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FINAL

ENVIRONMENTAL STATEMENT

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

Prepared by

US ARMY ENGINEER DISTRICT, NEW ORLEANS
NEW ORLEANS, LOUISIANA

August 1974

Final Environmental Statement

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
(HURRICANE PROTECTION)

BASIC ECONOMIC DATA, EXTRACTED FROM US ARMY CORPS OF ENGINEERS LMV FORM 23 (REV), PREPARED 16 MAY 1974, WHICH REPRESENTS AN UPDATING OF DATA INCLUDED IN HOUSE DOCUMENT NO. 231, 89TH CONGRESS, 1ST SESSION, 1965 AND IN THE US ARMY CORPS OF ENGINEERS INTERIM SURVEY REPORT, 21 NOVEMBER 1962. COMPLETE DOCUMENTS AVAILABLE AT US ARMY ENGINEER DISTRICT, POST OFFICE BOX 60267, NEW ORLEANS, LOUISIANA 70160.

SUMMARY OF ECONOMIC ANALYSES OF THE SELECTED PLAN
IN THOUSANDS OF DOLLARS

First Cost	Average Annual Cost	Average Annual Benefits	Benefit-Cost Ratio
$327,000.00	$13,134.00	$165,678.00	12.6 to 1

ITEMIZED AVERAGE ANNUAL BENEFITS

Flood Damage Prevented		$157,296,000
Crop	$ 19,000	
Noncrop	$157,277,000	
Enhancement		
Land Intensification	5,696,000	5,696,000
Redevelopment	2,686,000	2,686,000
Total		$165,678,000

NONQUANTIFIABLE ENVIRONMENTAL BENEFITS AND COSTS HAVE NOT BEEN REFLECTED IN BENEFIT TO COST DETERMINATION TO THE FOLLOWING EXTENT:

LOSS OF MARSH AND SHALLOW OPEN WATER AREAS TO PROJECT FEATURES, LOSS OF DETRITAL MATERIALS FROM LEVEED WETLANDS, TURBIDITIES ASSOCIATED WITH CONSTRUCTION OF PROJECT FEATURES, ADJUSTMENT OF SALINITIES IN LAKE PONTCHARTRAIN BY THE SEABROOK COMPLEX, AND IMPACTS ASSOCIATED WITH ENHANCEMENT OF URBANIZATION AND INDUSTRIALIZATION IN LEVEED WETLANDS.

SUMMARY

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

(   ) Draft   (X) Final Environmental Statement

Responsible Office: US Army Engineer District, New Orleans
New Orleans, Louisiana

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

2. Description of Action: This project provides for the construction of a barrier along the east side of Lake Pontchartrain, a levee along the St. Charles Parish lakefront, a new levee along the Citrus and New Orleans East lakeshores, the improvement and enlargement of existing protective works on the south and north shores of the lake, along the Gulf Intracoastal Waterway (GIWW) and the Inner Harbor Navigation Canal (IHNC) including a dual-purpose lock at Seabrook, and necessary modifications to roads, pipelines, pumping stations, and drainage facilities. In view of the inclusion of Bayous LaBranche and Trepagnier in the Louisiana Natural and Scenic Rivers System, the construction of the St. Charles Parish levee has been deferred. The Chalmette Area Plan provides for construction of a new levee along the south shore of the Mississippi River-Gulf Outlet (MR-GO) from the IHNC to the vicinity of Verret and thence to the Mississippi River at Caernarvon. Control structures at Bayous Bienvenue and Dupre and a drainage structure at Whitehall Canal are provided. The purpose of this project is to provide for protection of life and property for existing development and future improvement against flooding caused by hurricane waves and surges.

3. Summary:

a. Environmental Impacts. The construction of the proposed hurricane tide barrier along the east side of Lake Pontchartrain will not affect the existing salinity gradient in the lake. Construction of the lock at Seabrook will allow for adjustment of salinities in the lake to maintain fish and wildlife resources. The improvement of existing levees will cause no significant project effects because of the normal metropolitan expansion that the area is presently undergoing. The destruction of marshes by the construction of levees in some areas along the lakefront will decrease the amount of marsh which produces and releases detritus into Lake Pontchartrain thereby decreasing the amount of secondary production or organic material in Lake Pontchartrain. Environmental changes that will occur at the Chef Menteur and Rigolets construction sites will be the destruction of brackish marsh by the construction of protective levees, new channels, and control structures. Turbid water conditions with associated silting, due to dredging, pumping, and levee construction, will occur only during construction periods. Beneficial aspects of the Chef Menteur and Rigolets construction on and near the construction area are the formation of ponds for duck hunting and fishing in land area borrow excavations, and the formation of deep fishing holes by removing borrow materials from the bottom of Lake Pontchartrain and other waterways. The removing of bottom materials with the formation of deep holes creates desirable fishing spots for croakers, drum, and speckled trout. Temporary turbid water conditions during construction will decrease the amount of primary production in the disturbed area by decreasing the light available to phytoplankton and other aquatic plants. The construction of a levee along the lakefront in St. Charles Parish would result in reduced release of detritus into the lake and invasion of the open marsh by cypress. Conditions which exist in Lake Pontchartrain during hurricanes will no longer flood the marshes and lowlands protected by the project and, accordingly, the barrier system will vastly decrease the great destruction of wildlife and wildlife habitat caused by tidal surges, associated wave action, and introduction of more saline waters. Indirectly, the plan will hasten urbanization and industrialization of valuable marshes and swamps by providing for further flood protection and land reclamation.

b. Adverse Environmental Effects. Approximately 5,265 acres of marsh and swamp wetlands will be used for construction of the hurricane protection plan. The acreage of the total marsh which produces and releases detritus into Lake Pontchartrain will decrease. This action will possibly decrease the amount of secondary production of organic material in Lake Pontchartrain. Wildlife of significant value is present in the project area, primarily waterfowl and fur animals. These resources will have significant project-occasioned losses. Three Indian sites which have not been studied in St. Charles Parish would be affected by the proposed hurricane protection levee. The middens are located to the east of Bayou LaBranche approximately one-fourth of a mile south of the lakeshore and along Bayou Piquant. These middens have been damaged by wave action. Artifacts from these sites have not been collected. These sites which at present are of indeterminate archeological value would be buried or partially destroyed.

A buried shell midden south of the junction of the MR-GO and the GIWW is contiguous with the new hurricane levee. This site has been studied and is covered with spoil from the MR-GO.

The proposed levee in St. Charles Parish would result in the conversion of open marsh to cypress-gum-maple swamp and ultimately to urbanization. This would result in the loss of wildlife habitat and recreational hunting.

The Chalmette Area Plan will provide sector-gated structures at Bayous Bienvenue and Dupre for the passage of small boats and intercepted drainage flows. Alteration of four water and 10 gas pipelines, and four telephone cable crossings will be required along the IHNC. Alteration of 12 gas pipeline crossings and two aerial electric power transmission lines will be required to clear the levee through the remainder of the alinement. Release of detritus from the marshes enclosed by the project levees will be restricted to flow into Lake Borgne and other surrounding open water areas. The proposed project will induce the conversion of marsh and swamplands in the project area to urban use. The project plan will hasten urbanization and industrialization of valuable marsh and swampland by providing basic features for further flood protection and reclamation. All of the marsh and swampland made available by the project for conversion to urban use will be lost when local interests choose to drain and fill these areas.

4. Alternatives: One alternative to the proposed action would be to forego the hurricane protection project. Urbanization of the project area would proceed at a much reduced pace if the hurricane protection plan were not implemented. The results of such inaction were very well emphasized in September 1965 when Hurricane Betsy passed west of New Orleans. The combined barrier for Lake Pontchartrain and the Chalmette area combine both areas in the proposed plan into one plan. There would be delays to navigation as well as environmental damages to larger areas of marsh. Another alternative to the

proposed barrier plan was to build high level protective levees along the lakeshore of the various units fronting the lake. Enlargement and improvement of the existing Chalmette back levee were considered an alternative to the proposed Chalmette Area Plan which is part of the overall hurricane protection plan. Two alternate plans were investigated for that portion of the Lake Pontchartrain barrier in the vicinity of The Rigolets. Another alternative is to eliminate the lakefront levee and drainage structure in St. Charles Parish. Construction of the levee has been deferred. The benefits from the St. Charles Parish lakefront levee are almost exclusively land enhancement, but the added cost of construction is economically justified. The omission of the lakefront levee in New Orleans East is also an alternate plan for the New Orleans East lakefront portion of the Lake Pontchartrain project. However, the New Orleans East lakefront levee will protect a substantial amount of existing development and future improvements that would occur even in the absence of the project.

5. Comments Received:

The Daily Sentry-News, Slidell, Louisiana

New Orleans East, Inc., which includes inclosure from Wallace-McHarg-Roberts-Todd, Land Planners for the New Orleans East New Town-in-Town project.

Arthur Crowe, Department of Marine Science, Louisiana State University

US Department of the Interior, Assistant Secretary - Program Policy

US Department of Commerce, The Assistant Secretary of Commerce

US Department of Health, Education, and Welfare, Public Health Service

Environmental Protection Agency

State of Louisiana, Department of Public Works

Louisiana State Parks and Recreation Commission

Louisiana Wild Life and Fisheries Commission

Louisiana Wildlife Federation

Mayor, City of New Orleans

Police Jury, St. Charles Parish

Lake Borgne Basin Levee District

Orleans Levee District

New Orleans Sierra Club

Orleans Audubon Society

6. Draft statement to CEQ: 17 August 1972

Final statement to CEQ:

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

FINAL
ENVIRONMENTAL STATEMENT

SECTION 1--PROJECT DESCRIPTION

1.01 The purpose of this report is to describe the protective features and identify the environmental effects of the Lake Pontchartrain, Louisiana, and Vicinity hurricane protection project. This project was authorized by the Flood Control Act of 1965 (Public Law 89-298), approved 27 October 1965, and described in House Document No. 231, 89th Congress, 1st Session. The project is located in southeastern Louisiana in the general vicinity of the city of New Orleans, and its inherent function is to prevent or reduce loss of lives and property damage due to hurricane flooding. The project area includes the lowland and water areas between the natural levee deposits of the Mississippi River and the Pleistocene escarpment to the north and west. The main topographic feature of the project area is Lake Pontchartrain which covers approximately 640 square miles in area and averages 12 feet in depth. Lake Pontchartrain is connected to Lake Maurepas to the northwest and to Lake Borgne, the Mississippi Sound, and the Gulf of Mexico to the south and east. Approximately 4,700 square miles of tributary area drain into the lake. The project area consists of about 780 square miles of land area. The benefit-cost ratio of the project is 12.6 to 1 as of May 1974.

