppt and near 27°C	June-October (Spatfall) Reef waters greater than 20 ppt and 29°C	All year (Seed oysters) Reef waters 5-15 ppt	All year (Cultured oysters on bedding grounds) reef water 10-25 ppt	All year Reef waters 5-30 ppt
Spotted Seatrout	April-October Lower estuary, near tidal passes, bays, sounds shallow Gulf, greater than 20 ppt and near 25°C	May-September (5-15 mmSL) Lower estuary, tidal passes, bays, sounds	All year Mid-upper estuary, nursery grounds, shallow marsh, shorelines to freshwater	All year Mid-lower estuary, bayous, lakes, bays, sounds, above 5 ppt and 10°C	All year Mid-lower estuary, Gulf of Mexico, bayous, lakes, bays, sounds, above 5 ppt and 10°C
Red Drum	August-November Gulf of Mexico, near tidal passes, greater than 20 ppt	September-November (5-15 mmSL) Lower estuary, tidal passes, bays, sounds	All year Mid-upper estuary, nursery grounds, shallow marsh, shorelines to freshwater	All year Mid-lower estuary,	All year Lower estuary, Gulf of Mexico greater than 20 ppt
Gulf Menhaden	October-April Gulf of Mexico, less than 20 fathoms	February-April (12-21 mmSL) Lower estuary, tidal passes, bayous bays, sounds	May-October Upper estuary, nursery grounds shallow marsh, shorelines less than 15 ppt to freshwater	September-December Lower estuary, bayous, lakes, bays, sounds, nearshore, Gulf of Mexico	All year Gulf of Mexico
Atlantic Croaker	September-April Gulf of Mexico, mid-outer continental shelf	November-February (5-15 mmSL) Lower estuary, tidal passes, bays, sounds	January-August Upper estuary, nursery grounds, shallow marsh, shorelines to freshwater	May-December Mid-lower estuary, lakes, bays, bayous, sounds	All year Lower estuary, Gulf of Mexico

Hydrologic Restoration project area. Five of these sites were recorded in the early 1950's during a non-systematic investigation of the entire Louisiana coastal zone (McIntire 1958), while the remaining three were recorded during the 1970's and 1980's. The only systematic survey work within the project area was a sample survey conducted along canal segments and portions of the Mauvais Bois Ridge by Coastal Environments, Inc. in 1986 (Weinstein and Kelley 1992). Based on the distribution of known sites, additional sites can be expected to be present along the subsided natural levees of the former distributaries occupied by Turtle Bayou, Bayou de Cade and Bayou Mauvais Bois.

EXISTING AND PLANNED PROJECTS

EXISTING PROJECTS

The landowners of the project area have participated in marsh conservation practices for the purposes of reducing erosion and improving waterfowl and furbearer habitat within the area. A conservation plan was implemented by the landowner in 1966 with assistance from the Lafourche-Terrebonne Soil and Water Conservation District, USDA-SCS (LTSWCD-SCS). In 1988, the plan was updated. Improvements included earthen plugs, water control structures, and bank stabilization. A continuous spoil bank was constructed along Jug Lake in 1968 and has been maintained to date. Also at the request of the landowner, approximately 2,000 feet of shoreline along the south bank of Bayou Penchant was stabilized with a limestone embankment by UNOCAL Exploration Co. in 1992 (Sec. 18, T-19-S, R-15-E).

On a second tract, the landowner signed a cooperative agreement for a conservation plan with the LTSWCD-SCS in 1956, which was updated in 1987. Improvements included fixed crest weirs and armored plugs, some of which were installed in the late 1950's. Although the management objectives of the conservation plan included erosion reduction and habitat improvement for waterfowl and furbearers, other objectives were added in the 1987 plan: 1) nursery usage by marine organisms of commercial and/or recreational importance and 2) increased growth of SAV.

In addition, the U.S. Department of the Interior, Fish and Wildlife Service constructed the Bayou La Loutre (Otter Bayou) - Jug Lake Marsh Study/Research Project, a small marsh management pilot project which is currently being monitored by the National Biological Survey. The project consists of four experimental research units that are located along both sides of Bayou La Loutre, north of Jug Lake.

The Brady Canal Hydrologic Restoration project will not adversely affect nor be adversely affected by these three existing management projects. Conversely, the proposed project will compliment the three smaller projects with the improved distribution and retention of fresh water and sediments.

PLANNED PROJECTS

The Upper Bayou Penchant Watershed Management project (PTE-26) encompasses the entire Penchant subbasin and is one alternative proposed under the CWPPRA to help restore this subbasin. Project objectives of the Upper Bayou Penchant Watershed Management project include improving marsh conditions in a number of subbasins by optimizing the utilization of water and sediments supplied by the Atchafalaya River. The Brady Canal Hydrologic Restoration project (PTE-26b) comprises a portion of the larger project. No other projects are currently proposed under either the State's Coastal Wetlands Conservation and Restoration Plan (Fiscal Year 1995-96) or under CWPPRA, within the immediate vicinity of the project area.

Because the larger project has not been fully defined, impacts from its full or partial implementation on the Brady Canal Hydrologic Restoration project area cannot be fully evaluated at this time. At the same time, the Brady Canal Hydrologic Restoration project does not preclude the achievement of the objectives of the larger project. Furthermore, the Brady Canal Hydrologic Restoration project design provides for modification of operational procedures, if required.

FORMULATION AND COMPARISON OF ALTERNATIVES

FORMULATION PROCESS

The Brady Canal Hydrologic Restoration project was developed by a team of NRCS personnel, scientists, and landowner representatives. Formulation occurred on the basis of field investigations that documented vegetative communities, soil types, hydrologic conditions, marsh elevations and drainages, and other pertinent information. Documentation of historical changes in the area was also compiled and included timing and trend of changes in hydrology, land loss rates, vegetative communities, and salinity.

Synthesis of the above information by the project team resulted in the identification of two alternatives: 1) no action and 2) hydrologic restoration. The hydrologic restoration alternative conforms to the short-term wetland conservation measure proposed by the Louisiana Coastal Wetlands Conservation and Restoration Task Force for the Terrebonne Basin portion of which the project area is a part. Long-term wetland renewal through increased diversion of Atchafalaya River water and sediment was not considered a feasible alternative at present because of: uncertainty with regard to feasibility of its implementation as related to flood control and navigation; implementation being unlikely within a time frame required for conservation of the project area's wetlands; and uncertainty with regard to desirability of near-future implementation of a large scale diversion because of potential adverse impacts on interior freshwater wetlands within the Penchant Basin.

DESCRIPTION OF ALTERNATIVE PLANS

NO ACTION

This alternative consists of no treatment for the project area. No measures would be taken to reduce wetland loss in the project area.

HYDROLOGIC RESTORATION

Hydrologic restoration, in this case, refers to the partial restoration of historic hydrologic conditions that were characterized by overbank flows, and lower rates of water exchange and water-level and salinity fluctuations than those presently occurring. Restoration of the overbank flow regime and low energy hydrologic conditions will provide for greater utilization and retention of freshwater and sediments, protect the fragile organic soils, and enhance plant growth. By reducing the rate of tidal water exchange and improving the utilization of introduced freshwater and sediment, this alternative will protect and enhance physical and biological integrity of the project area. These objectives are to be achieved through a number of structural measures as shown in Figure 4 (page 15).

A bulkhead with a boat bay and variable crest, flap-gated sections will replace the existing Brady Canal structure at Bayou Penchant. Existing structures around Jug Lake and along Little Bayou Carencro will be replaced. A fixed-crest weir with a barge bay will be placed in an oil field canal which extends from Bayou de Cade north, to the center of the project area. A fixed crest weir will replace an existing structure along the Jug Lake shoreline. Spoil banks along Brady Canal, Little Bayou Carencro, and Voss Canal will allow overbank flow into the project area. Bank maintenance will be done along 21,513 feet of the Superior Canal, Bayou de Cade, and Turtle Bayou as required. An earthen embankment will be constructed from Jug Lake along the north bank of Bayou de Cade and the east bank of Voss Canal. A rock plug will be placed in an oil field canal to stop tidal exchange, and two channel entrances will be armored with rock to stabilize the channel cross-section and prevent an increase in the rate of water exchange. Specific structure locations and descriptions are given in the Proposed Measures section (page 39) and Figure 4.

EFFECTS OF ALTERNATIVE PLANS

NO ACTION

This alternative would allow land loss to continue as marine tidal influences increase. According to the WVA, the land loss rate in the Brady Canal Hydrologic Restoration project area was calculated at 19 acres per year based on the available data at that time (Louisiana Coastal Wetlands Restoration Task Force 1993). However, more recent data indicate that this rate is increasing rapidly (Dunbar et al. 1992) as marshes in the the project area become subject to greater tidal influences through hydrologic linkage with open water to the south.

Prior to the passage of Hurricane Andrew in August of 1992, this process was more concentrated south of the Mauvais Bois Ridge while marshes north of the ridge were protected against tidal influences by the ridge and were maintained through freshwater and sediment introduction via the numerous channels in the project area and through overbank flow from the Brady Canal. However, Hurricane Andrew has caused almost complete deterioration of the Bayou de Cade bankline, thereby destroying its protective function and subsequently increasing tidal and erosional processes on the Mauvais Bois Ridge.

Hurricane impact caused extensive erosion of the Bayou de Cade bankline between Jug Lake and the Voss Canal resulting in almost complete destruction of the already broken and deteriorating marshes in the southern portion of the project area. Under the present conditions, conversion of marsh to open water is likely to accelerate even more as marsh ponds are progressively linked with developing tidal channels both south and north of the Mauvais Bois Ridge as the ridge continues to deteriorate.

The Brady Canal Hydrologic Restoration project area has been managed for a number of years utilizing management measures such as earthen plugs, spoil banks, water control structures, and bank stabilization. Although the existing measures appear to have been effective in reducing land loss since the implementation of these conservation plans by reducing rates of tidal water exchange and increasing freshwater and sediment utilization within the project area, especially north of the ridge, the management objectives of these conservation plans are no longer being met adequately. The no action alternative will result in further reduction of sediment retention in the project area, in increased erosion and salinity, and in the conversion of the remaining marsh lands to open water.

Vegetative communities in the project area would be expected to eventually become dominated by more salt tolerant species. However, erosion in the project area will, initially,

significantly reduce wetland acreages. The area would remain open for estuarine organism access, and access would increase as the area continues to open, but reduction of emergent wetlands and SAV within the project area would reduce the habitat's functional value for estuarine-dependent fish and shellfish species. Also, reduced emergent vegetation would provide less habitat for wildlife species and decrease economic and recreation opportunities dependent upon them.

Oil and gas activities will continue, with access canals potentially breaking the perimeter of the project area and possibly increasing tidal water movement into the area. Land use will be affected as the area opens up subsequently changing marsh related activities to open water related activities. Cultural resources in the area will continue to be lost to erosion and subsidence.

HYDROLOGIC RESTORATION

In general, the proposed action is anticipated to reduce the rate of water exchange in the southern portion of the project area, and enhance utilization of fresh, sediment-laden water in the northern portion of the project area. The freshwater introduction and reduced rate of tidal water exchange will decrease turbidity and scouring in the existing channels, enhance sediment retention, and restore the slight freshwater hydraulic-head that historically dampened tidal effects and protected the project area.

Vegetative communities in the area are expected to stabilize. Vegetation would remain fresh north of the Mauvais Bois Ridge (CTU 1 and 2) and intermediate in the south (CTU 3). The expected increase in SAV within the project area would also enhance the habitat for estuarine organisms and wildlife. Continued maintenance of emergent vegetation will extend and enhance the level of biological productivity within the project area, sustaining estuarine habitat for a longer period of time.

The construction and repair of the earthen embankment along the north bank of Bayou de Cade and the east bank of Voss Canal, from Jug Lake up to the Mauvais Bois Ridge, will be accomplished by locally borrowing sediments from the canal and bayou. This embankment is anticipated to reduce the further deterioration of the Mauvais Bois Ridge, protect the remaining marshes south of the ridge from excessive tidal influences, decrease water level and salinity fluctuations, and minimize scouring of the existing channels. In addition, this embankment is expected to reduce excessive tidal water exchange and enhance sediment retention within the project area. Land loss rates should be reduced and emergent vegetation will be protected by creating a more stable environment. Some expansion of emergent marsh into shallow open water areas could occur.