1.02 The project is divided into two separate protective plans--the Lake Pontchartrain Barrier Plan and the Chalmette Area Plan. A detailed description of each of these protective plans follows and the protective features of the entire project are illustrated on the plate included in this report.

a. LAKE PONTCHARTRAIN BARRIER PLAN

(1) The areas surrounding Lake Pontchartrain are susceptible to serious flooding from wind-driven hurricane tides from the lake. This condition is aggravated by increases in lake level resulting from the influx of hurricane surges from

Lake Borgne and the Gulf of Mexico. Overtopping of existing protective works along the south shore of the lake and flooding of developed areas have occurred several times in the past. Stages in Lake Pontchartrain resulting from a Standard Project Hurricane (SPH) would cause overtopping of all existing protective works by several feet resulting in ponding in developed areas and the pumping system on which removal of all floodwaters is dependent would be inoperable for an extended period of time.

(2) An SPH is one that may be expected from the most severe combination of meteorological conditions that are considered reasonably characteristic of the region. The general SPH that is characteristic for the coastal region of Louisiana was developed in cooperation with the Hydrometeorological Section, US Weather Bureau (now the National Weather Service), and corresponds to one having a frequency of once in about 200 years in the study area. The SPH has a central pressure index of 27.6 inches of mercury and a maximum wind velocity of 100 miles per hour (5-minute average 30 feet above ground) at a radius of 30 nautical miles from storm center. These parameters define a hurricane which is similar in intensity to the September 1915 hurricane. The SPH would inundate a land area of approximately 700,000 acres to depths up to 16 feet in the study area.

(3) The SPH critical to the south shore of Lake Pontchartrain has an average translation speed of 6 knots. Over water the speed is about 8 knots, and over land, at the time of recurvature, the speed is 4 knots. This SPH approaches from the south, traverses the coast west of the Mississippi River delta, and curves eastward over Lake Borgne. The SPH critical to the north shore of Lake Pontchartrain has a translation speed of 5 knots. This hurricane approaches from the south-southeast, traverses the coast west of the Mississippi River delta, and curves northward passing west of Lake Maurepas. The SPH critical to the Chalmette area, the back levees of Citrus and New Orleans East, and from the Lake Borgne side in the vicinity of The Rigolets and the Chef Menteur Pass has a translation speed of 11 knots. This hurricane approaches from the east, traverses the coast east of the Mississippi River delta and south of Lake Borgne, and curves slightly northward passing to the west of Lake Maurepas.

(4) Prolonged inundation would cause enormous damage to private and public property, create serious hazards to life and health, disrupt business and community life, and require

immense expenditure of public and private funds for evacuation and subsequent rehabilitation.

(5) The barrier consists of three major structural complexes at The Rigolets, Chef Menteur Pass, and Seabrook. These and other features of the barrier are subsequently described in detail.

(6) As shown on the inclosed protection map, the Chef Menteur Complex and Rigolets Complex are proposed at the tidal passes connecting Lake Pontchartrain and Lake Borgne. These complexes consist of similar protective works and the complexes will be interconnected by barrier levees and by segments of the US Highway 90 embankment. These combined works will provide a continuous barrier system from the Orleans Parish levee system to Apple Pie Ridge in St. Tammany Parish.

(7) The Chef Menteur Pass Complex consists of a gated control structure, a navigation structure, related channels, earthen closures at the Gulf Intracoastal Waterway (GIWW) and the Chef Menteur Pass and adjoining barrier levees. Additionally, a small segment of the GIWW will be realined southward of its existing location.

(8) The gated control structure and channel will be constructed west of the Chef Menteur Pass and south of the present GIWW. The gated control structure will be 400 feet wide with a sill elevation of -25 feet.[1] Eight gate openings 46 feet wide will provide 9,200 square feet of opening below elevation 0. The openings will be closed by lowering the two gate sections in each of the eight gate bays by means of a gantry crane. These gate sections will be stored in each gate bay. In the stored position, the bottom of the gates will be at elevation 3 feet. The approach channels will flare at a 12.5° angle horizontally from the 400-foot width at the structure to a width of 700 feet. From this point a constant channel width of 700 feet will be maintained. The channel bottom will slope 1 on 10 from the structure to a depth of 40 feet from which point a constant channel depth of 40 feet will be maintained. A closure dam will be located in the present Chef Menteur Pass channel and at two locations along the existing GIWW.

[1]The reference datum plane for all elevations mentioned in this environmental statement is mean sea level (m.s.l.) unless otherwise specifically stated.

(9) The Chef Menteur Pass navigation canal will run from west of the Lake Borgne opening of the existing channel to the Chef Menteur Pass channel near the L&N Railroad bridge. The approach channel will be 125 feet wide. The navigation structure will be 84 feet wide with the sill at -16 mean low gulf (m.l.g.). Sector gates will be used because of reverse head conditions and so the structure can be converted to a lock in the future if needed. The structure will consist of a concrete gate bay on timber pilings, flanked by floodwalls. The top of the gate bay and floodwalls will be at elevation 14.0 feet.

(10) Also included in the Chef Menteur Pass Complex is the relocation of the GIWW to the south of its existing location. Barrier levees will be constructed to adjoin the Chef Menteur Pass Complex structures to each other and to the US Highway 90 embankment which also serves as portions of the barrier levee. The protection levee will be at an elevation of 14.0 feet adjacent to and in between the structures and will be at an elevation of 9.0 feet at other locations. This elevation of 9 feet will allow flood surge overtopping for a short period during a hurricane, but this overtopping will not significantly affect the water elevation of Lake Pontchartrain and affect the function of the barrier system.

(11) The Rigolets Complex will be located south of the US Highway 90 bridge. It will consist of a gated control structure and a closure dam in the present Rigolets channel, a navigation channel and lock east of the natural channel, and adjoining barrier levees.

(12) The gated portion of the control structure will be 800 feet long and 50 feet wide with a sill depth of -30 feet. There will be 16 gate bays each 46 feet wide. Each bay will have three vertical lift steel gates which will be raised and lowered by an overhead gantry crane.

(13) The approach channel to the control structure will have an 800-foot bottom width and a depth of -30 feet at the structure sill. On the gulf side, the channel will slope downward from the structure along a 1 on 10 slope to a depth of -35 feet and remain level for a distance of 100 feet, thence slope upward along a 1 on 10 slope to a depth of -30 feet and continue at this elevation for 2,900 feet, thence slope upward on a 1 on 10 slope to the existing channel bottom. On the lake side, the channel bottom will slope downward from the structure

along a 1 on 10 slope to a depth of -35 feet and remain level for a distance of 100 feet, thence slope upward along a 1 on 10 slope to a depth of -30 feet and continue at this elevation for 2,300 feet, thence slope upward on a 1 on 10 slope to the existing channel bottom. The channel sides will slope 1 on 3 from the bottom of the channel to the surface of the ground.

(14) The closure dam will be located adjacent to the east and west sides of the control structure. It will consist of a western embankment 710 feet long and an eastern embankment 3,965 feet long. The crest elevation will be at 14.0 feet.

(15) A navigation canal and lock will be constructed east of the closure dam. The lock will be 110 feet wide with 800 feet usable chamber length. The lock will be provided with sector gates with sill elevation at -14.0 feet (-13.2 feet m.l.g.).

(16) The proposed levee network south of The Rigolets consists of 2.4 miles of highway levee and 0.4 mile of connecting levee. The levee system will utilize the existing embankment of US Highway 90, where its grade is equal or greater than 9 feet which is some 3.3 miles west of the existing bridge crossing at The Rigolets. From this point, going east, the levee will be constructed on the southern side and parallel to the existing highway embankment and will terminate at the intersection of the connecting levee between the highway embankment and the closure dam. The controlling elevation of the levee system is 9.0 feet.

(17) The levee network north of The Rigolets consists of 0.2 mile of levee between the closure dam and navigation lock and 1.8 miles of levee extending north of the lock to US Highway 90 at Apple Pie Ridge.

(18) A multipurpose navigation and hurricane protection structure will be constructed at the lakeward terminus of the Inner Harbor Navigation Canal (IHNC) in the vicinity of Seabrook bridge in New Orleans, Louisiana. This feature is termed the Seabrook Complex.

(19) This complex includes a navigation lock, a gated control structure, and a connecting rock dike. The navigation lock has a chamber 84 feet wide, a usable chamber length of 800 feet, a sill elevation of -15.8 feet (-15.0 m.l.g.), and

a chamber floor elevation of -16.8 feet. The outlet structure has three gate openings, each 32 feet wide with gate sills at -15.8 feet and with gates 20 feet high. The rock dike has a crest elevation of 7.2 feet and serves as an overflow weir for high stage floodwater relief.

(20) The purpose of the Seabrook Complex is to eliminate high current velocities in the IHNC, to provide high stage flood surge relief to industries along the IHNC, to restrict inflow of water into the lake during the approach of hurricanes similar to the purpose of the Chef Menteur and Rigolets structures, to control salinities, and to provide adequate water flow for riparian users along the IHNC. The planned operational procedures for the locks at Seabrook and at The Rigolets provide that all lock gates remain in the open position so that marine craft may readily transit the locks (without locking) until the current velocity through the lock chambers becomes prohibitive for safe passage. Only then would vessels have to be "locked" through. Specifically, the Seabrook lock would require locking operation for approximately 7 hours over a 24-hour period. The vessels which currently utilize the IHNC and future prime users of Seabrook lock are, in vast majority industrially related.

(21) The locking period will greatly increase the navigable utility of the IHNC by mitigating the adverse currents and eddies which now affect user safety. Engineering study reveals that excess current velocities through Rigolets lock would develop very infrequently under normal daily conditions and that locking would be required for about 2 1/2 hours per 24-hour period. Actual locking operation would otherwise be required only during adverse weather conditions or upon the approach of a hurricane. The Chef Menteur navigational floodgate would remain open at all times and would be closed only when a hurricane enters the Gulf of Mexico.

(22) The operational procedures for the Chef Menteur Pass and Rigolets control structures will require that these structures be closed when a hurricane enters the Gulf of Mexico and stages in the gulf are higher than those in Lake Pontchartrain. These structures would remain closed until hurricane tides had receded and the storm no longer posed a threat to the project area. The Seabrook Complex control structure would likewise be closed when a storm entered the gulf. This structure, however, would be reopened fully when a stage of 3.5 feet m.s.l. was reached on the IHNC side of the structure and it would then

remain open throughout the duration of the storm. This procedure would result in lower stages along the IHNC; but this flow would not be significant enough to elevate the level of Lake Pontchartrain and thus this procedure would not violate the rationale of the barrier system.