The water control structures and plugs will reduce and halt water exchange with the surrounding water bodies, respectively. Estuarine organism access will be reduced to a more historic cross-sectional area, by the construction of an embankment along Bayou de Cade, the addition of a rock plug at ES 7, and the reduction of channel cross-sections at ES 10 and ES 20. However, a major access point to the entire project area is maintained through the weir with a large barge bay at the oil-field access canal at ES 6. Modification of existing weirs at some sites may improve access for marine organisms at those sites.

Reduced flow velocities are likely to cause settlement of sediments from suspension in plugged canals and shallow open water ponds. In the absence of coarse-grained sediments, these changes are not likely to decrease grain-size of the substrate. No significant physical or chemical changes of the substrate characteristics are expected where plugs and water control structures will be placed and where channel cross-sections will be stabilized with rock.

The placement of new and replacement of existing water management structures will result in temporary, localized increases of turbidity during the construction phase of the project. Construction of the embankment will be also be associated with localized, increased turbidities. Non-mobile benthic organisms would suffer immediate impacts from construction activities in areas adjacent to specific project features due to sediment excavation and deposition. All construction activities would cause only minor and temporary disturbance to adjacent wetlands. None of these activities is anticipated to have long-term adverse impacts on the environment.

A reduction in wetland loss and continued access for estuarine organisms will allow continued support of fish and wildlife populations and associated economic and recreation activities. Oyster leases occur outside the project area and are not expected to be affected by the project. The Water Management section (page 39) compares the cross sectional area for inflow and outflow of water through the project. Analysis indicates that the net outflow will be decreased with the project. In addition, dredging for the project is confined to Bayou de Cade and northward and should not affect oyster leases.

Oil and gas activities would continue within the project area, but future access needs will require consideration of project integrity. Land use would continue as it is at present, and cultural resources would be protected by the reduced erosion rates.

COMPARISON OF ALTERNATIVE PLANS

The No Action Plan provides no protection or enhancement of the project area wetlands. Approximately 380 or more acres of wetlands would be lost within the 20-year life of the project, thus adversely affecting fish, wildlife, and human activities associated with the project area.

The Hydrologic Restoration Plan does provide protection to the Brady Canal area wetlands. Reduced tidal water exchange and greater utilization of sediment-laden fresh water within the project area will reduce land loss an estimated 306 acres and enhance 188 acres of emergent vegetation, with accordant benefits to fish and wildlife and related human activities.

RISK AND UNCERTAINTY

The hydrologic restoration project will not eliminate the risk of wetland loss. The risk of destruction or damage of the project by hurricanes and major natural or human-induced processes cannot be eliminated. While largely beyond the scope of this evaluation, these factors have been incorporated to some extent through the evaluation of land loss rates. A second uncertainty exists with regard to the specific effect of structural measures upon water levels and circulation. To minimize risks in this regard, the project will be closely monitored and operational adjustments made accordingly.

RATIONALE FOR PLAN SELECTION

Hydrologic restoration must currently be considered the best and most feasible alternative to meet the objectives of the federal and state government, and the landowners to maintain existing marshes and to increase marsh productivity in the project area. Accomplishing this through enhanced utilization of currently available freshwater and sediments and a reduction of tidal water exchange in order to reduce associated erosion and salinity fluctuations is consistent with the goals, objectives, and concerns expressed by the Louisiana Coastal Wetlands Conservation and Restoration Task Force with regard to this

portion of the Mississippi River Deltaic Plain. An intensive monitoring program will be relied upon to document changes of key physical, chemical, and biological parameters and to make adjustments in the project operation if needed.

CONSULTATION AND PUBLIC PARTICIPATION

PUBLIC CONCERN

Public understanding of the functional values of coastal wetlands has increased dramatically in recent years as has the perception that wetland loss has significant, adverse consequences. The public recognizes that the continued loss of coastal marshes can ultimately result in the displacement of entire communities, the loss of jobs and recreational opportunities, and the forfeiture of a unique culture and way of life. Louisianians' sentiments about addressing the coastal land loss problem were clearly demonstrated by the overwhelming support for the constitutional amendment establishing the Coastal Wetlands Conservation and Restoration Fund (CWCRF). This statutorily dedicated fund has provided a funding mechanism for implementing coastal restoration and protection measures.

The Brady Canal Hydrologic Restoration project has been discussed at several public meetings in Houma, LA. The project was presented at public hearings on the CWPPRA third priority list for the Terrebonne Basin in Houma on 7 April 1993.

On 7 August 1995, a public meeting was held at the Bayou DuLarge Fire Station to outline the project features. One concern was raised by a member of the public. His concern was that the entire area should be considered in planning as to not affect another area. NRCS personnel announced the upcoming release of the Penchant Basin Resource Plan and explained that the Brady Canal project is part of the entire basin plan.

The U.S. Department of Interior, National Biological Service, was unable to attend the public meeting and therefore sent a letter of support for the project (see Appendix D).

CONTACT WITH LANDOWNERS

NRCS personnel presented a preliminary management plan for the Basin at the Bayou Penchant Basin Landowners meeting, held on 4 November 1992, in Houma, Louisiana. Landowners were given an overview of the entire basin, associated problems, and recommendations. Participants provided valuable input through observations and suggestions.

NRCS held the Brady Canal Hydrologic Restoration Landowners Meeting on 30 September 1994, in Houma, Louisiana. Participants, including NRCS personnel and representatives from both landowners of the project area, reviewed and discussed project components and landowner concerns. The meeting resulted in a favorable response with all parties agreeing to an on-going dialog while the planning process progressed.

As evaluation of the Penchant Basin progressed, NRCS identified the need to divide the greater than 500,000-acre basin into three smaller watershed-management units: 1) Point au Fer, 2) the lower tidal zone, and 3) the upper zone. The northern part of the Brady Canal Hydrologic Restoration project area is located in the upper tidal zone, while the southern part of the project area is in the lower tidal zone of the basin. NRCS held a landowners meeting in

Houma, Louisiana, on 23 February 1995, for the purpose of discussing the overall Penchant Resource Plan (Faye Talbot, USDA, NRCS, pers. commun., 1995).

INTERAGENCY COORDINATION

This Project Plan/EA and the unsigned Finding of No Significant Impact will be sent to the following agencies for review and comment:

Advisory Council of Historic Preservation
Governor's Executive Assistant for Coastal Activities
Louisiana Department of Environmental Quality
Louisiana Department of Natural Resources/Office of Coastal Restoration and Management
Louisiana Department of Wildlife and Fisheries
Louisiana State Historic Preservation Officer
Louisiana Universities Marine Consortium
U.S. Department of the Army, Corps of Engineers
U.S. Department of Commerce, National Marine Fisheries Service
U.S. Department of the Interior, Fish and Wildlife Service
U.S. Environmental Protection Agency

Representatives from the Louisiana Department of Natural Resources/Office of Coastal Restoration and Management (LDNR/OCRM) participated in a field investigation of the project area with NRCS personnel on 5 October 1994. The LDNR/OCRM provided technical data and assistance to NRCS. Comments previously received from the Louisiana Coastal Wetlands Conservation Restoration Task Force agencies and landowners have been incorporated into the development of the project plan. In addition, all comments received during the public notice period of the permit application will be considered.

LOUISIANA COASTAL WETLANDS CONSERVATION PLAN

The Louisiana Coastal Wetlands Conservation and Restoration Task Force adopted a long-term protection and restoration plan for coastal Louisiana in 1993. The Brady Canal Hydrologic Restoration project (PTE-26b) is a component of the plan to protect, restore, and enhance wetlands in the Terrebonne Basin and is included in the plan's third priority project list. The Brady Canal Hydrologic Restoration project helps to fulfill the plan's stated objectives of making the most effective use of freshwater and sediment resources in the Terrebonne Basin.

RECOMMENDED PLAN

PURPOSE AND SUMMARY

The hydrologic restoration alternative was selected as the preferred plan. The project has been developed to combat wetland loss in the area and to enhance existing conditions. Project objectives will be accomplished using structural means to reduce water velocities and enhance utilization of freshwater and sediments that are being introduced into the project area.

Structural measures to be utilized in the project will include weirs (fixed and variable crest), plugs, flapgated structures, channel stabilization, and shoreline and bank restoration.

The major goal of the project is to reduce adverse tidal effects on the project area, as well as to better utilize available freshwater and sediment for maintenance of the project area marshes. The project is expected to reduce wetland loss rates, increase emergent marsh vegetation, and improve fish and wildlife habitat on 7,653 acres of fresh, intermediate, and brackish marsh and shallow open water bodies. The project goals will be accomplished through management of hydrologic parameters.

PROPOSED MEASURES

Project measures and their location are identified in Figure 4 (page 15). Locations of project features are identified by ES numbers. Typical structure drawings are found in Appendix B. Project implementation will involve the following:

A) Approximately 140 feet of bulkhead with boat bay and flapgated variable crest sections (1)

B) Approximately 215 feet of fixed crest weir with barge bay (1)

C) Approximately 240 feet of fixed crest weir with variable crest sections (3)

D) Approximately 140 feet of fixed crest weir (1)

E) Approximately 315 feet of rock plug (1) and stabilized channel cross-sections (rock) (2)

F) Approximately 15,000 feet of earthen embankment

G) Bankline maintenance, if necessary.

STRUCTURE DESCRIPTIONS

A) Weirs with boat bays will be installed at ES 1 and 6. The weir at ES 1 will be a sheet pile weir with a ten (10) feet wide boat bay in the center and two six (6) feet wide variable crest sections, each with an interior flap gate. The boat bay will have a bottom elevation of 8.0 feet below marsh level. Structure ES 1 will allow fresh water and sediment to enter Brady Canal. The structure is intended to be passively managed, but can be actively managed. Conditions that could cause structures to be actively operated include the need for lesser or greater water exchange, as indicated by project monitoring results, excessive flooding duration resulting from a tropical storm or similar event. Additionally, the Brady Canal structure may be operated to prevent negative impacts to oyster grounds south of the project area.

B) A weir with a barge bay will be placed at ES 6. The weir will be a fixed crest weir with a 70-foot wide boat bay in the center. The barge bay will have a bottom elevation of 8.5 feet below marsh level. The structure is designed to increase the freshwater and sediment retention times and reduce excessive tidal induced water level fluctuations.

C) Variable crest weirs without boat bays will be installed at ES 14, 21, and 23. The weir at ES 14 will replace an existing timber weir. A six (6) feet variable crest center section will allow some flexibility should monitoring dictate. The structure at ES 21 also will replace an existing timber weir. This structure will be a fixed crest weir with three variable crest sections. The structure at ES 23 will replace an existing timber weir with a fixed crest weir with two variable crest sections. All of these weirs will be operated passively. However, variable crest sections will allow some flexibility in operation should monitoring dictate, and provide additional opening to enhance drainage after hurricanes and major flood events.

D) A fixed crest weir will replace the existing timber weir at ES 24.

E) A rock plug will be constructed at ES 7 to stop tidal water exchange through this oil field canal. Rock will be used to stabilize channel cross-sections at ES 10 and ES 20 to allow continued water exchange without enlargement of the channel cross-section.

F) Shore and earthen embankment will be constructed along 12,500 feet of the southern project boundary to reestablish the bank of Bayou de Cade. Also, an additional 2,500 feet of embankment will be constructed along the eastern side of the Voss Canal. These embankments will be earthen material placed upon geo-textile fabric where needed. The settled crest elevation and base-width of the embankment will vary with the location. The embankment will be maintained during the projected 20 year life of the project.

G) Bank maintenance will be done along 29,600 feet of the Superior Canal, Bayou de Cade, and Turtle Bayou, if needed, during the projected 20 year life of the project.

WATER MANAGEMENT

The operation of structures will be passive. Water movement through the project will be regulated consistently during all seasons and years. Structures do allow some flexibility in regulating water flow following special conditions such as storm surges, if needed, or to respond to future monitoring information.

The modification of the Brady Canal area will not make the area a "water tight" system. Instead it will be considered a "leaky" system in which the flow of water from outside sources will be retarded within the system. This will be accomplished through the installation of structural measures along the western and southern boundaries of the area.

For the pre-project or existing conditions the major inflow of outside water into the western/southern portion of the area is assumed to occur at sites 1, 14, 17 (17S - south and 17W - west canals) (Figure 4). The total cross sectional area for these four points is approximately 602 square feet (Table 6). This assumes that all water entering through site 1 is available for the marsh. Discharge from this area occurs in the openings at sites 6, 7, 10, and 20 (Figure 4). This total area equates to a total cross sectional area of 5,870 square feet. The available area for both inflow and outflow are referenced as area below marsh elevation.

For the proposed project conditions, inflow to the west side of the area is basically through the four openings at the locations identified above. These four areas are identified as Sites 1, 14, 17S, and 17W (Figure 4). Modifications to the existing structures at 1 and 14 are

proposed. The sum of the maximum cross sectional areas (includes opening of variable crest bays) for these four sites equates to approximately 726 square feet (Table 6). The outflow from this area with the proposed project in place is primarily through sites 6, 10, and 20. The existing opening at site 7 is proposed to be closed with a rock plug, a weir with a barge bay is proposed at site 6, and the openings at 10 and 20 are proposed to be rock lined. The sum of these outflow cross sectional areas is approximately 1,945 square feet. This equates to a net potential outflow area that is 1,219 square feet (Table 6) larger than the inflow area. NRCS has used with success in the past a design criteria of 1 foot of weir length for 70 acres of marsh. The proposed weir at site 6 has 145 feet of fixed crest weir set at 0.5 below marsh level. This fixed section should adequately provide drainage for the area behind the structure.

Table 6. Comparison of Cross Sectional Areas for the Existing and Recommended Plan.

Site ** No.	Cross Sectional Area Existing (Sq. Feet.)	Cross Sectional Area Proposed (Sq. Feet.)	Cross Sectional Area Proposed Maximum (Sq. Feet.)
1 (In)	45	50	110
6 (Out)	1,390	668	668
7 (Out)	2,330	0	0
10 (Out)	1,292	720	720
14 (In)	33	42	72
17S (In)	296	296	296
17W (In)	276	276	276
20 (Out)	990	557	557
21	48	48	138
23	56	58	118
24	130	150	150

** "In" refers to inflow into the system and "Out" to outflow from the system

Notes:

1. All cross sectional areas shown above are referenced to below marsh level.
2. Existing cross sectional area corresponds to existing sections.
3. Proposed cross sectional area depicts measures proposed without additional area provided in variable crest elevation bays.
4. Proposed maximum cross sectional area refers to area inclusive of variable crest elevation bays.
5. Only sites where structural measures will be installed or replace existing structures are depicted in this table.

Using the net outflow area of 1219 square feet (Table 6) as available discharge area, it appears that this is an adequate cross sectional area to discharge both the water introduced from outside the system and provide internal drainage associated with storm water runoff. By reducing the size of available opening on the southern end of the project area with implementation of the proposed measures, water levels can be somewhat stabilized and the exchange velocities reduced. As a result of the throttling of the water exiting the system, nutrients and sediments can be retained to enhance the marsh.

The earthen embankment proposed along Bayou DeCade and Voss Canal will eliminate water exchange between the inside and outside. The structures at site 21, 23, and 24 will be of basically the same dimensions, and set at the same elevation, as the existing structures with the exception of the structures at 21 and 23, that will have variable crest elevation bays. These variable crest elevation bays will allow for modification of the operation of these structures should monitoring or changes in the flow pattern of the system so dictate.

ANTICIPATED BENEFITS

Over the life of the project, measures would enhance 188 acres of fresh, intermediate, and brackish marsh through greater utilization of freshwater and sediment and improved hydrologic conditions. Land loss rates will be reduced and approximately 306 acres of emergent vegetation will be protected (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993). Expansion of the emergent marsh into shallow open water areas and increased plant productivity are expected to result from implementation of the project. Benefits are projected for a project life of 20 years; however project benefits may extend beyond 20 years (Louisiana Coastal Wetlands Conservation and Restoration Task Force 1993).

PERMITS AND COMPLIANCE

All necessary permits and approvals will be obtained before project construction is authorized. Applicable federal and state statutes are shown in Table 7. The proposed action is not expected to cause adverse environmental impacts requiring environmental mitigation.

None of the known archaeology sites fall within specific construction locales, although 16 TR 29 is located on the south side of Bayou de Cade, opposite a proposed spoil bank. Three other known sites, 16 TR 46, 16 TR 113, and 16 TR 217, could be impacted if spoil banks are constructed along Turtle Bayou and Superior Canal. The greatest potential for impacts is to potential, unrecorded, sites located along Bayou de Cade and Bayou Mauvais Bois in the area of the proposed spoil bank, and sites that could be destroyed as a result of erosional forces if no action is taken. Sites will be mitigated depending upon impacts and significance of the site.

COSTS

The total cost for the project was estimated, including cost for the duration of construction and life expectancy of the project. Information pertaining to project costs is provided in Appendix C.

Table 7: Environmental Compliance

STATUTE	COMPLIANCE
Federal	
Archaeological and Historic Preservation Act of 1974	Full
Clean Water Act of 1977, as amended	Partial [a]
Coastal Zone Management Act of 1972, as amended	Partial [b]
Endangered Species Act of 1973, as amended	Full
Fish and Wildlife Coordination Act, as amended	Full
National Environmental Policy Act of 1969, as amended	Partial [c]
National Historic Preservation Act of 1966, as amended	Full
Protection and Enhancement of the Cultural Environment, (Executive Order 11593)	Full
Protection of Wetlands (Executive Order 11990)	Full
River and Harbor and Flood Control Act of 1970	Full
State	
Louisiana State and Local Coastal Resources Management Act of 1978	Partial [b]
Louisiana Water Control Act	Partial [a]

[a] An application for a State of Louisiana Water Quality Certificate will be submitted.

[b] The permit application for the proposed project will be sent to the Louisiana Department of Natural Resources/Coastal Zone Management division.

[c] Upon completion of a Section 404(b)(1) Evaluation, circulation of a Public Notice, receipt of a State Water Quality Certificate, State concurrence with a Consistency determination, review of the Project Plan/EA by appropriate agencies and individuals, and signing of the FONSI, full compliance with these statutes will be achieved.

CONCLUSION

The United States Department of Agriculture, Natural Resources Conservation Service finds no significant impacts to endangered species, cultural resources, fisheries, wildlife, and water quality associated with the Brady Canal Hydrologic Restoration project. A passive water management plan is proposed to alleviate the ongoing trends of land loss and increased tidal water movement within the 7,653-acre project area. Approximately 188 acres of wetlands will be enhanced. The loss of approximately 306 acres of emergent wetlands will be prevented by installation and maintenance of the project. The long-term protection and enhancement of the project area will provide habitats critical to fish and wildlife in the area.

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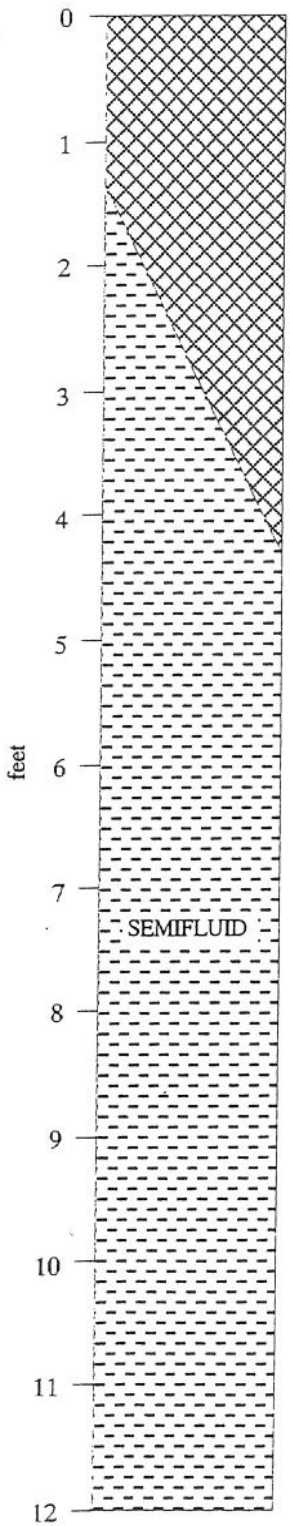
APPENDICES

APPENDIX A - SOIL PROFILES

ALLEMANDS SERIES

SOIL PROFILE



This series consists of very poorly drained semi-fluid organic soils which occupy large freshwater marsh areas. These soilt are near mean sea level along the landward side of marshes or along distributary channels buried under the marsh The salinity ranges from 0 to 5 ppt.

Allemands soils are geographically associated with the Kenner, Larose, Barbary, Clovelly and Lafitte soils. The Barbary and Larose soils have thin organic surface layers. The Kenner and Lafitte soils have thicker organic layers, and Lafitte and Clovelly occupy brackish marsh rather than fresh.

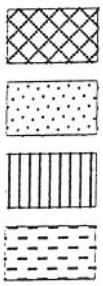
Soil Characteristics

The organic surface layers are black peat or muck 16 to 51 inches thick. The underlying mineral layers are gray semi-fluid clayey material. The reaction of the organic layers ranges from neutral to strongly acid and the mineral layers range from strongly acid to moderately alkaline. After drainage, the upper 15 inches range to extremely acid and the organic layer will be firmer.

Use and Management

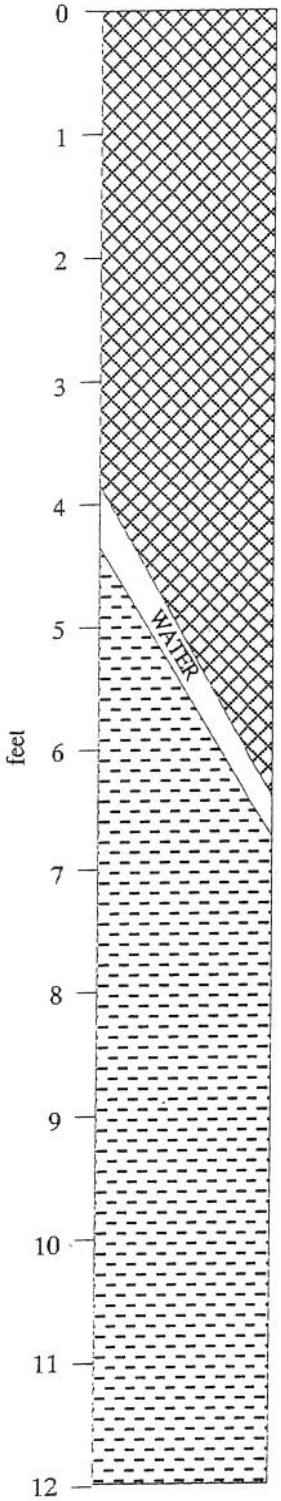
The major land use for this soil is related to wildlife. Most of it is managed for hunting, trapping, and fishing. Deer, alligator, crawfish, rabbit, nutria, and duck populations are usually high. The typical plants growing on this soil are maidencane, bulltongue, alligatorweed, cattail, giant cutgrass, pickerelweed, smartweed and common rush. Scattered bald cypress trees are on this soil adjoining swamps.

The dominant limitations influencing the use and management of the Allemands soil are the high subsidence potential, low bearing strength, danger of deep flooding during storms and the threat of salt water intrusion which could change the vegetative type. Structures such as weirs require piling due to the low soil strength. When these soils are drained they become extremely acid and subside below sea level. Maintenance cost of urban and residential development are high due to pumping costs and damage to sidewalks, driveways, porches, and underground utilities.



Please Note A Bancker soil profile sheet is not available at this time. Larose could be substituted. Both soil profiles are similar in their geographic setting, drainage, permeability, soil development and land use. However, Bancker formed in brackish coastal marshes, versus fresh coastal marshes for Larose. Thus, you have a difference in water salinity and plant community for these soils.

SOIL PROFILE

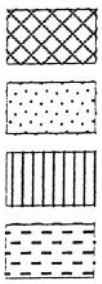


CARLIN PEAT

This is a very poorly drained soil that occurs in large areas in the "floating" marshes. The surface layer is strongly acid to neutral very dark grayish brown mucky peat about 12 inches thick. The underlying layer is moderately alkaline, very dark grayish brown mucky peat. The fibrous peat surface layer floats on a layer of water that is greater than 50 inches to the mineral layers. Small areas of other soils with different properties may be included with this soil.

Permeability is rapid, but there is little movement of air because the water table is high. There is no internal drainage and runoff is very slow. Trafficability is poor.