(23) In addition to the barrier the Lake Pontchartrain barrier plan provides for construction of a new levee 5.5 miles in length approximately 500 feet south of the lake along the St. Charles Parish lakeshore from the Bonnet Carre' Spillway to the Jefferson Parish boundary. An interior drainage canal would be provided along the levee alinement from Bayou LaBranche to the Parish Line Canal. The levee would have a crown elevation of 12 to 12.5 feet and a crown width of 20 feet with riprap slope protection on the lakeside extending from 15 feet beyond the levee toe to elevation 6.5 feet. The levee would be approximately 400 feet wide at its base.

(24) A drainage structure would be constructed in the levee 2 miles west of the parish boundary at Bayou Piquant. The drainage structure was designed to have sufficient capacity to dispose of inflows from high intensity storms and normal rainfalls without excessive overflow of lands and to provide for prompt evacuation of impounded runoff during periods of normal tides.

(25) The alinement of the protective works was located a sufficient distance from Lake Pontchartrain to assure that the normal retreat of the shoreline would not endanger the stability of the levee within its project life. The Bonnet Carre' Spillway east guide levee enlargement, to be constructed of haul material from Bonnet Carre' Spillway, would extend 500 feet south of Lake Pontchartrain. The enlargement would consist of one lift constructed to a gross grade of 14.0 feet.

(26) By letter dated 27 August 1974, the administration of the Louisiana Natural and Scenic Rivers System indicated that, in view of the inclusion of Bayous Trepagnier and LaBranche in that system, the St. Charles Parish levee could not be built without contravening state law. Accordingly, construction of this feature of the project has been indefinitely deferred.

(27) The Jefferson Parish area is currently protected from tidal overflow from the lake by a levee system and stee.

sheet pile. The existing levee crown along the lakefront is at elevation 14.0 feet. The length of the improvement is 10.2 miles. The existing protective system will be adequate to protect against occurrence of a SPH with the barrier in place.

(28) The existing back levees landward of the seawall in the 4.1-mile reach in Orleans Parish will be raised to an elevation of 12 feet. The existing levee along 5.8 miles of the west side of the IHNC will be raised to an elevation of 13 to 14 feet. The existing levee is 9.5 - 10.0 feet high.

(29) In the Citrus lakefront area a levee 6.1 miles in length will be constructed south of the existing railroad embankment near Lake Pontchartrain with a crest elevation of 13.5 feet and a crown width of 20 feet. Riprap slope protection will be provided on the lakeside slope for wave erosion protection. Incorporation of the railroad embankment in the protection levee was impracticable because of the heterogeneous nature of the railroad embankment. The levees on the east side of the IHNC, 3.1 miles in length, will be raised to an elevation of 13-14 feet. The Citrus Back Levee, 7.6 miles along the GIWW will be enlarged to an elevation of 13 to 14 feet west and 18 feet east of Paris Road. Riprap shore protection against erosion by wave wash will be provided.

(30) A lakefront levee 6.3 miles long will be constructed south of the existing railroad embankment in New Orleans East. It will have a crest elevation of 14.0 feet and a crown with of 20 feet, and riprap slope protection on the lakeside below elevation 9.5 feet. The existing levee from South Point to US Highway 90 will be improved. From this point to the GIWW, and thence along the GIWW the levee will require enlargement for a distance of 8.5 miles to a cres elevation of 14.0-17.5 feet with a crown width of 10 feet.

(31) The existing seawall at Mandeville, Louisiana, will be strengthened by the placement of a shell backfill to an elevation of 6 feet and a riprap blanket along the toe in the lake to an elevation of 1 foot along the entire length of the existing wall. The project also provides for reconstruction of 200 feet of concrete pile wall to an elevation of 6 feet in badly deteriorated locations.

b. CHALMETTE AREA PLAN

(1) The plan provides for the construction of a new levee 27.8 miles in length along the southern shore of the Mississippi River-Gulf Outlet (MR-GO) from the IHNC to a point approximately 6 miles southeast of Bayou Dupre, thence southwest to Verret, thence west to the Mississippi River levee at Caernarvon, Louisiana. The levee will have a crown width of 10 feet and a grade of 14 feet west of Paris Road, 17.5 feet east of Paris Road, 17 feet near the drainage structure close to Verret, and 16.5 feet from the drainage structure to Caernarvon, Louisiana.

(2) Riprap shore protection against wave-wash erosion from shipping along the MR-GO will be provided. Construction of a floodwall with steel sheet piling driven in the levee to a crest elevation of 14 feet will improve the existing levee along the east side of the IHNC. Navigable floodgates have been constructed at Bayous Bienvenue and Dupre, and a drainage structure included approximately 3 miles west of Verret, Louisiana. In addition to providing drainage, the control structures will serve to protect the general area from hurricane tidal overflows and will allow water traffic to proceed normally to and from the MR-GO via Bayous Bienvenue and Dupre. Rainfall runoff from 46,700 acres will be passed through the two control structures. The control structure gates will be closed when water levels in the ponding area reach an elevation of 2.0 in advance of hurricane warnings. The ponding area is north of Louisiana Highway 46.

(3) The control structures consist of concrete sector gate bays supported on untreated timber piles, treated timber guide walls, and inverted "T" and "I" type floodwalls connecting the gate chamber to the earthen levee on each side. The drainage structure will consist of corrugated metal pipes controlled by flap gates at the downstream end and emergency slide gates for positive cutoff.

1.03 Data which have been accumulated for this project are presented in the following Design Memoranda (DM):

DM No. 1, Hydrology and Hydraulic Analysis, Part 1, Chalmette, approved October 1966; Part 11, Barrier, approved October 1967; Part 111, Lakeshore, approved March 1969; Part IV, Chalmette, approved December 1967;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Advance Supplement, Inner Harbor Navigation Canal Levees, approved May 1967;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Citrus Back Levee, approved December 1967;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 1, Lake Pontchartrain Barrier, Rigolets Control Structure, Closure Dam and Adjoining Levees, approved November 1970;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 2, Lake Pontchartrain Barrier, Rigolets Lock and Adjoining Levees, approved October 1971;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 3, Lake Pontchartrain Barrier, Chef Menteur Pass Complex, approved September 1969;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 4, New Orleans East Back Levees, approved August 1971;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 5, Orleans Parish Lakefront Levees - West of IHNC, scheduled August 1975;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement 5A, Citrus Lakefront Levees, IHNC to Paris Road, scheduled January 1975;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement 5B, New Orleans East Lakefront Levee, Paris Road to South Point, approved December 1972;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement 5C, Orleans Parish Outfall Canals, West of the IHNC, scheduled July 1976;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 6, St. Charles Parish Lakefront Levees, approved November 1970;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 7, St. Tammany Parish Mandeville Seawall, indefinite schedule;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 8, IHNC Remaining Levees, approved June 1968;

DM No. 2, Lake Pontchartrain Barrier Plan, GDM, Supplement No. 9, New Orleans East Levee from South Point to GIWW, approved May 1973;

DM No. 3, Chalmette Area Plan, GDM, approved January 1967;

DM No. 3, Chalmette Area Plan, GDM, Supplement No. 1, Chalmette Extension, approved August 1969;

DM No. 4, Lake Pontchartrain Barrier Plan and Chalmette Area Plan, GDM, Florida Avenue Complex, IHNC, scheduled March 1975;

DM No. 5, Chalmette Area Plan, DDM, Bayous Bienvenue and Dupre Control Structures, approved October 1968;

DM No. 6, Lake Pontchartrain Barrier Plan, DDM, Rigolets Control Structure and Closure, indefinite schedule;

DM No. 7, Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Control Structure and Closure, scheduled November 1974;

DM No. 8, Lake Pontchartrain Barrier Plan, DDM, Rigolets Lock, approved December 1973;

DM No. 9, Lake Pontchartrain Barrier Plan, DDM, Chef Menteur Navigation Structure, scheduled August 1975;

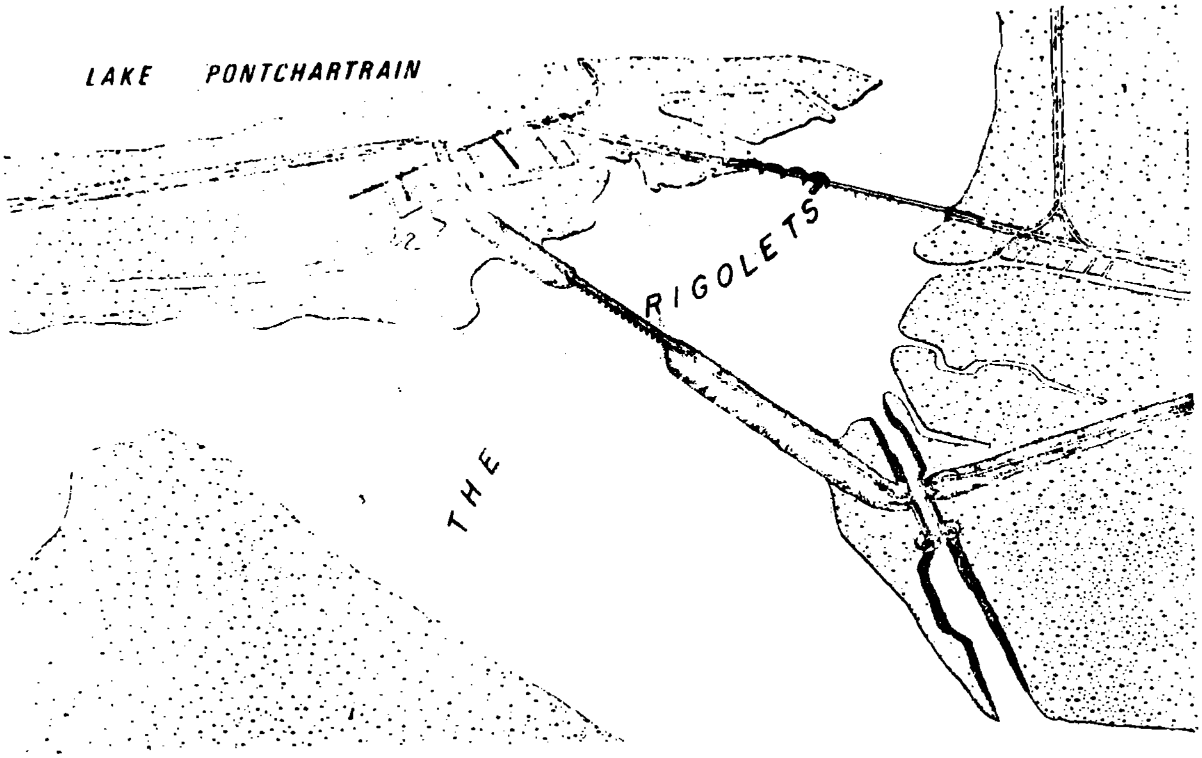
DM No. 10, Lake Pontchartrain Corrosion Protection, approved May 1969;