Carlin soils are used for wildlife habitat. They provide fair habitat for ducks, geese, and other waterfowl. They also provide excellent habitat for furbeares and alligators. Water control structures for wildlife management purposes are extremely difficult to install because of the water layer and the unstable nature of the organic material. A few areas of this soil may change locations due to winds from hurricanes.



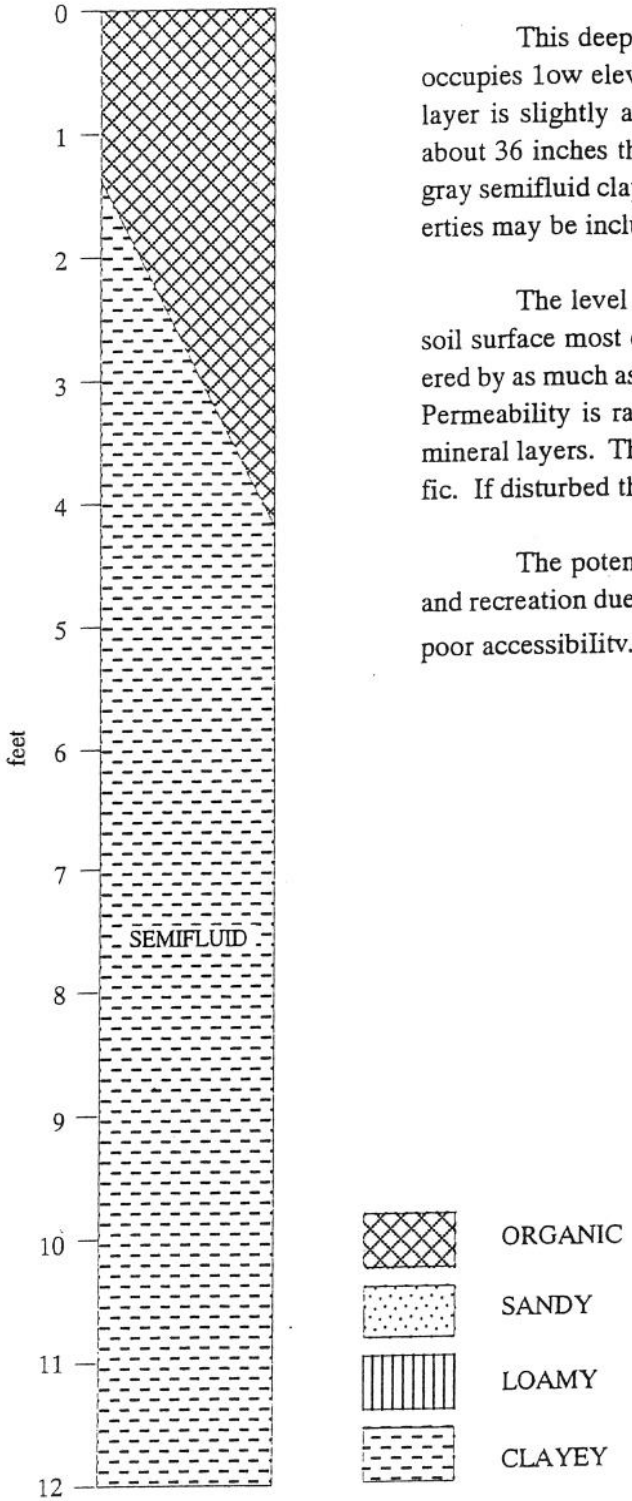
ORGANIC

SANDY

LOAMY

CLAYEY

SOIL PROFILE



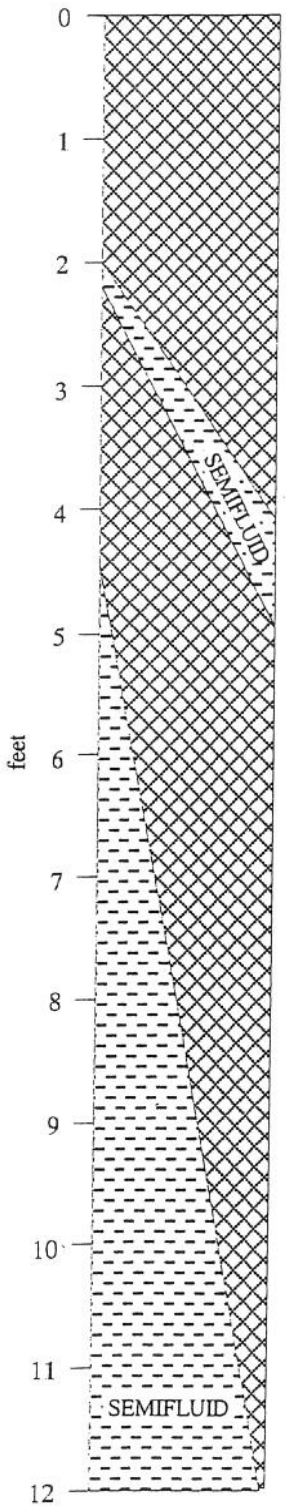
CLOVELLY MUCK

This deep, level, very poorly drained brackish marsh soil occupies low elevations along major drainageways. The surface layer is slightly acid, very dark grayish brown organic material about 36 inches thick. The underlying layer is neutral black and gray semifluid clay. Small areas of other soils with different Properties may be included with this soil.

The level of moderately saline water is near or above the soil surface most of the year. During storm tides this soil is covered by as much as 3 feet of water. Surface runoff is slow or none. Permeability is rapid in the organic layers and very slow in the mineral layers. This soil will not support human or livestock traffic. If disturbed the soil tends to liquity.

The potential is very poor for all uses other than wildlife and recreation due to wetness, flooding, salinity, low strength, and poor accessibility.

SOIL PROFILE

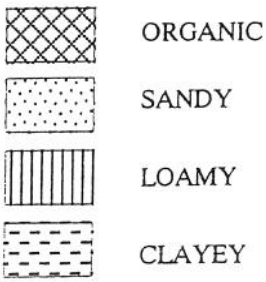


KENNER MUCK

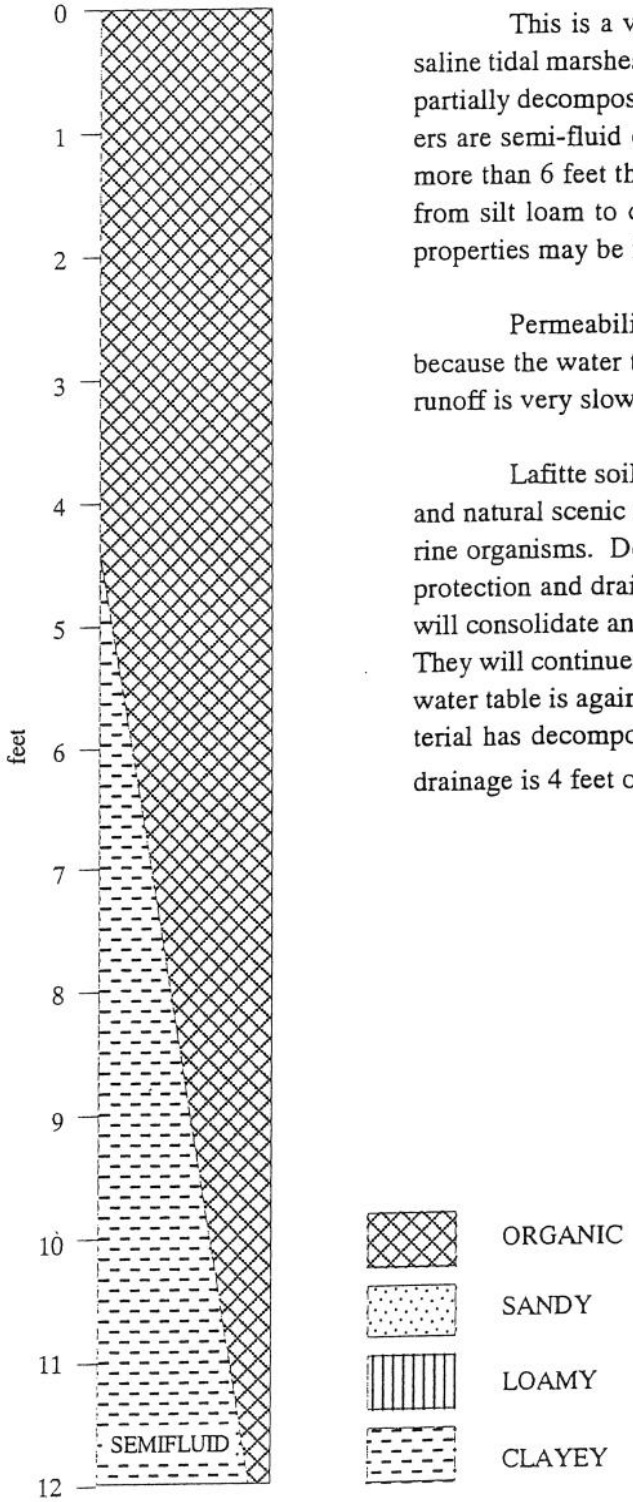
This unprotected, undrained soil oocupies low elevations in fresh or slightly saline coastal marshes. Typically this soil consists of very poorly drained, organic soils that have more than 51 inches of very dark gray to black, well decomposed organic material stratified with thin semifluid gray clayey layers. Small areas of other soils with.different properties may be included with this soil.

The water table ranges from 1/2 foot below to 1 foot above the soil surface. Surface runoff is very slow. Permeability is rapid in the organic material and very slow in the mineral layers. If disturbed this soil tends to liquiefy.

The potential is very poor for all uses other than wildlife and recreation due to wetness, flooding, poor accessibility and low strength.



SOIL PROFILE



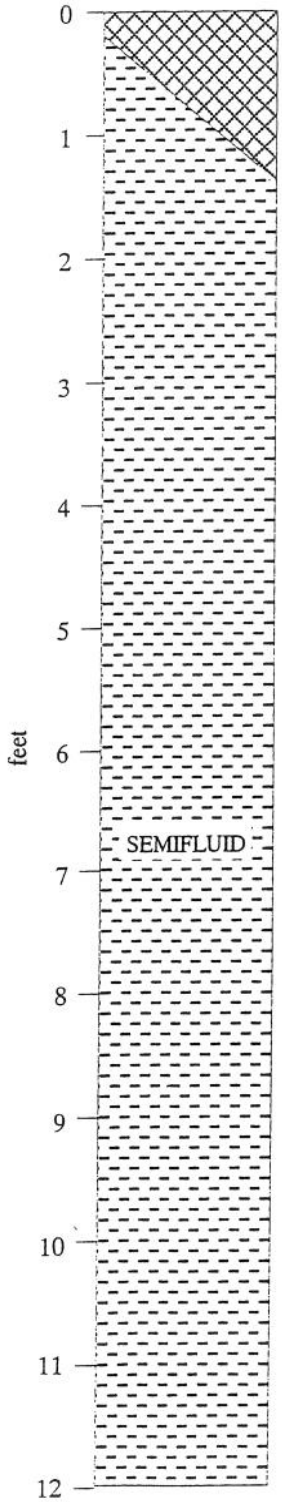
LAFITTE MUCK

This is a very poorly drained organic soil in the slightly saline tidal marshes. The surface layer is a dense mat of living and partially decomposed herbaceous plant roots. The underlying layers are semi-fluid organic materials. The organic layers are 4 or more than 6 feet thick and underlain by mineral layers that range from silt loam to clay. Small areas of other soils with different properties may be included with this soil.

Permeability is rapid, but there is little movement of air because the water table is high. There is no internal drainage and runoff is very slow. Trafficability is very poor.

Lafitte soils are suitable for wetland wildlife, open space, and natural scenic or study areas. They are nursery areas for marine organisms. Development for urban use requires major flood protection and drainage by pumps. If drained, the organic layers will consolidate and shrink to about one-half the original volume. They will continue to subside about 1 to 2 inches per year until the water table is again at the surface or until most of the organic material has decomposed. Total potential subsidence as a result of drainage is 4 feet or more.

SOIL PROFILE

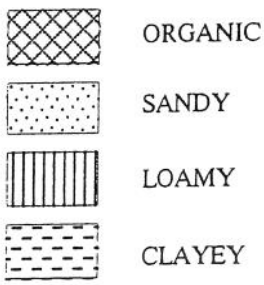


LAROSE MUCK

This unprotected, undrained soil occupies low elevations in fresh coastal marshes. The surface layer is dark gray muck about 5 inches thick. The underlying layers are gray, dark gray, or greenish gray semifluid clay to a depth of about 84 inches. Small areas of other soils with different properties may be included with this soil.

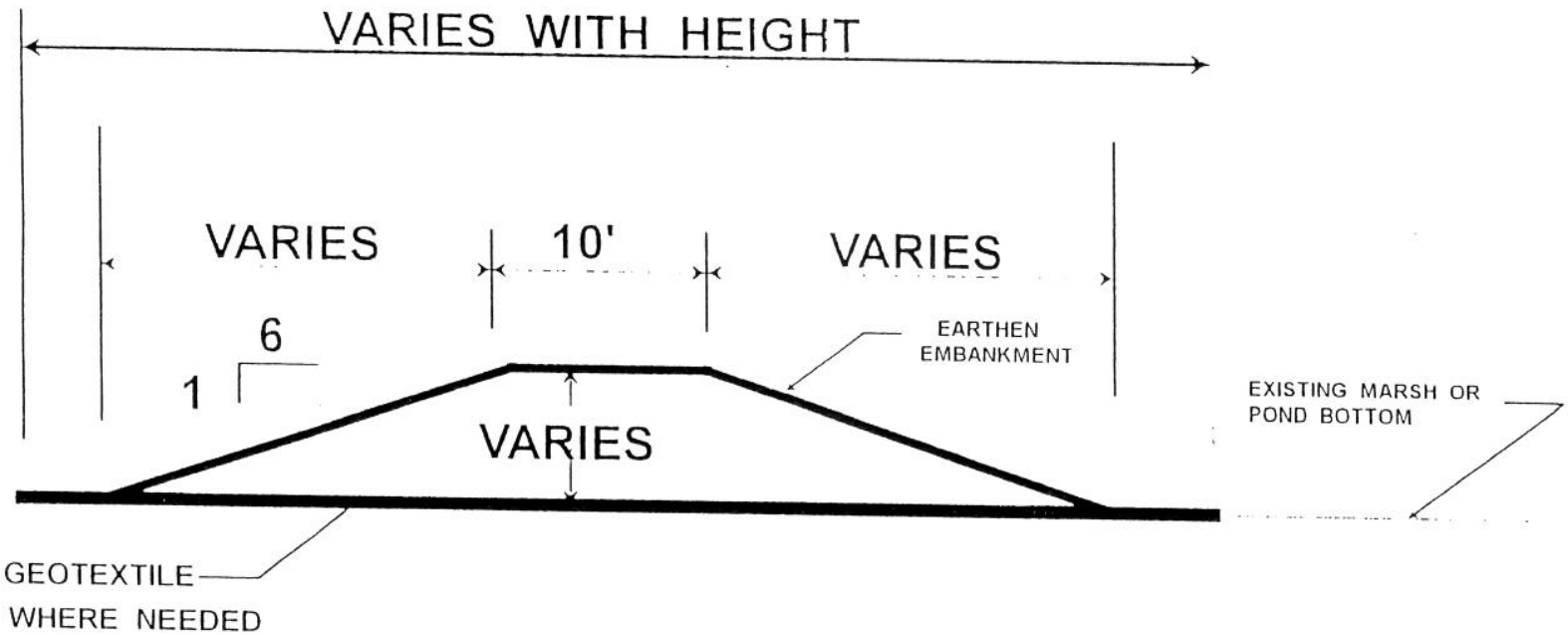
The water table ranges from 1/2 foot below to 2 feet above the soil surface. Surface runoff is very slow and permeability is very slow. If disturbed, this soil tends to liquify.

The potential is very poor for all uses other than wildlife and recreation due to the wetness, flooding, poor aocessibiIity and low strength.



APPENDIX B - TYPICAL STRUCTURAL DRAWINGS

TYPICAL SECTION
EARTHEN EMBANKMENT



NOT TO SCALE

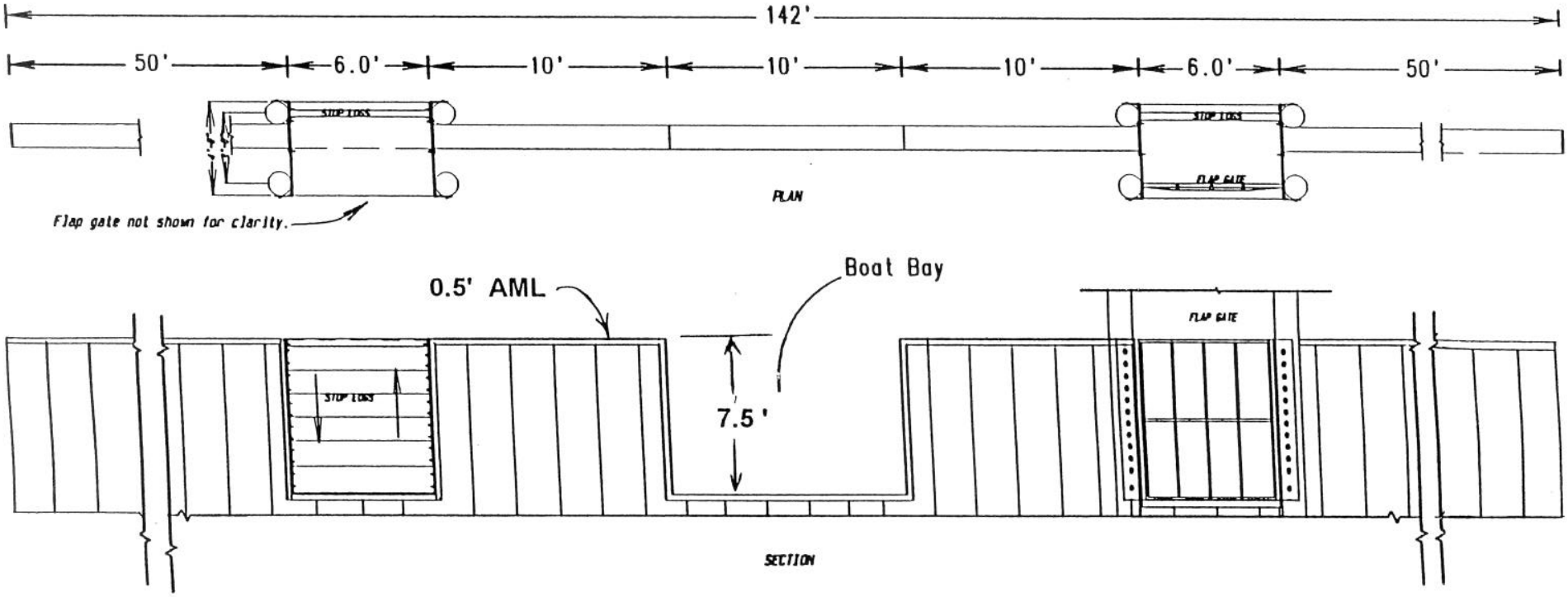
BRADY CANAL HYDROLOGIC RESTORATION

EARTHEN EMBANKMENT

TERREBONNE PARISH, LA

Typical Drawing

Weir w/Boat Bay & VC Sections w/Flap Gates



NOT TO SCALE

NOTE:
Dimension shown based upon planning surveys.

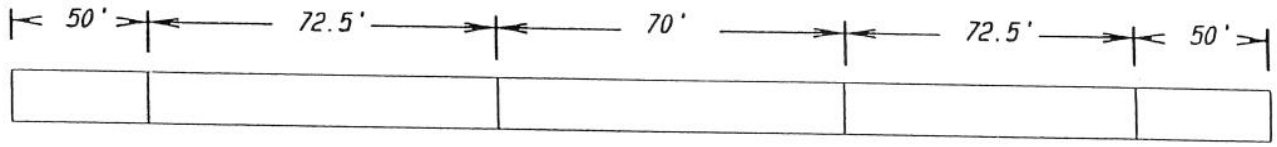
Brady Canal
Hydrologic Restoration

ES-1 Weir W/Boat Bay and
VC Sections w/Flap Gates

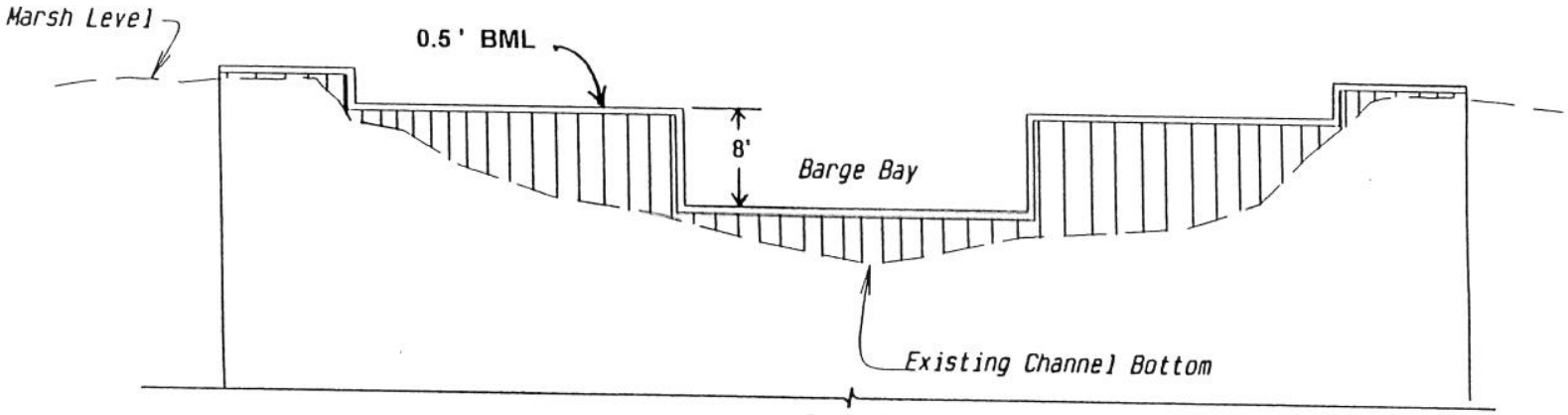
Terrebonne Parish, La.

TYPICAL DRAWING

FIXED CREST WEIR WITH BARGE BAY



Plan View



Section

NOTE:

Dimensions shown based upon planning surveys.

Not to Scale

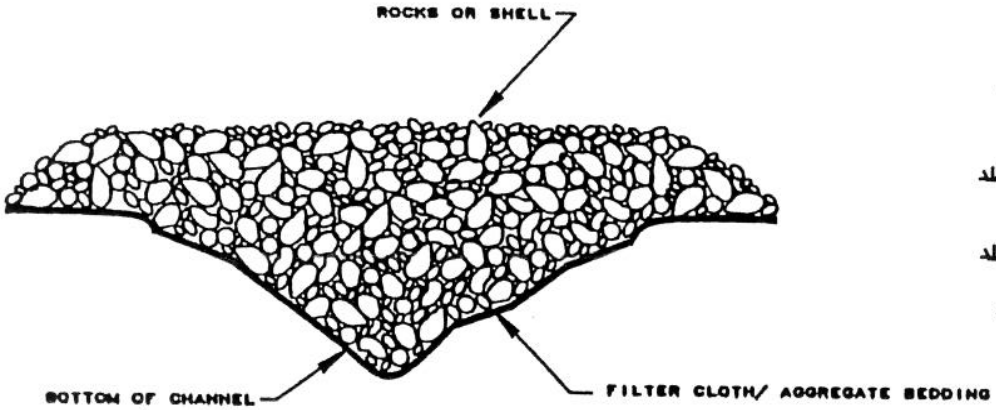
Brady Canal

Hydrologic Restoration

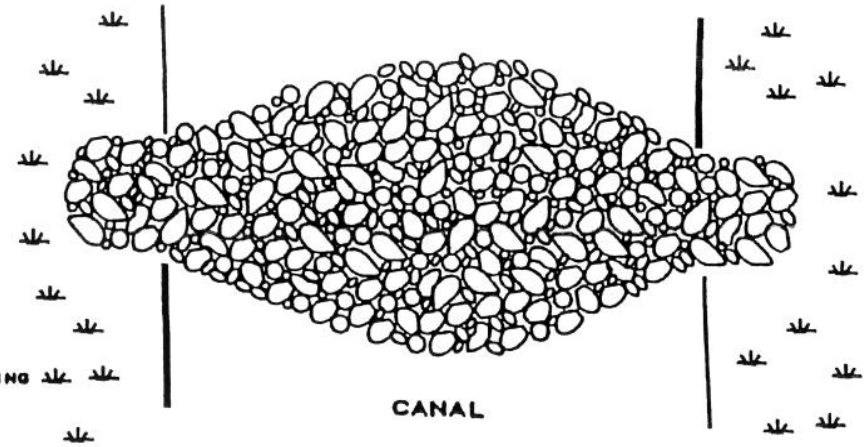
ES-6 Fixed Crest Weir W/Barge Bay

Terrebonne Parish, La.