DM No. 12, Sources of Construction Materials, approved August 1966;

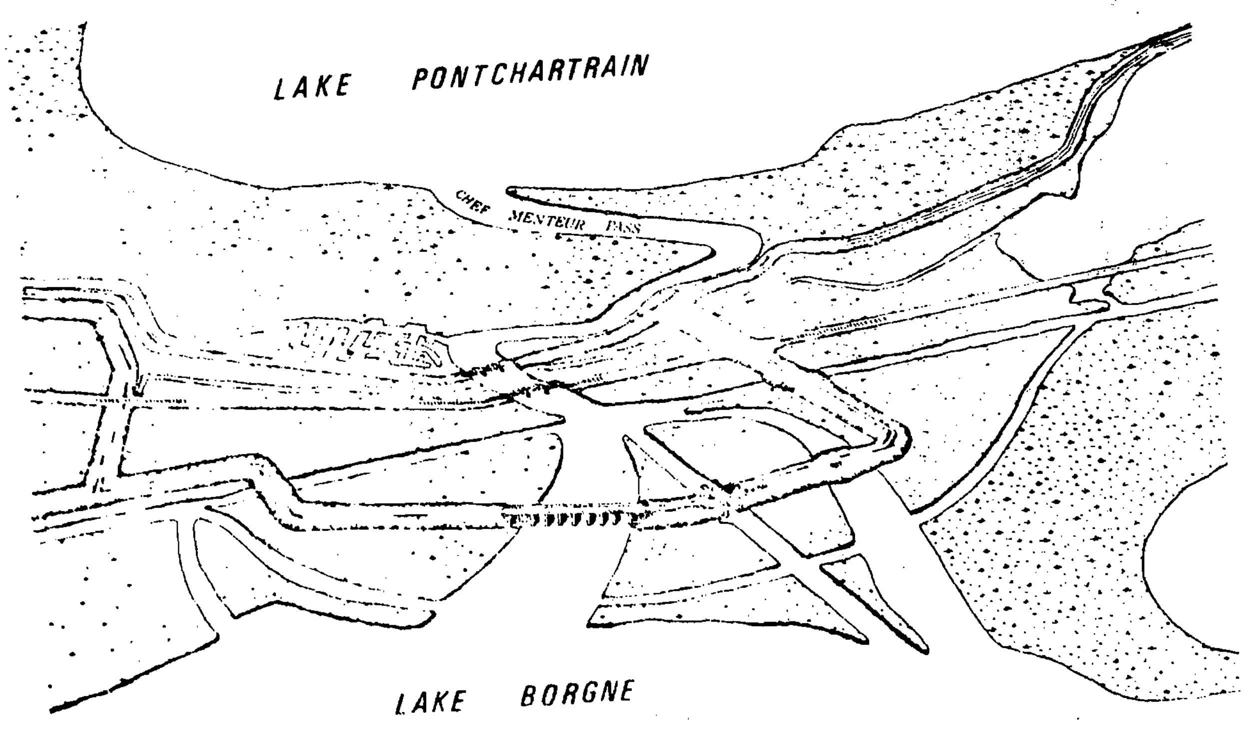
DM No. 1, Lake Pontchartrain, Louisiana, and Vicinity, and Mississippi River-Gulf Outlet, Louisiana, GDM, Seabrook Lock, approved November 1970;

DM No. 2, Lake Pontchartrain, Louisiana, and Vicinity, and Mississippi River-Gulf Outlet, Louisiana, GDM, Seabrook Lock, scheduled June 1975.

All of these documents are or will be available for examination at the New Orleans District.



THE RIGOLETS COMPLEX



CHEF MENTEUR COMPLEX

SECTION 2--ENVIRONMENTAL SETTING WITHOUT THE PROJECT

2.01 The project area is located in southeastern Louisiana in the vicinity of New Orleans. It comprises the lowland and water areas between the Mississippi River alluvial ridge and the Pleistocene escarpment to the north and west. The following are descriptions of the environmental elements of the proposed improvement area:

a. GEOLOGICAL ELEMENTS

(1) The project area, known as the Pontchartrain Basin, is situated along the northeastern flank of the Mississippi River Deltaic Plain and is located within the Central Gulf Coastal Plain. The basin is a shallow depression which lies between the alluvial ridge of the Mississippi River and the gulfward-sloping uplands on the north and west. Except for short stretches along the northern shore of Lake Pontchartrain in the vicinity of Mandeville where the uplands border the lake, and behind the seawall along the south shore at New Orleans where sandfill has been placed, the lake is separated from the uplands and alluvial ridges by marsh and swamplands. The area is of extremely low relief. The land elevations adjacent to the Mississippi River in St. Charles, Jefferson, and Orleans Parishes averages about 10 feet and slopes away from the river at approximately 1 foot per 1,000 feet to a minimum of at or near sea level in St. Charles Parish, and to -5 feet or greater in Jefferson and Orleans Parishes. The area east of New Orleans to the general vicinity of The Rigolets is essentially marshland with elevations ranging from about -8 to -10 feet between the IHNC and Paris Road, to at or near sea level east of Paris Road.

(2) Dominant physiographic features are the swamps, marshes, natural levees, and abandoned distributaries. A low, alluvial ridge (Metairie-Gentilly ridge), marking the position of an ancient distributary and subdelta of the river, extends northeastward from New Orleans towards the uplands and subdivides the basin.

(3) The north shore of Lake Pontchartrain, comprising the area in St. Tammany Parish, is composed of low-lying marsh and swamp at an elevation of about 1.5 feet m.s.l., except in

the vicinity of Mandeville where the shoreline abuts the Pleistocene uplands and elevations reach 15-25 feet. At the present time, a general shoreline retreat is the dominant process within Lake Pontchartrain and average retreat rates range from 7 to 8 feet per year in St. Charles Parish, from 5 to 6 feet per year along Jefferson Parish, from 2 to 8 feet per year along New Orleans East lakefront, from 2 to 2.5 feet per year in the vicinity of Slidell, and from 1 to 2 feet per year at the Mandeville shoreline.

(4) Surface and near surface soils along the lakeshore may be partially described by the soils represented along the shoreline beach zone. However, a distinct change in soil types is noted in most areas just inland from the beach margin and lakeward in many areas as water depths approach the -6 feet m.s.l. contour. The inclosed map depicts the general beach types and depositional environments just inland from the shoreline. The following is a general description of the inland materials:

Swamp - Very soft to soft organic clays with lenses and layers of silt and peat, wood and roots; high water content; supports tree growth.

Marsh - Very soft to soft organic clays with lenses and layers of silt and peat; (supports grass and sedge growth); high water content.

Pleistocene Terrace - Stiff to very stiff oxidized clays with lenses and layers of silts, silty sands, and sands; (low water content).

(5) A general description of materials comprising the bottom surface lakeward of the beach zone is as follows:

(a) Along North Shore between Rigolets and Milton's Island (a relict beach 3 miles west of the Tchefuncta River inlet): From one to several feet of lacustine deposits (Holocene), consisting of very soft to soft clays with silt and sand strata, shell, shell fragments, and wood, overlying stiff to very stiff Pleistocene clays which contain large lenses and layers of silt, silty sand, and sand. An area of more granular deposits (silty sand and sand) is normally found in the areas surrounding the mouths of the small streams emptying into the lake.

(b) Southward from Milton's Island to the vicinity of Bonnet Carre' Spillway: very soft to soft clays with lenses and layers of silt, organic matter, and shells.

(c) Along Bonnet Carre' Spillway: approximately 10 feet of very soft to soft lean clay with lenses and layers of silt overlying swamp and marsh deposits consisting of highly organic very soft fat clay with wood.

(d) East guide levee of Bonnet Carre' Spillway to a point 2 miles eastward: approximately 10 feet of silt with organic materials, shell and shell fragments (Bay Sound), overlying about 3 feet of marsh deposits consisting of very soft organic clay with wood and shell fragments.

(e) Eastward to vicinity of Metairie Outfall Canal (Jefferson-Orleans Parish boundary): bottom materials grade into marsh deposits about 5 feet thick consisting of peat and very soft highly organic fat clays with overlie lacustrine clay deposits.

(f) The area between the Metairie Outfall Canal and the New Orleans Lakefront Airport has been extended into the lake by construction of a concrete seawall and earth fill. The -6-foot contour is therefore much closer to the shore along this reach than it is along reaches of natural undisturbed shoreline. Bottom sediments consist of a thin layer of very soft clay underlain by silty sands and sands.

(g) Eastward from New Orleans Lakefront Airport to the vicinity of Little Woods: silt, silty sand, and sand to a maximum of about -25 feet m.s.l. immediately east of the airport to a minimum of about -10 feet m.s.l. in the vicinity of Little Woods.

(h) Eastward from Little Woods to Pointe aux Herbes: lake bottom sands thin and grade into soft clays. The silts and sands are underlain by very soft to soft clays with shell and shell fragments. (The bottom sediments in the vicinity of the mouth of Irish Bayou Lagoon are an exception to the above in that extensive silt deposits are present in this area.)

(i) Pointe aux Herbes to Rigolets: very soft organic clays with alternating thin layers of silt and sand underlain by extensive sands at approximately -20 feet m.s.l.

(6) It should be noted that all of the surface soil types have been located and identified from readily available

existing information (soil boring logs, geologic reports, and personal knowledge), and should be applied only in a broad general manner as much of the information was extrapolated from limited points of control, some dating back to the 1950's. It should further be emphasized that all of the natural unprotected shoreline of Lake Pontchartrain is experiencing critical erosion which is accelerated during each storm tide with resultant movement and winnowing of bottom and nearshore sediments. Therefore, many areas may have experienced some rather drastic changes in lake bottom and nearshore conditions.