TYPICAL DRAWING
ROCK PLUG



ELEVATION VIEW
NOT TO SCALE



PLAN VIEW
NOT TO SCALE

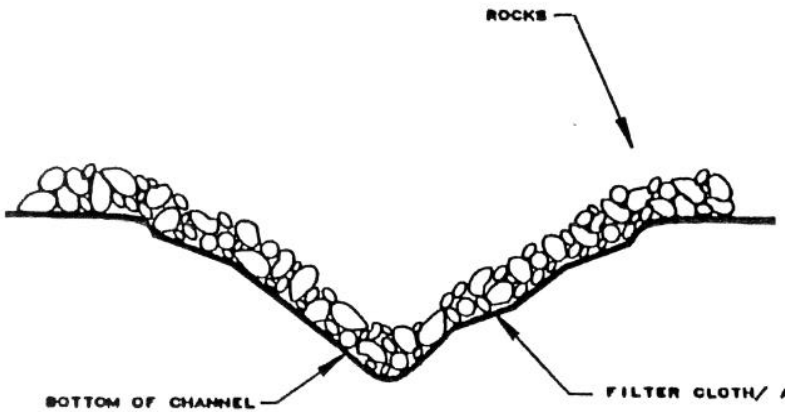
Brady Canal
Hydrologic Restoration
ES-7 Rock Riprap Plug

Terrebonne Parish, La.

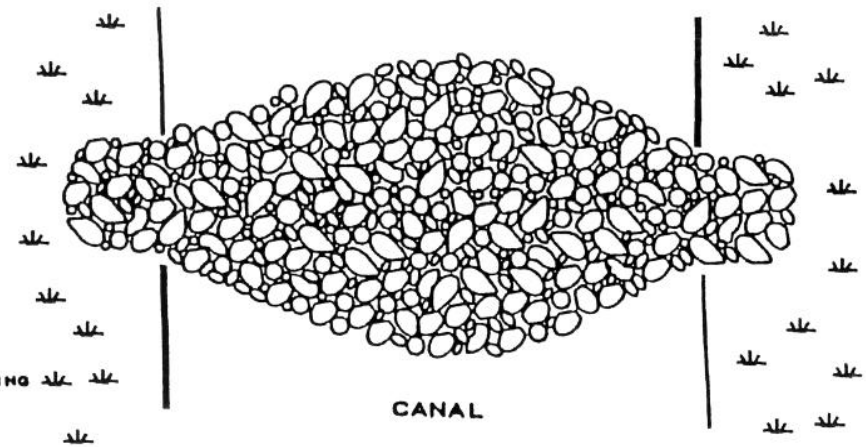
BRADY7

TYPICAL DRAWING

ROCK CHANNEL LINER



ELEVATION VIEW
NOT TO SCALE



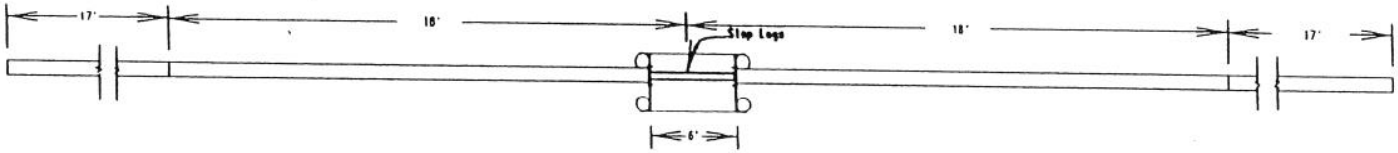
PLAN VIEW
NOT TO SCALE

Brady Canal
Hydrologic Restoration
ES-10,20 Rock Channel Liner
Terrebonne Parish, La.

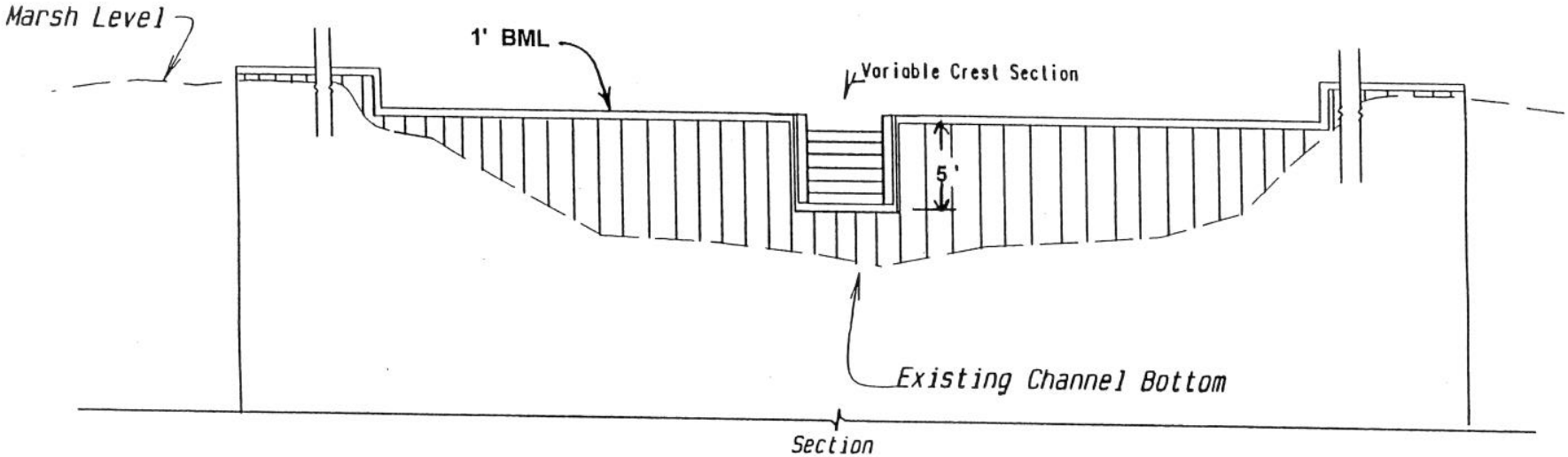
brady18

TYPICAL DRAWING

WEIR W/VARIABLE CREST SECTION



Plan View



Section

Not to Scale

NOTE:
Dimensions shown based upon planning surveys.

Brady Canal

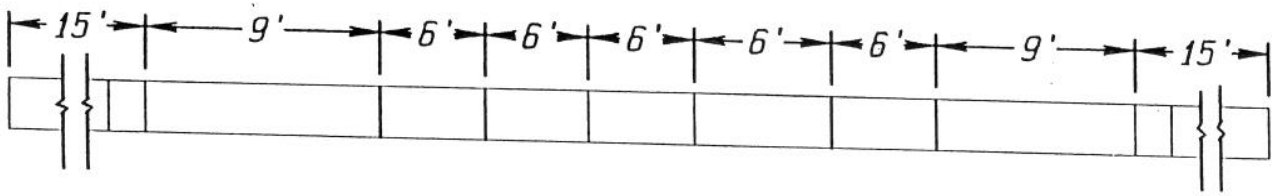
Hydrologic Restoration

ES-14 Weir W/Variable Crest Sections

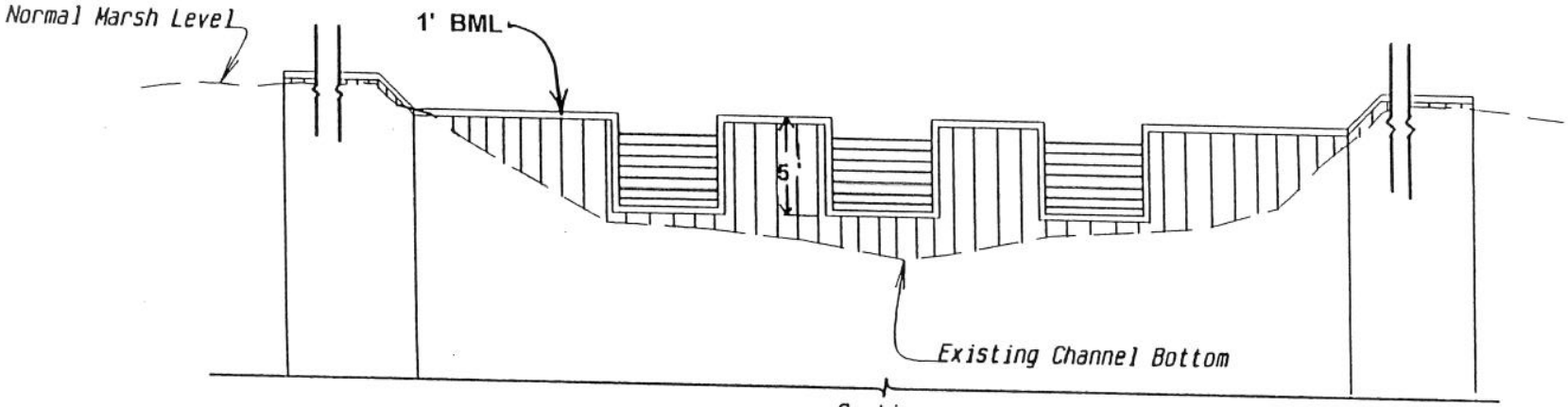
Terrebonne Parish, La.

TYPICAL DRAWING

WEIR WITH VARIABLE CREST SECTIONS



Plan View



Section

NOTE:
Dimensions shown based upon planning surveys.

Not to Scale

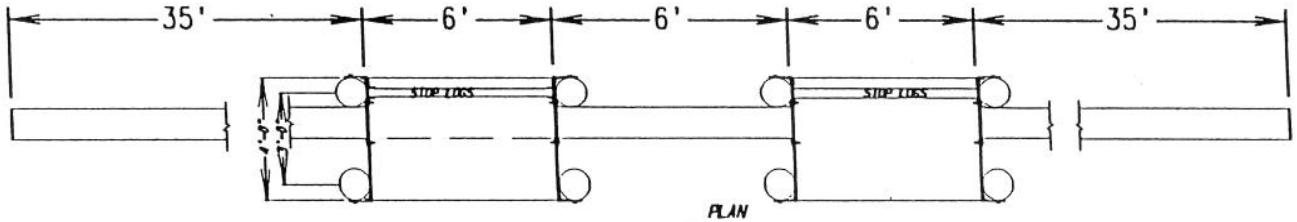
Brady Canal

Hydrologic Restoration

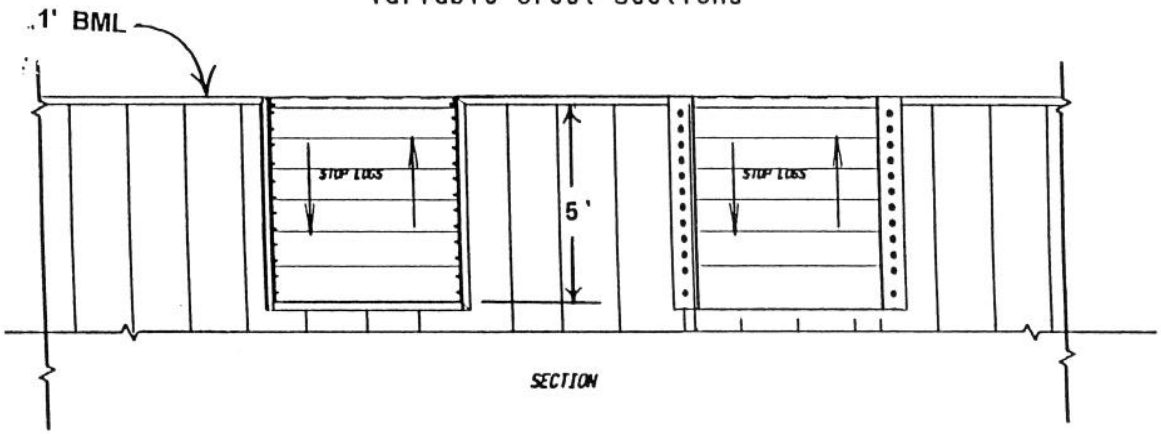
ES-21 Weir W/Variable Crest Sections

Terrebonne Parish, La.