(7) Figure 3 notes the generalized beach types and habitat along the periphery of Lake Pontchartrain. Pleistocene terrace, reclaimed marsh, reclaimed swamp and marsh and swamp soil types are shown. Generalized beach types delineating sand, silt, and shell, and silt, sand, and shell are illustrated on figure 3.

b. HYDROLOGICAL ELEMENTS

(1) Lake Pontchartrain is an oval-shaped low salinity estuary with a water surface of about 640 square miles. It was formed from a remnant of an arm of the Gulf of Mexico which was impounded by deltaic deposits of the Mississippi River and gradually freshened. It is about 25 miles wide along its north-south axis and 40 miles long along its east-west axis. The depth averages 12 feet.

(2) Lake Pontchartrain lies adjacent to and just north of the city of New Orleans, Louisiana, and is connected with Lake Maurepas on the west by Pass Manchac, with Lake Borgne on the east by Chef Menteur and Rigolets Passes, and with the MR-GO channel by the IHNC and Intracoastal Waterway. Lake Pontchartrain is about 25 miles wide at its widest point, about 40 miles long, has a shoreline of 112 miles, and covers 640 square miles. Its depth averages 12 feet west and 16 feet east of a 25-mile long causeway that connects New Orleans with the north shore near Mandeville, Louisiana.

(3) The principal streams that flow into Lake Pontchartrain are the Blind, Amite, and Tickfaw Rivers, which flow into Lake Maurepas and thence into Lake Pontchartrain through Pass Manchac; the Tangipahoa and Tchefuncta rivers and the Lacombe and Bonfouca Bayous from the north; and Bayou St. John in the heart of New Orleans from the south. Also connected

with Lake Pontchartrain on the south are the IHNC, which is connected with the Mississippi River by lock, and the Bonnet Carre' Spillway with a design capacity of 250,000 cubic feet per second (c.f.s.), which passes flow from the Mississippi River to Lake Pontchartrain when necessary to reduce Mississippi River floodflows that would endanger low-lying areas downstream from the spillway. The Pearl River, with its branches of West and Middle Pearl Rivers, flows from the north into Lake Borgne near the eastern end of Rigolets. Lake Borgne is connected with the MR-GO channel by several bayous; the principal ones are Bayous Bienvenue, Dupre, Yscloskey, La Loutre, and St. Malo. The total drainage area having significant effect on the lake system covers approximately 4,700 square miles.

(4) On the east, Lake Pontchartrain is connected through The Rigolets and Chef Menteur Pass, Lake Borgne, and the Mississippi Sound to the Gulf of Mexico. To the south, Lake Pontchartrain is connected to the Gulf of Mexico through the IHNC, the GIWW, and the MR-GO. On the west, Lake Pontchartrain is connected through Pass Manchac to Lake Maurepas, a shallow tidal basin having a surface area of about 90 square miles. Lake Pontchartrain has a tributary drainage area of about 4,700 square miles, including the Tangipahoa and Tchefuncta Rivers and Bayous Lacombe, Liberty, Bonfouca, and Castine along its north shore, and the Blind, Amite, Natalbany, and Tickfaw Rivers which empty into Lake Maurepas. Other drainage into Lake Pontchartrain includes bayous and drainage outfall canals along the southern shore and infrequently the Bonnet Carre' Spillway. In event of flood, the spillway has a design capacity of carrying 250,000 c.f.s. of freshwater from the Mississippi River to Lake Pontchartrain. It is capable of reducing Mississippi River floodflow in low-lying areas downstream from the spillway and was last opened in 1973.

(5) The MR-GO is a ship channel extending from the GIWW to the Gulf of Mexico. Shallow-draft channels in the Chalmette area maintained by the Federal Government are available in Bayous Dupre, LaLoutre, and St. Malo. Many other natural channels and lakes are usable by small boats.

(6) The salinity in Lake Pontchartrain usually averages below 5 parts per thousand (p.p.t.) but considerable variation occurs in different areas of the lake and during different seasons of the year. Salinities below 1 p.p.t. occur

in the northwestern areas near freshwater inflow, and values as high as 18 p.p.t. have been reported after storms from eastern areas near the Chef Menteur and Rigolets passes.

(7) Tides are diurnal in Lake Pontchartrain and adjoining lakes. The mean tide range at Long Point, near the eastern end of Rigolets, is 1.0 feet. In Lake Pontchartrain the range decreases to about 0.4 foot, and further decreases to about 0.3 foot in Pass Manchac and Lake Maurepas for conditions of mean freshwater discharge. The mean freshwater discharge into the lake system is about 18,096 c.f.s. of which 60 percent is from the Pearl River and its branches. The man tidal prism at Rigolets is about 9 billion cubic feet. The approximate mean maximum current velocity in Rigolets is 1.9 feet per second (f.p.s.), in Chef Menteur 2.8 f.p.s., and in Pass Manchac 2.0 f.p.s., while current velocities in Lake Pontchartrain are of the order of 0.5 f.p.s. or less. The maximum velocities are about the same for both flood and ebb currents but the duration of the ebb currents is slightly longer.

(8) The mean tide range at Point Chicot in Chandeleur Sound, which is the point of prototype tidal observations nearest the entrance to the MR-GO channel into the Gulf of Mexico, is 1.3 feet. This range gradually decreases upchannel towards New Orleans until at Seabrook Bridge, over the IHNC near its junction with Lake Pontchartrain, the range is only 0.3 foot. The time of high water at Point Chicot precedes the time of high water at Long Point by 1.5 hour. The tidal prism at the Gulf of Mexico entrance to the channel is about 130 million cubic feet. The mean maximum velocities in the channel between Lake Pontchartrain and the gulf range from 0.8 foot to 1.7 f.p.s., being greater near Lake Pontchartrain in the IHNC. The maximum velocities are generally greater for the flood currents than for the ebb currents. The duration of the flood currents is slightly longer near Lake Pontchartrain in the IHNC and the duration of the ebb currents is slightly longer near the gulf in the vicinity of Bayou Yscloskey.

(9) Salinity in Lake Pontchartrain and connected lakes does not occur in stratified form, as is the case in many estuaries. Rather the lake system is in the category of well mixed estuaries in which salinities from surface to bottom are essentially uniform. Available prototype date indicate that salinities in Lake Pontchartrain vary from an average minimum

of about 850 p.p.m. to an average maximum of about 4,250 p.p.m., in Lake Borgne from an average minimum of about 1,125 p.p.m. to an average maximum of about 8,125 p.p.m., in Rigolets from an average minimum of about 425 p.p.m. to an average maximum of about 7,785 p.p.m., in Chef Menteur from an average minimum of about 1,325 p.p.m. to an average maximum of about 6,585 p.p.m., and in Pass Manchac from an average minimum of about 75 p.p.m. to an average maximum of about 1,990 p.p.m. Similar variations in salinity also occur in Lake Maurepas. These variations can be attributed to the varying freshwater inflow from the streams tributary to the lake system and the varying salinity of the tidal flow from Mississippi Sound. The salinity of Mississippi Sound varies from an average of about 7,290 p.p.m. in the area west of Pass Marianne to an average of about 15,625 p.p.m. in the area east of Pass Marianne. Again, the variation in salinities is attributable to the freshwater inflow into the south, the water nearer the major point of inflow being less saline than that farther away.

(10) The Chandeleur-Breton Sound area of the Gulf of Mexico, into which the MR-GO channel enters, has an average salinity of about 31,300 p.p.m. near Chandeleur, Gosier, and Breton Islands, decreasing gradually shoreward to an average salinity of about 21,700 p.p.m. in the vicinity of Chicot Island. The overall average salinity of the Chandeleur-Breton Sound area, as determined from salinity observations at several stations, is about 28,000 p.p.m. From model observations, it has been determined that on completion of the MR-GO channel, with no obstruction between the channel and Lake Pontchartrain, the following salinity conditions will exist in the channel.

(11) For a high freshwater inflow year, bottom salinities will decrease from the average of 28,000 p.p.m. at the channel entrance into the sound to a mean of about 26,000 p.p.m. in the IHNC near its entrance into Lake Pontchartrain, while surface salinities, which are essentially the same as bottom salinities at the entrance into the sound, will decrease to a mean of about 7,500 p.p.m. near the entrance into Lake Pontchartrain.

(12) For a low freshwater inflow year, bottom salinities will decrease about the same amount as for the high inflow year, while surface salinities will decrease to a mean of about 10,000 p.p.m.

(13) The relatively large decreases in surface salinities referred to in paragraph (11) and (12) are attributed to a layer of less saline water from Lake Pontchartrain that overrides and mixes with the upper layers of the salt wedge moving upchannel; this layer of less saline water gradually dissipates as it moves downchannel toward the gulf.

(14) The lake is being polluted by wastes discharged from urbanized areas and its periphery. Plankton and microbiological analyses by Stern et al. (1968) indicate that Lake Pontchartrain is being polluted by wastes from Jefferson and Orleans Parishes.

(15) Available hydrological data for Lake Pontchartrain from 1968 to 1973 are presented in Tables 1, 2, and 3. The mean, minimum, and maximum salinities in 1,000 p.p.m. are given monthly for three locations. These sites are Pass Manchac near Ponchatoula, Louisiana, north end of the Causeway, and Little Woods, Louisiana.

(16) January, February, March, June, July, November, and December are months that receive heavy rainfall in southeast Louisiana. This increased amount of fresh rainwater tends to reduce the salinity. Tidal influence tends to regulate the rainwater runoff during months receiving heavy precipitation.

(17) The Bonnet Carre' Spillway was opened 8 April and closed 21 June 1973. The drastic decrease in salinities in April may be noted on tables 1, 2, and 3. The salinity of the lake is being restored rapidly as indicated by the slow climb through December 1973 on tables 1, 2, and 3.

(18) Average seasonal temperatures for the area vary from 53 degrees in winter to 81 degrees in summer. Mean monthly temperatures for the area are as follows:

Jan	52.2 degrees	Jul	81.4 degrees
Feb	54.4 degrees	Aug	81.2 degrees
Mar	59.4 degrees	Sep	77.1 degrees
Apr	66.4 degrees	Oct	68.4 degrees
May	73.6 degrees	Nov	57.8 degrees
Jun	79.8 degrees	Dec	52.8 degrees

Distribution of rainfall over the basin is uniform. Average annual precipitation is approximately 61 inches with monthly averages varying from 2.8 inches in October to 6.5 inches in July.

TABLE 1

LAKE PONTCHARTRAIN SALINITIES - NORTH END OF CAUSEWAY

(1,000 parts per million)

Middle Chlorides Converted from Cond/Salinity (Mid-depth)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
*1968												
Mean	3.3	2.9	3.0	2.8	2.4	2.2						
Max	3.7	3.2	3.5	3.5	2.7	2.3						
Min	2.7	2.5	2.5	2.5	2.2	2.2						
1969												
Mean										2.7	2.8	2.7
Max										3.8	3.2	3.0
Min										1.3	1.6	2.3
1970												
Mean	2.9	3.1	2.6	2.3	2.8	2.3	2.0	2.0	1.5	2.2	1.9	2.9
Max	5.8	3.2	3.0	2.6	3.2	2.6	2.1	2.1	2.6	2.5	2.6	3.2
Min	1.4	3.0	1.7	2.0	2.4	1.8	1.7	1.7	1.3	1.8	1.6	2.4
1971												
Mean	2.8	2.6	2.1	1.9	2.0	1.4	1.7	2.0	2.3	2.0	1.9	2.0
Max	3.1	3.0	2.5	2.2	2.4	1.7	2.6	2.4	3.0	2.3	2.3	2.5
Min	2.3	1.2	1.5	1.1	1.3	1.1	1.3	1.5	1.6	1.5	1.5	1.3

*Chloride readings from North Bascule, Station 85583

TABLE 1 (contd)

LAKE PONTCHARTRAIN SALINITIES - NORTH END OF CAUSEWAY

(1,000 parts per million)

Middle Chlorides Converted from Cond/Salinity (Mid-depth)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1972												
Mean	1.2		0.5	1.0	2.3	1.7	1.0	1.4	1.7	2.6	2.7	3.2
Max	1.4		0.9	1.4	2.9	3.1	2.6	1.8	1.9	4.9	3.1	3.4
Min	1.0		0.1	0.2	0.8	0.5	0.6	1.2	1.5	1.8	2.5	2.9
1973												
Mean	3.0	2.6	1.7	0.8	0.2	0.1	0.1	0.1	1.2	1.6	1.3	1.4
Max	3.3	2.9	2.5	1.3	0.9	0.2	0.1	0.2	3.9	3.2	2.4	2.0
Min	2.8	2.3	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.5	0.2	1.0

TABLE 2

PASS MANCHAC SALINITIES NEAR PONCHATOULA, LA

(1,000 parts per million) Middle Chlorides (Mid-depth)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968												
Mean	1.410	1.399	1.425	1.287	1.358	1.525	1.594	1.503	1.613	1.923	1.924	1.456
Max	2.300	2.750	2.050	2.475	2.475	2.200	2.225	2.200	2.200	3.100	2.750	2.500
Min	0.925	0.875	1.100	0.950	0.950	1.175	1.200	1.125	1.200	1.500	1.425	0.950
1969												
Mean	1.237	1.203	1.064	0.552	0.513	0.775	0.956	1.146	1.157	1.648	1.853	1.930
Max	3.250	2.500	2.300	1.350	1.325	1.200	1.525	1.525	1.850	2.750	2.425	3.000
Min	0.675	0.550	0.450	0.140	0.325	0.350	0.575	0.650	0.700	1.000	1.200	1.200
1970												
Mean	1.490	1.682	1.645	1.473	1.720	1.777	1.577	1.574	1.422	1.385	1.032	0.885
Max	2.000	3.400	3.200	2.500	2.925	4.000	2.500	2.300	2.750	2.725	1.575	2.150
Min	1.100	1.000	0.800	1.000	0.900	1.000	1.200	1.100	1.000	0.925	0.725	0.425
1971												
Mean	0.644	1.066	0.593	0.800	0.877	0.735	0.868	0.943	0.937	0.629	1.074	0.666
Max	1.450	2.500	1.425	1.700	1.500	1.660	1.750	1.550	2.500	1.700	2.425	2.425
Min	0.240	0.600	0.160	0.325	0.550	0.360	0.500	0.550	0.300	0.325	0.550	0.150

TABLE 2 (contd)

PASS MANCHAC SALINITIES NEAR PONCHATOULA, LA

(1,000 parts per million)

Middle Chlorides (Mid-depth)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1972												
Mean	0.168	0.126	0.111	0.410	0.391	0.567	0.865	0.892	1.491	1.944	1.906	1.227
Max	0.410	0.287	0.454	0.851	0.922	1.135	1.631	1.489	2.305	3.545	3.546	23.76
Min	0.070	0.050	0.035	0.043	0.149	0.241	0.532	0.390	1.099	1.276	1.206	0.532
1973												
Mean	0.836	0.633	0.422	0.128	0.047	0.029	0.029	0.060	0.284	0.268		
Max	2.269	1.879	1.489	0.426	0.227	0.049	0.035	0.064	0.788	0.376		
Min	0.355	0.273	0.160	0.021	0.018	0.018	0.023	0.030	0.140	0.218		

TABLE 3

LAKE PONTCHARTRAIN SALINITIES AT LITTLE WOODS, LA

(1,000 parts per million) Middle Chlorides (Mid-depth)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968												
Mean	3.100	2.798	3.308	3.092	3.121	3.208	3.024	3.056	3.533	4.016	4.092	3.982
Max	3.500	3.500	3.750	3.250	3.750	4.000	3.250	3.750	3.750	4.500	4.500	4.250
Min	2.750	2.500	2.750	2.750	2.500	2.500	2.750	2.500	3.250	3.500	3.750	3.500
1969												
Mean	3.575	3.194	3.173	2.430	1.884	2.050	2.244	2.890	3.485	4.113	3.902	4.610
Max	4.000	3.500	3.500	3.250	2.400	2.400	2.500	3.750	3.750	5.500	5.000	5.000
Min	3.250	2.750	2.750	2.000	1.600	1.800	1.900	2.100	3.100	3.500	3.250	4.000
1970												
Mean	3.852	3.500	3.346	3.557	3.106	2.704	3.115	3.397	3.847	3.961	3.272	2.838
Max	4.500	4.000	4.000	4.000	3.400	3.600	4.000	4.000	4.700	5.600	4.400	3.400
Min	3.000	2.750	2.250	3.000	2.700	1.900	2.500	2.700	2.600	2.600	2.000	2.000
1971												
Mean	2.978	2.912	2.836	2.563	2.843	3.208	3.096	3.385	3.526	3.425	3.259	3.718
Max	3.600	4.000	5.500	3.100	3.700	3.400	4.200	4.000	4.000	3.750	3.500	4.500
Min	2.500	0.350	2.300	2.200	2.500	2.900	2.000	2.600	2.750	3.000	3.000	2.750

TABLE 3 (contd)

LAKE PONTCHARTRAIN SALINITIES AT LITTLE WOODS, LA

(1,000 parts per million)

Middle Chlorides (Mid-depth)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1972												
Mean	1.893	1.440	1.664	1.937	1.559	2.256	2.730	3.118	3.973	4.226	4.834	3.851
Max	2.800	1.700	1.900	3.015	2.588	3.333	3.545	4.185	4.895	5.000	5.495	5.035
Min	1.400	1.200	1.425	1.600	0.266	1.418	1.915	2.021	2.837	3.155	4.430	2.907
1973												
Mean	3.273	2.584	2.670	1.141	0.103	0.134	0.676	1.358	2.270	2.115	2.275	2.216
Max	3.690	3.049	3.085	2.766	0.213	0.213	1.055	2.184	4.280	2.396	2.487	2.609
Min	2.766	1.596	2.411	0.085	0.035	0.035	0.247	0.971	0.101	1.607	2.062	1.820

(19) Generally, the salinity gradient in the lake is fairly uniform, increasing from near-fresh waters in Lake Maurepas progressively through Lake Pontchartrain to more saline conditions at the lake connection with Lake Borgne. Discharge of freshwater from the Pearl River acts to dilute Lake Borgne water; however, since the MR-GO opened in 1963, salinities have increased in Lake Pontchartrain and Lake Borgne due to the inflow of more saline waters from the gulf. Mean annual chlorides from eastern Lake Pontchartrain for a 5-year period after the opening of the MR-GO are two to three times higher for a similar prior period before the opening of the outlet.

c. ARCHEOLOGICAL ELEMENTS

(1) Two historic state monuments are located in the project area. Fort McComb located on the west shore of Chef Menteur Pass and south of Highway 90 and Fort Pike, located on the west shore of The Rigolets and just south of Highway 90. These forts were constructed after the war of 1812 to defend New Orleans. Fort Pike and surrounding grounds are incorporated into Fort Pike State Park where picnic tables, comfort stations, boat-launching facilities, and a developing museum are provided.

(2) The following historical properties are located in Orleans Parish: Big Oak-Little Oak Islands, the Cabildo, George Washington Cable House, the Garden District, Girod House, Hermann-Grima House, Jackson Square, Lafitte's Blacksmith Shop, Madame John's Legacy, Old Ursuline Convent, Pilot House, The Presbytere, St. Mary Assumption Church, Vieux Carre' Historic District, French Market (Old Meat and Vegetable Market), Merieult House, Lower Garden District and Lafayette Cemetery No. 1. Homeplace Plantation House in St. Charles Parish is another historical property within the project area.

(3) The Chalmette National Historical Park in St. Bernard Parish commemorates the Battle of New Orleans between American and British forces, 8 January 1815. The park covers a part of the ground over which the battle was fought. Along the Rodriguez Canal a series of historical markers identifies the various sites of battle events. The park covers about 141 acres and includes a 100-foot high monument which commemorates the action and memorializes the American soldiers who died there. The National Register has been consulted and no National Register properties are affected by the project.

(4) Archeological evidence indicates that Indians were present in the Pontchartrain Basin by approximately 1800 B.C. (Saucier, 1963). *Rangia cuneata* have matured, spawned, and died for the past 9,000 years in Lakes Pontchartrain and Maurepas (Saucier, 1963). Numerous shell heaps in the area testify that mollusks were a basic part of their diet. The most widely utilized mollusks were a freshwater clam (*Unio*), a brackish-water clam (*Rangia cuneata*), and the oyster (*Crassostrea virginica*). At least 30 sites are known to have been destroyed and many others severely damaged in recent years, most of these in the New Orleans area. Residential and commercial establishments have damaged or destroyed these sites by construction on or near them.

(5) Archeological sites on the south shore in St. Charles Parish and New Orleans East have been severely damaged by tidal action. Those sites which are directly on the lakeshore have been exposed to wave action and exhibit damage or truncation. In some cases, sites have been completely destroyed, but usually the shell and the more durable artifacts remain, concentrated by wave action along the nearby shore. Sites of this type, where none of the materials remains in their original location, are referred to as beach deposits. Since the collections from such an area include materials from all parts of the site and possibly several sites, there is a complete loss of stratigraphy.