TYPICAL DRAWING
WEIR W/VARIABLE CREST SECTIONS



Variable Crest Sections



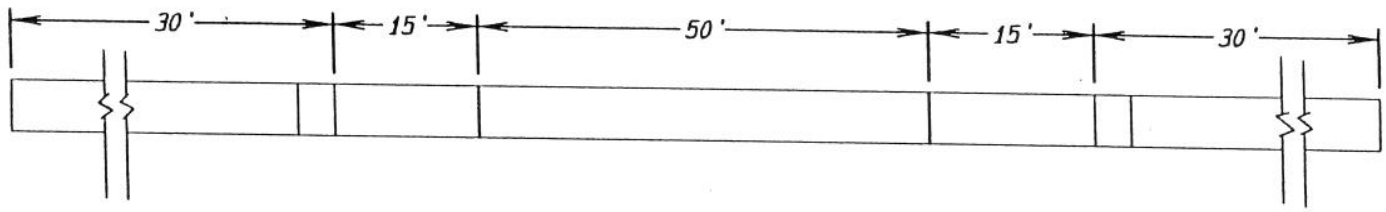
NOT TO SCALE

NOTE:
Dimensions shown based upon planning surveys.

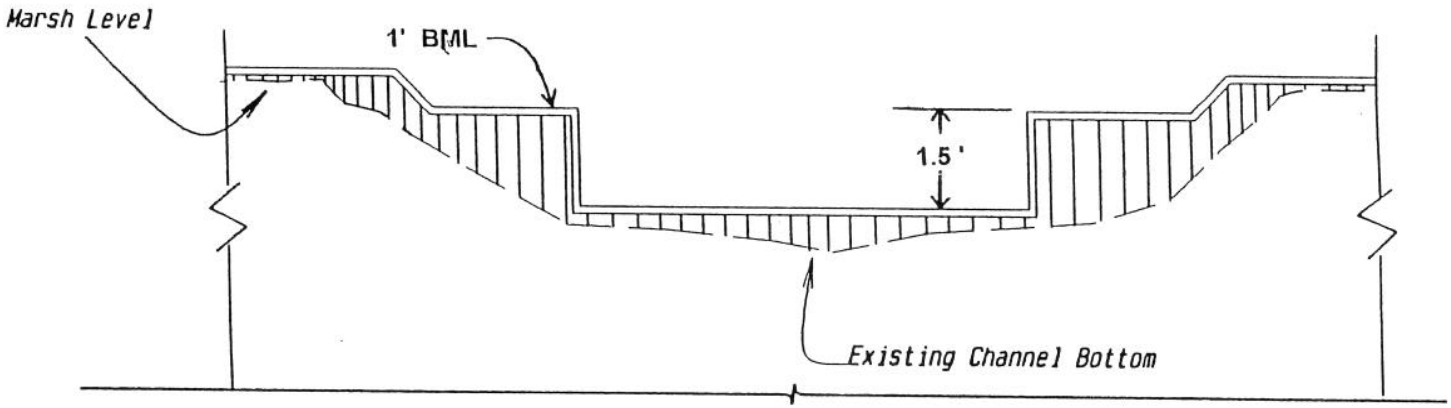
Brady Canal
Hydrologic Restoration
ES-23 Weir W/Variable Crest Sections
Terrebonne Parish, La.

TYPICAL DRAWING

FIXED CREST WEIR



Plan View



Section

Not to Scale

NOTE:
Dimensions shown based upon planning surveys.

Brady Canal
Hydrologic Restoration
ES-24 Fixed Crest Weir

Terrebonne Parish, La.

APPENDIX C - COSTS

Table C-13
Brady Canal Hydrologic Restoration
PTE-26b

Item	Description	Quantity	Unit	Unit Cost ($)	Amount ($)
1	Mob and Demob	1	LS		0
2	Overflow Bank	25,100	LF	29.00	728,000
3	Rock Weir	1,150	LF	305.00	351,000
4	60-in Aluminum Pipe	300	LF	55.00	17,000
5	60-in Aluminum Flap Gate	6	Ea	3,800.00	23,000
6	Fill Material	2,700	CY	15.00	41,000
7	Structure Installation	6	Ea	70,000.00	420,000
8	Rock Levee	300	LF	75.00	23,000
Total Construction Cost					1,603,000

From LA Coastal Wetlands Conservation and Restoration Task Force, 3rd Priority List.

Coastal Wetlands Conservation and Restoration Plan
Priority Project List

Brady Canal Hydrologic Restoration (PTE-26b)

First Costs and Annual Charges

Year	Fiscal Year	Engineering & Design	Easements & Land Rights	Supervision & Administration	Supervision & Inspection	Contingency	First Cost Construction	Total First Cost
5 Compound		$0	$0	$0	$0	$0	$0	$0
4 Compound		$0	$0	$0	$0	$0	$0	$0
3 Compound	1995	$48,889	$30,000	$20,000	$0	$0	$0	$98,889
2 Compound	1996	$61,111	$0	$60,000	$71,429	$285,884	$1,143,536	$1,621,959
1 Compound Base Year	1997	$0	$0	$10,000	$28,571	$114,354	$457,414	$610,339
TOTAL		$110,000	$30,000	$90,000	$100,000	$400,238	$1,600,950	$2,331,188

Year	Fiscal Year	Monitoring Costs	O&M Costs	Other Costs
1 Discount	1998	$25,875	$38,000	$0
2 Discount	1999	$25,875	$38,000	$0
3 Discount	2000	$25,875	$38,000	$0
4 Discount	2001	$25,875	$38,000	$0
5 Discount	2002	$25,875	$38,000	$0
6 Discount	2003	$25,875	$38,000	$0
7 Discount	2004	$25,875	$38,000	$0
8 Discount	2005	$25,875	$38,000	$0
9 Discount	2006	$25,875	$38,000	$0
10 Discount	2007	$25,875	$38,000	$0
11 Discount	2008	$25,875	$38,000	$0
12 Discount	2009	$25,875	$38,000	$0
13 Discount	2010	$25,875	$38,000	$0
14 Discount	2011	$25,875	$38,000	$0
15 Discount	2012	$25,875	$38,000	$0
16 Discount	2013	$25,875	$38,000	$0
17 Discount	2014	$25,875	$38,000	$0
18 Discount	2015	$25,875	$38,000	$0
19 Discount	2016	$25,875	$38,000	$0
20 Discount	2017	$25,875	$38,000	$0
Total		$517,500	$760,000	$0

From LA Coastal Wetlands Conservation and Restoration Task Force, 3rd Priority List.

20-Sep-93

Costs amortized over 20 year operation life

Coastal Wetlands Conservation and Restoration Plan
Priority Project List

Brady Canal Hydrologic Restoration (PTE-26b)

Project Construction Years:	4	Total Project Years	24
Interest Rate	8.25%	Amortization Factor	0.10375
Total First Costs	$2,331,200	Total Fully Funded Costs	$4,717,900

Annual Charges	Present Worth	Average Annual
Interest & Amortization	$2,686,800	$278,800
Monitoring	$249,400	$25,900
O & M Costs	$366,200	$38,000
Other Costs	$0	$0
Total	$3,302,400	$342,700
Average Annual Habitat Units		337
Cost Per Habitat Unit		$1,017
Average Annual Acres of Emergent Marsh		156

From LA Coastal Wetlands Conservation and Restoration Task Force, 3rd Priority List.

20-Sep-93

Costs amortized over 20 year operation life

Coastal Wetlands Conservation and Restoration Plan
Priority Project List

Brady Canal Hydrologic Restoration (PTE-26b)

Present Valued Costs Total Discounted Costs $3,302,390 Amortized Costs $342,623

Year	Compound Rates	Fiscal Year	Engineering & Design	Easements & Land Rights	Supervision & Administration	Supervision & Inspection	Contingency	First Cost Construction	Total First Cost
5	1.486	0	$0	$0	$0	$0	$0	$0	$0
4	1.373	0	$0	$0	$0	$0	$0	$0	$0
3	1.268	1995	$62,015	$38,054	$25,370	$0	$0	$0	$125,439
2	1.172	1996	$71,610	$0	$70,308	$83,700	$335,001	$1,340,002	$1,900,622
1	1.083	1997	$0	$0	$10,825	$30,929	$123,788	$495,151	$660,692
		Total	$133,625	$38,054	$106,503	$114,629	$458,788	$1,835,153	$2,686,753

Year	Discount Rates	Fiscal Year	Monitoring Costs	O&M Costs	Other Costs
-1	0.924	1998	$23,903	$35,104	$0
-2	0.853	1999	$22,081	$32,429	$0
-3	0.788	2000	$20,398	$29,957	$0
-4	0.728	2001	$18,844	$27,674	$0
-5	0.673	2002	$17,408	$25,565	$0
-6	0.621	2003	$16,081	$23,617	$0
-7	0.574	2004	$14,855	$21,817	$0
-8	0.530	2005	$13,723	$20,154	$0
-9	0.490	2006	$12,677	$18,618	$0
-10	0.453	2007	$11,711	$17,199	$0
-11	0.418	2008	$10,819	$15,888	$0
-12	0.386	2009	$9,994	$14,677	$0
-13	0.357	2010	$9,232	$13,559	$0
-14	0.330	2011	$8,529	$12,525	$0
-15	0.304	2012	$7,879	$11,571	$0
-16	0.281	2013	$7,278	$10,689	$0
-17	0.260	2014	$6,724	$9,874	$0
-18	0.240	2015	$6,211	$9,122	$0
-19	0.222	2016	$5,738	$8,427	$0
-20	0.205	2017	$5,301	$7,784	$0
		Total	$249,387	$366,250	$0
	Average Annual		$25,874	$37,998	$0

From LA Coastal Wetlands Conservation and Restoration Task Force, 3rd Priority List.

20-Sep-93 Costs amortized over 20 year operation life

Coastal Wetlands Conservation and Restoration Plan
Priority Project List

Brady Canal Hydrologic Restoration (PTE-26b)

Fully Funded Costs — Total Fully Funded Costs $4,717,928 — Amortized Costs $489,485

Year	Inflation Factor	Fiscal Year	Engineering & Design	Easements & Land Rights	Supervision & Administration	Supervision & Inspection	Contingency	First Cost Construction	Total First Cost
5		0	$0	$0	$0	$0	$0	$0	$0
4	1.031	0	$0	$0	$0	$0	$0	$0	$0
3	1.064	1995	$52,017	$31,920	$21,280	$0	$0	$0	$105,217
2	1.101	1996	$67,297	$0	$66,074	$78,659	$314,824	$1,259,298	$1,786,153
1	1.140	1997	$0	$0	$11,398	$32,565	$130,337	$521,349	$695,649
		TOTAL	$119,315	$31,920	$98,751	$111,224	$445,162	$1,780,647	$2,587,019

Year	Inflation Factor	Fiscal Year	Monitoring Costs	O&M Costs	Other Costs
-1	1.180	1998	$30,524	$44,827	$0
-2	1.221	1999	$31,592	$46,396	$0
-3	1.264	2000	$32,698	$48,020	$0
-4	1.308	2001	$33,842	$49,701	$0
-5	1.354	2002	$35,027	$51,440	$0
-6	1.401	2003	$36,253	$53,241	$0
-7	1.450	2004	$37,522	$55,104	$0
-8	1.501	2005	$38,835	$57,033	$0
-9	1.553	2006	$40,194	$59,029	$0
-10	1.608	2007	$41,601	$61,095	$0
-11	1.664	2008	$43,057	$63,233	$0
-12	1.722	2009	$44,564	$65,447	$0
-13	1.783	2010	$46,124	$67,737	$0
-14	1.845	2011	$47,738	$70,108	$0
-15	1.910	2012	$49,409	$72,562	$0
-16	1.976	2013	$51,138	$75,101	$0
-17	2.046	2014	$52,928	$77,730	$0
-18	2.117	2015	$54,780	$80,451	$0
-19	2.191	2016	$56,698	$83,266	$0
-20	2.268	2017	$58,682	$86,181	$0
		Total	$863,206	$1,267,703	$0

From LA Coastal Wetlands Conservation and Restoration Task Force, 3rd Priority List.