(6) Indian mounds were built out of earth, shell, and occasionally a combination of both. These were usually associated with a village site and were built either as a burial ground or a temple base. Most of the 15 mounds found in the area are low dome or cone-shaped structures about 40 feet in diameter at the base and about 4 to 6 feet high. Mounds with few exceptions, contain fewer artifacts than middens or village sites.

(7) In March, 1970, the Louisiana Archeological Survey, Department of Geography and Anthropology, Louisiana State University, Baton Rouge, contracted with the National Park Service in a concerted effort to determine, by way of a field survey, if any archeological remains exist along the paths of the hurricane protection project, one of several in Louisiana being directed by the Department of the Army, New Orleans District, Corps of Engineers. The archeological survey for sites in the proposed construction area of the hurricane protection project was conducted intermittently over a period

of 7 days between June 8 and June 18, 1970 and resulted in a report (Neuman, 1970). The participants consisted of one archeologist and an assistant. Most of the survey was conducted by boat, but the areas in and around New Orleans and south of Bayou Terre aux Boeufs, in St. Bernard Parish, were surveyed by automobile and on foot. During the survey two previously unrecorded sites were visited. Both sites are manifested as low-rise shell middens along the shore of Lake Pontchartrain, at the mouth of Bayou Piquant, in St. Charles Parish. Investigations at both sites would contribute substantial data to the relatively meagre archeological record of this region.

d. BOTANICAL ELEMENTS

(1) Vegetation of the project area south of Lake Pontchartrain consists of second-growth swamp and marshland. A swamp is an area of wet, spongy land which is saturated and may be flooded intermittently or year-round. These areas are covered with tree growth and are strictly freshwater communities. Marshes, in contrast to swamps, are usually characterized by the absence of trees except on elevated ridges or spoil sites and are covered largely with herbaceous plants such as grasses, rushes, and sedges. Marshes in the basin vary from nearly fresh to strongly brackish. The vegetation north of Lake Pontchartrain consists of swamp and marshland with pine woods on the Prairie terrace to the north and west.

(2) Abundant plants along the roadside and disturbed areas include Dallis grass, smut grass, crab grass, Bermuda grass, little barley, bedstraw, wild geranium, sensitive plant, yellow foxtail, Johnson grass, spiny-leaved sow-thistle, cocklebur, ironweed, white clover, dandelion, santa maria, giant ragweed, goose grass, daisy fleabane, poor man's peppergrass, evening primrose, bahia grass, and buttercup. Other common plants in these waste places are pigweed, buttonweed, butterweed, morning glory, vervain, goldenrod, false dandelion, carpet grass, and chickweed. The large number of weedy species in the disturbed areas of the project area is indicative of human activity.

(3) Frontwoods near the Mississippi River are covered mainly with cottonwood, sweetgum, American elm, sycamore, hackberry, black willow, sandbar willow, boxelder, live oak, water oak, nuttall oak, rough-leafed dogwood, and wax myrtle. Vines in the frontwoods consist of poison ivy, peppervine, trumpet flower, ladies eardrops, rattan vine, blackberry, and dewberry.

Herbaceous species in these areas are smartweed, alligatorweed, horsetail, panic grasses, love grasses, day flower, and other numerous species which may be noted in Appendix A.

(4) Swamp vegetation is dominated by baldcypress, water tupelo (commonly called tupelo gum), Drummond red maple, pumpkin ash, water ash, black willow, and sweetgum. In the swamp, common plants are buttonbush, palmetto, shield fern, royal fern, ladies eardrop, buckwheat vine, poison ivy, and blackberry or dewberry. Areas of the swamp with standing water contain scattered trees mixed with alligatorweed, sawgrass, cattail, and water hyacinth. Invasion of brackish water has created dead cypress in many areas especially along Bayou Sauvage in eastern Orleans Parish. Plant succession has occurred slowly with cypress invading the open marsh in St. Charles Parish. Dead cypress trees are scattered in the marsh near LaBranche, Louisiana, in St. Charles Parish. Normal flooding of the marsh with tidal saline waters of Lake Pontchartrain has restricted rapid succession. Cypress is not tolerant to saline conditions but has invaded the open marsh. The area in St. Charles Parish affected by the project would remain an open marsh and cypress-tupelo gum swamp in the absence of the hurricane protection features.

(5) A study of the baldcypress swamp bordering the marsh in St. Charles Parish was made by Montz and Cherubin (1973). A comparison of township maps of 1840-58 and quadrangle maps of 1891-1969 revealed that many acres of marsh have been converted into a swamp community. Apparently this plant succession has occurred over many years. The average tree diameters at diameter basal height showed a progressive increase from the marsh moving into the swamp. Only baldcypress trees were recorded in this study with 56 percent of a total of 639 trees being dead. The large numbers of dead baldcypress trees in the open marsh and surrounding swamp are indicative of unfavorable environmental conditions. Local residents in the parish have noted that trees have been affected only in recent years. Further work is needed to clarify the death of baldcypress trees bordering Lakes Pontchartrain and Borgne. The authors of this paper feel that saltwater intrusion into these areas is a factor contributing to destruction of the trees, but more intensive work is needed to verify this. Salinity control of Lake Pontchartrain will be beneficial to the freshwater plant and animal species in the Lake Pontchartrain basin.

(6) Thieret (1972 a) compiled a checklist of aquatic and marsh plants of Louisiana and another checklist of ferns and fern allies, gymnosperms and monocotyledons of Louisiana (Thieret, 1972 b).

(7) Table 4 gives a list of the species in hydrologic units 1 and 2 and table 5 gives the composition of plant species by vegetative type in Louisiana (Chabreck, 1972). The hydrologic units on page 13 of this publication include the wetlands above the active delta of the Mississippi River along the east bank of the river including the Pontchartrain Basin.

(8) Montz (1970) studied the vegetation of the batture, levees, roadsides, frontwoods, swamp and marsh in St. Charles Parish. The study resulted in 308 species being recorded for the east bank of the parish.

(9) Lemaire (1961) prepared a preliminary checklist of the vascular plants of the marshes and included higher lands of St. Bernard Parish. This list contains 280 species collected from Indian shell mounds, canal spoil banks and bayous, natural levees and oak ridges in the brackish and salt marshes and swamp. The species noted in this study in St. Bernard Parish are included in Appendix A.

(10) Brown (1936) studied the vegetation of Indian mounds in the St. Bernard Parish area and neighboring vicinities and noted that plants common to slight rises in the marshes contrast to the surrounding marsh vegetation. He concluded that change in vegetation was indicative of differences in elevation and soil salinity and that marsh elder and salt reed grass (hogcane) were best suited for elevations rising above the general marsh level in the area studied.

(11) Basically, there are three types of marsh vegetation in the project area. These are fresh, intermediate, and brackish marsh types bordering the lake. In St. Charles and St. Tammany Parishes and over most of eastern Orleans Parish are extensive areas of brackish to freshwater marsh. Elevation, drainage, and salinity are factors which control distribution of plants. There is an overlap of some species among types in the three categories.

(12) Vegetation of the fresh marshes in the Pontchartrain Basin consists mainly of alligatorweed, duckweed (several

TABLE 4

PLANT SPECIES COMPOSITION OF VEGETATIVE TYPES BY HYDROLOGIC UNIT OF THE LOUISIANA COASTAL MARSHES (From Chabreck 1972)

Species	Vegetative Type			
	Saline	Brackish	Intermediate	Fresh
	----------Percent----------			
	Hydrologic Unit 1			
Acnida alabamensis	- -	- -	- -	1.12
Bacopa monnieri	- -	- -	- -	6.74
Cladium jamaicense	- -	- -	- -	31.46
Cyperus odoratus	- -	- -	- -	2.25
Cyperus sp.	- -	- -	2.21	- -
Distichlis spicata	10.47	7.09	- -	- -
Ipomoea sagittata	- -	- -	- -	2.25
Juncus effusus	- -	- -	- -	2.25
Juncus roemerianus	19.36	4.48	- -	- -
Osmunda regalis	- -	- -	- -	13.48
Pancium virgatum	- -	- -	- -	1.12
Panicum sp.	- -	- -	- -	8.99
Phragmites communis	- -	- -	- -	4.50
Sagittaria falcata	- -	- -	- -	11.24
Sagittaria sp.	- -	- -	2.21	- -
Scirpus olneyi	- -	3.11	9.93	- -
Scirpus robustus	- -	4.35	- -	- -
Spartina alterniflora	65.65	5.72	- -	- -
Spartina cynosuroides	- -	3.66	- -	- -
Spartina patens	1.81	67.99	84.99	- -
Taxodium distichum	- -	- -	- -	1.12
Typha spp.	- -	- -	- -	6.74
Vigna repens	- -	- -	- -	6.74
Other species	2.71	3.60	.66	- -
	Hydrologic Unit 2			
Batis maritima	6.07	- -	- -	- -
Distichlis spicata	13.78	6.80	- -	- -
Echinochloa walteri	- -	1.11	- -	- -
Eleocharis parvula	- -	4.20	- -	- -
Eleocharis sp.	- -	- -	8.50	- -
Juncus roemerianus	- -	2.78	- -	- -
Pluchea camphorata	13.24	3.19	1.36	- -
Ruppia maritima	- -	1.11	- -	- -
Scirpus olneyi	1.95	5.27	16.33	- -
Scirpus robustus	- -	1.15	- -	- -
Spartina alterniflora	61.14	6.13	- -	- -
Spartina patens	3.50	63.87	71.43	- -
Vigna repens	- -	2.04	- -	- -
Other species	.32	2.35	.66	- -

TABLE 5

PLANT SPECIES COMPOSITION OF VEGETATIVE TYPES IN THE LOUISIANA COASTAL MARSHES (From Chabreck 1972)