20-Sep-93 — Costs amortized over 20 year operation life

APPENDIX D - LETTERS OF COMMENT AND RESPONSES

The following pages document the comments on the Draft EA that were received from federal and state agencies, and the response to those comments by the NRCS. Comments are summarized and, with responses, are grouped by agency. Page numbers used in individual agency comments refer to the Draft EA. Page numbers used in NRCS's response to those comments refer to the present document. Copies of agency letters are provided at the end of this Appendix.

UNITED STATES DEPARTMENT OF COMMERCE,
National Oceanic and Atmospheric Administration,
National Marine Fisheries Service

GENERAL COMMENTS:

Comment 1: Discussion of impacts on various resources is insufficient and difficult to follow. The EA should be revised such that impacts on various resources are identified and discussed separately.

Response: Impacts were described conform to the NRCS Plan/EA format. The discussion of impacts on the various resources and activities for the preferred alternative (Hydrologic Restoration) has been reorganized topically, by paragraph corresponding to the discussion under the No-Action Alternative.

SPECIFIC COMMENTS:

Comment: page 35, ¶7 - Should be revised to state that, without project implementation, marsh types are not expected to change significantly.

Response: NRCS is of the opinion that, without the proposed measures, the continuing loss of marsh to the south of the project area will increase exchange of water between the general project area and Lake Mechant. This is expected to result in an increase in water salinity, especially during the summer and fall season, when Atchafalaya River discharges are low and tidal water levels are elevated. It is not implied that this will result in a shift from intermediate to brackish marsh. With further deterioration of the Mauvais Bois Ridge, however, even a moderate increase in salinity is likely to result in a shift from fresh to intermediate marsh north of the Mauvais Bois Ridge and, at least, in a change in vegetative composition of the intermediate marsh south of the ridge.

Comment: page 40, ¶1 - The depth of the boat bay should be indicated, and causes for operation of the structure should be discussed.

Response: Text has been revised to include this information.

Comment: page 40, ¶2 - The depth of the barge bay should be indicated.

Response: Text has been revised to include this information.

Comment: page 40, ¶6 and ¶7 - Elevations and widths of proposed embankments should be indicated. Text should mention that dredging and filling for maintenance purposes would have to be undertaken several times during the 20-year project life in order to maintain project integrity and achieve projected benefits.

Response: As shown in the appendix, embankments will be constructed with a crest width of 10 feet and a side slope of 1V : 6H. The footprint will therefore depend on height of the embankment above the underlying surface. These heights vary with location of the embankment because of considerable local variation in water depths. Specific height cannot be provided until final engineering and design has been completed. Generally the height is expected to be in the order of 6 feet, resulting in a bottom width of about 80 feet.

The extent to which maintenance is required cannot be predicted and will depend largely on the magnitude, path, and proximity of tropical depressions during the next 20 years. The text has been revised to indicate that embankment maintenance will be performed during the 20-year project life when required.

UNITED STATES DEPARTMENT OF THE INTERIOR,
Fish and Wildlife Service

SPECIFIC COMMENTS:

Comment: The Arctic peregrine falcon was recently removed from the Federal list of threatened and endangered species and need not be discussed in that context.

Response: Text has been modified accordingly.

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

October 20, 1995

Planning Division
Environmental Analysis Branch

Ms. Faye Talbot
Field Office Project Support Staff
U.S. Department of Agriculture
Natural Resources Conservation Service
3470 NE Evangeline Thruway
Lafayette, Louisiana 70507-2554

Dear Ms. Talbot:

We have reviewed the Environmental Assessment for the Brady Canal Hydrologic Restoration (PTE-26b) project in Terrebonne Parish, Louisiana. Section 10 and Section 404 permits from the U.S. Army Corps of Engineers would be required for the proposed features of this project. We have no additional comments to offer regarding this document.

Sincerely,

R. H. Schroeder, Jr.
Chief, Planning Division

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive
St. Petersburg, Florida 33702

September 28, 1995

F/SE024/RH:jk
504/389-0508

DSTC
BCL ASTC/NR
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Faye 10

Mr. Bennett C. Landreneau
Natural Resources Conservation Service
3737 Government Street
Alexandria, Louisiana 71302

Dear Mr. Landreneau:

The National Marine Fisheries Service has received the Draft Project Plan and Environmental Assessment (EA) for the Brady Canal Hydrologic Restoration Project (PTE-26b) transmitted by your September 8, 1995, letter. The EA describes the anticipated environmental impacts of the installation of water control structures and rebuilding of the shoreline of Bayou de Cade and Voss Canal to promote freshwater introduction and retention, and reduce tidal flux in 7,653 acres of fresh and intermediate marsh in Terrebonne Parish, Louisiana. Detailed project planning was authorized pursuant to the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA).

We have reviewed the EA and offer the following general and specific comments.

GENERAL COMMENTS

While the EA adequately describes existing conditions in the project area, the discussion of the impacts of the preferred plan on various resources in the project area is insufficient and difficult to follow. The EA should be revised such that the impacts of project implementation on various described resources and activities are identified and discussed separately.

SPECIFIC COMMENTS

FORMULATION AND COMPARISON OF ALTERNATIVES
EFFECTS OF ALTERNATIVE PLANS
NO ACTION

Page 35, paragraph 2. This paragraph indicates, without project implementation, the marsh would be expected to become vegetated with salt tolerant species. Information provided in the EA clearly demonstrates the project area has changed from brackish marsh to a fresh-intermediate mixture. With the growth of the Atchafalaya Delta, it is unlikely this marsh will revert back to a brackish habitat without project implementation. This paragraph should be revised to state that, without project implementation, marsh types are not expected to change significantly.

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RECOMMENDED PLAN
PROPOSED MEASURES
STRUCTURE DESCRIPTIONS

Page 40, paragraph 1. The depth of the boat bay in the weir to be installed at ES 1 should be indicated in the structure description. In addition, conditions that may cause the structures to be actively operated should be identified and discussed.

Page 40, paragraph 2. The depth of the barge bay in the weir to be installed at ES 6 should be indicated in the structure description.

Page 40, paragraphs 6 and 7. The elevations and width of all embankments proposed for construction or maintenance should be indicated to allow for a determination of the area impacted by filling. In addition, these paragraphs should indicate it is likely that dredging and filling to rebuild shorelines, because of subsidence and wave and storm erosion, probably would need to be undertaken several times during the 20-year project life to successfully maintain these boundaries and estimated project benefits.

We appreciate the opportunity to review and comment on this EA. If you wish to discuss this project further or have questions regarding our comments, please contact Richard Hartman at (504) 389-0508.

Sincerely,

Ricky N Ruchsamen

for Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

United States Department of the Interior

FISH AND WILDLIFE SERVICE
825 Kaliste Saloom Road
Brandywine Bldg. II, Suite 102
Lafayette, Louisiana 70508

October 19, 1995

STC
DSTC
ASTC/WR
ASTC/P
SAO
SRC
SCE
SSS
PAS
IEM
PER
SNM
WR

Mr. Bennett C. Landreneau
Assistant State Conservationist
Natural Resources Conservation Service
3737 Government Street
Alexandria, Louisiana 71302

Dear Mr. Landreneau:

We have reviewed the draft Environmental Assessment (EA) for the Brady Canal Hydrologic Restoration Project (PTE-26b) in Terrebonne Parish, Louisiana. That EA was transmitted by your September 8, 1995, letter to this office. The project is being funded by the Coastal Wetlands Planning, Protection and Restoration Act. The following comments are provided in accordance with provisions of the National Environmental Policy Act of 1969 and the Endangered Species Act of 1973, as amended.

Overall, the EA adequately describes the impacts of the project to fish and wildlife resources. The following comment addresses our specific concern.

The peregrine falcon is mentioned in the threatened and endangered species discussions on pages 1 and 28. The Arctic peregrine falcon is the only listed falcon species expected to occur in the project area; that species was recently removed from the Federal list of threatened and endangered species. Therefore, the peregrine falcon need not be included in these discussions.

The Fish and Wildlife Service concurs in the findings of the EA and supports implementation of the project, which will protect and enhance wetlands. Project implementation will also provide valuable information for planning future hydrologic management features in the Penchant subbasin.

Please contact Gerry Bodin of this office (318) 262-6662, extension 244, if questions arise.

Sincerely,

Russell C. Watson
Acting Field Supervisor

cc: EPA, Dallas, TX
NMFS, Baton Rouge, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
US Army Corps of Engineers, New Orleans, LA

United States Department of the Interior

NATIONAL BIOLOGICAL SURVEY
Southern Science Center
700 Cajundome Boulevard
Lafayette, Louisiana 70506

31 July 1995

Ms. Faye Talbot
Natural Resource Conservation Service
3470 NE Evangeline Throughway
Lafayette, LA 70507-2554

Dear Ms. Talbot:

Because I am unable to attend the public hearing for the Brady Canal Hydrologic Restoration Project, please include my written comments.

Although landscape-level restoration projects are not well understood, I strongly support the construction of the Brady Canal Project as a reasonable and well-thought-out attempt to direct natural processes (hydrologic and sedimentologic) to benefit emergent wetlands. It is likely that there will be certain benefits and losses to this technique and a great deal of fine-tuning will be required in attempts to optimize the factors influencing wetland health. The best way for this to be done is with the assistance of a suite of wetland experts working in concert with landowners to measure, monitor, and adjust the variables that can be managed in the project area. The plan has been written honestly, and in a manner that reflects some of the uncertainties that will have to be dealt with following construction. I believe this to be a highly appropriate use of goverment (both State and Federal) funds and expertise. The questions resolved by efforts such as the Brady Canal are of a scale that landowners alone should not be expected to answer. Furthermore, without attempts such as this one, we will remain unable to advance the understanding and science of coastal restoration techniques. If sub-basin level restoration projects prove to be useful tools, the benefits are distributed to landowners, resource users and other concerned citizens.

This plan builds on an existing base of knowledge and reflects in its design that it has addressed the following key problems:

- Provides for ingress and egress of estuarine organisms
- Recognizes the limitations of construction in deltaic soils
- Designed to allow a flow-through system of sediment-laden waters
- Designed to achieve a check on the internal salinity gradient
- Risks resulting from hurricanes
- Configured to mute but not eliminate the tidal influence
- Considered and addressed the current-driven erosion of wetlands
- Recognized and supplemented the protection of natural barrier ridges
- Site access by boat

The U. S. National Biological Service's ongoing research project in the area should prove

very useful as a baseline for future monitoring efforts and we hope that our field research plans can be a supplement to the monitoring effort on the Brady Canal Project.

Sincerely,

A. Lee Foote, PhD

STATE OF LOUISIANA
DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
P. O. Box 94245
Baton Rouge, Louisiana 70804-9245

EDWIN W. EDWARDS
GOVERNOR

JUDE W. P. PATIN
SECRETARY

September 27, 1995

Ms. Faye Talbot
Staff Leader, Natural Resources
Conservation Service
U.S. Department of Agriculture
3470 Northeast Evangeline Thruway
Lafayette, Louisiana 70507-2554

Dear Ms. Talbot:

This is in response to your recent letter, requesting a response to your draft Environmental Assessment for the Brady Canal Hydrologic Restoration (PTE-266) project in Terrebonne Parish, Louisiana.

Please be advised that the Department of Transportation and Development supports your activities to combat wetland loss while maintaining and enhancing existing marshes.

If I can be of further assistance, please contact me or Mr. Curtis Patterson, (504) 379-1294.

Sincerely,

Jude W. P. Patin
Secretary

AN EQUAL OPPORTUNITY EMPLOYER
A DRUG-FREE WORKPLACE

State of Louisiana

Joe L. Herring
Secretary

Department of Wildlife and Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000
(504) 765-2800

Edwin W. Edwards
Governor

October 9, 1995

Ms Faye Talbot
Staff Leader
Natural Resources Conservation Service
3470 NE Evangeline Thruway
Lafayette, La. 70507-2554

Re: Draft Environmental Assessment for the Brady Canal Hydrologic Restoration (PRE-26b) project in Terrebonne Parish, Louisiana

Dear Ms. Talbot:

Personnel of our technical staff have reviewed the draft document for the above referenced project and have found that significant positive benefits to Brady Canal area of Terrebonne Parish should occur.

We very much appreciate the opportunity to review and comment on this project during the planning stages.

Sincerely,

Joe L. Herring
Secretary

JLH:fod

c: Phil Bowman