Species	Vegetative Type			
	Saline	Brackish	Intermediate	Fresh
	Percent			
Acnida alabamensis	--	.10	.30	.02
Aeschynomene virginica	--	--	--	.07
Alternanthera philoxeroides	--	--	2.47	5.34
Aster sp.	--	.08	.44	.13
Avicennia nitida	.60	--	--	--
Azolla caroliniana	--	--	--	.13
Baccharis halimifolia	--	.10	.56	.02
Bacopa caroliniana	--	--	.28	.34
Bacopa monnieri	--	.92	4.75	1.44
Bacopa rotundifolia	--	.11	.32	--
Batis maritima	4.41	--	--	--
Bidens laevis	--	--	--	.08
Borrichia frutescens	.67	.11	--	--
Brasenia schreberi	--	--	--	.67
Cabomba caroliniana	--	--	--	.71
Carex sp.	--	--	--	.02
Centella erecta	--	--	.16	.12
Cephalanthus occidentalis	--	--	--	.21
Ceratophyllum demersum	--	--	--	1.50
Cladium jamaicense	--	--	--	.84
Colocasia antiquorum	--	--	--	.39
Cuscuta indecora	--	.02	--	--
Cynodon dactylon	--	--	--	.10
Cyperus compressus	--	--	--	.02
Cyperus odoratus	--	.84	2.18	1.56
Daubentonia texana	--	--	.04	.17
Decondon verticillatus	--	--	--	.51
Dichromena colorata	--	--	--	.03
Distichlis spicata	14.27	13.32	.36	.13
Dryopteris thelypteris var. haleana	--	--	--	.44
Echinochloa walteri	--	.36	2.72	.77
Eichornia crassipes	--	--	--	1.43
Eleocharis parvula	--	2.46	.49	.54

TABLE 5 (contd)

Species	Vegetative Type			
	Saline	Brackish	Intermediate	Fresh
	----------Percent----------			
Eleocharis sp.	- -	.82	3.28	10.74
Eupatorium capillifolium	- -	- -	- -	.05
Eupatorium sp.	- -	- -	.08	.03
Fimbristylis castanea	.04	.11	.12	- -
Gerardia maritima	.01	.08	- -	- -
Heliotropium curassavicum	- -	.02	- -	- -
Hibiscus lasiocarpus	- -	- -	.10	.05
Hydrocotyle bonariensis	- -	- -	- -	.02
Hydrocotyle ranunculoides	- -	- -	- -	.11
Hydrocotyle umbellata	- -	- -	- -	1.93
Hymenocallis occidentalis	- -	- -	.04	.14
Hypericum virginicum	- -	- -	- -	.07
Ipomoea stolonifera	- -	- -	- -	.03
Ipomoea sagittata	- -	.13	.84	.19
Iva frutescens	.03	.10	- -	- -
Juncus effusus	- -	- -	- -	.11
Juncus roemerianus	10.10	3.93	.72	.60
Jussiaea diffusa	- -	- -	- -	.24
Jussiaea sp.	- -	- -	- -	.84
Kosteletzkya virginica	- -	.02	.18	.07
Lemna minor	- -	.02	.16	2.31
Leptochola fascicularis	- -	.32	2.17	.49
Leptochola filiformis	- -	- -	.04	- -
Limnobium spongia	- -	- -	- -	.16
Lippia nodiflora	- -	- -	- -	.06
Lycium carolinianum	.07	- -	- -	- -
Lythrum lineare	.01	.16	.18	.07
Myrica cerifera	- -	- -	- -	.16
Myriophyllum spicatum	- -	.15	.44	1.56
Myriophyllum heterophyllum	- -	- -	- -	.19
Najas quadalupensis	- -	- -	1.03	1.07
Nelumbo lutea	- -	- -	- -	.54
Nyphaea odorata/ tuberosa	- -	- -	- -	1.15

TABLE 5 (contd)

Species	Saline	Brackish	Intermediate	Fresh
	Vegetative Type			
	---Percent---			
Nymphoides aquaticum	- -	- -	- -	.11
Osmunda regalis	- -	- -	.16	.43
Ottelia alismoides	- -	- -	- -	.03
Panicum hemitomon	- -	- -	.76	25.62
Panicum repens	- -	- -	.92	.24
Panicum virgatum	- -	.14	2.51	.45
Panicum sp.	- -	- -	- -	.10
Paspalum dissectum	- -	- -	.40	.42
Paspalum vaginatum	- -	1.38	4.46	.35
Philoxerus vermicularis	- -	- -	.08	.01
Phragmites communis	- -	.31	6.63	2.54
Pluchea foetida	- -	- -	- -	.02
Pluchea camphorata	- -	.87	2.26	.36
Polygonum sp.	- -	- -	- -	.56
Pontederia cordata	- -	- -	- -	.07
Potamogeton nodosus	- -	- -	.28	.03
Potamogeton pusillus	- -	- -	.24	.62
Ruppia martima	- -	3.83	.64	- -
Sacciolepis striata	- -	- -	- -	.06
Sagittaria falcata	- -	- -	6.47	15.15
Sagittaria latifolia	- -	- -	- -	.21
Sagittaria platyphylla	- -	- -	- -	.23
Sagittaria sp.	- -	- -	.08	- -
Salicornia bigelovii	.12	- -	- -	- -
Salicornia virginica	.63	- -	- -	- -
Salix nigra	- -	- -	- -	.06
Saururus cernuus	- -	- -	- -	.16
Scirpus americanus	- -	- -	1.27	.13
Scirpus californicus	- -	- -	1.83	.42
Scirpus olneyi	- -	4.97	3.26	.45
Scirpus robustus	.66	1.78	.68	- -
Scirpus validus	- -	.08	- -	- -
Sesbania exaltata	- -	.06	.20	- -
Sesuvium portulacastrum	- -	.04	- -	- -
Setaria glauca	- -	.06	- -	- -
Setaria magna	- -	- -	- -	.03
Solidago sp.	- -	- -	.04	.08

TABLE 5 (contd)

Species	Vegetative Type			
	Saline	Brackish	Intermediate	Fresh
	Percent			
Spartina alterniflora	62.14	4.77	.86	- -
Spartina cynosuroides	- -	.89	1.19	.02
Spartina patens	5.99	55.22	34.01	3.74
Spartina spartineae	.01	.04	1.48	- -
Spirodela polyrhiza	- -	- -	- -	.20
Suaeda linearis	.23	- -	- -	- -
Taraxacum officinale	- -	- -	.02	- -
Taxodium distichum	- -	- -	- -	.02
Typha spp.	- -	- -	.98	1.57
Utricularia cornuta	- -	- -	- -	1.68
Utricularia subulata	- -	- -	- -	.21
Vallisneria americana	- -	.08	- -	- -
Vigna repens	- -	1.20	3.84	1.43
Woodwardia virginica	- -	- -	- -	.28
Zizaniopsis miliacea	- -	- -	- -	1.20

species), water pennywort, cattail, arrowhead (several species), bulltongue, maidencane, roseau, pink hibiscus, delta duck potato, marsh mallow, water hyssop, and sesbania.

(13) Species in the intermediate marshes are wiregrass, deerpea, cyperus, wild millet, hardstem bulrush, sawgrass, and morning glory.

(14) Typical vegetation in the brackish marshes includes wiregrass, great bulrush, hogcane, coco, widgeongrass, three-cornered grass, dwarf spikerush, oystergrass, salt grass, and black rush. These three latter species are dominants in the saline marshes of Louisiana.

(15) Vegetation occurring on the spoil lands and borrow material in the marshes consists mainly of marsh elder, eastern baccharis, elderberry, pigweed, black willow, hackberry, morning glory, camphorweed, and numerous species of the surrounding marshes.

(16) A vegetative type map by Chabreck, Palmisano, and Joanen (1968) of Louisiana marshes has been prepared. Plate 2 notes the marshes in the project area on this map.

(17) A preliminary list of species noted around the periphery of Lake Pontchartrain is included in Appendix A. Most of the species listed have been collected over the past 5 years and deposited in the Herbarium at Louisiana State University in Baton Rouge. Common names are included with the habitat for each species listed. Habitat types for each species bordering Lake Pontchartrain include fresh, intermediate, and brackish marshes, sand beaches, swamp, and ridges. Dominant plants in the fresh marsh south of the Illinois Central Railroad in St. Charles Parish include alligatorweed, Walter's millet, bulltongue, marshmallow, pigweed, water hyacinth, Cyperus odoratus, giant foxtail, deerpea, bulltongue, Sesbania exaltata, giant bulrush, pink hibiscus, roseau, and naiad. Abundant species in the fresh marshes along Lake Pontchartrain near Pass Manchac are Sesbania exaltata, Cyperus odoratus, pink hibiscus, alligatorweed, giant foxtail, maidencane, roseau, and belle dame. In the fresh marsh along the lake south of Madisonville, the abundant plants are royal fern, Cyperus odoratus, sawgrass, white grass, bulltongue, wild hibiscus, Ipomoea sagittata, giant foxtail, belle-dame, alligatorweed, common cattail, deerpea, and pickerelweed. The intermediate marsh north of Interstate 10 in St. Charles Parish

is covered with wiregrass with Ipomoea sagittata, dwarf spikerush, giant foxtail, Cyperus odoratus, stinking fleabane, and water hyssop being common. Intermediate marsh along the north shore from Fontainebleau State Park to Slidell includes water hyssop, belle-dame, yellow water lily, Ipomoea sagittata, wiregrass, black rush, Cyperus odoratus, bulltongue, and pink hibiscus. Brackish marshes closer to the lakeshore from Fontainebleau State Park to Slidell and New Orleans East are vegetated primarily with wiregrass and also three-cornered grass, saltgrass, black rush, oystergrass, camphorweed, Ipomoea sagittata, marshmallow, widgeongrass, coco, Walter's millet, water hyssop, Paspalum vaginatum, and Cyperus odoratus. Hogcane is noted on elevated areas in the brackish marsh. Many of these species may be found in the three marsh types around Lake Pontchartrain. Baldcypress-tupelogum swamps border the lake from Madisonville to the west extending to the Bonnet Carre' Spillway in St. Charles Parish. The ridges noted are elevated areas along the shoreline which include railroad spoilbanks, canal spoilbanks, natural levees of bayous, sand ridges along the shoreline and archeological middens. Many of these species are more upland weedy plants noted on ridges. Some of these species have been noted only on the north shore of the lake on ridges along the shoreline. These species are typically found in pineland sloughs in the Florida Parishes and are so noted because they are, in general, absent from the flood plain of the Mississippi River. This peculiarity is significant enough to be recognized.

(18) Field trips were made between January and April 1973 for purposes of surveying the submerged vegetation of Lake Pontchartrain prior to the 8 April opening of the Bonnet Carre' Spillway in St. Charles Parish.

(19) Quadrangle maps of the shoreline around the lake were used to select 102 survey areas. Ten of these survey sites were in North Pass and Pass Manchac. The area along the Bonnet Carre' Spillway in Lake Pontchartrain was not surveyed. Eleven additional sites were surveyed in the winter in Lake Maurepas from Pass Manchac to the Reserve Relief Canal along the southeast shore. The Lake Maurepas information is not included in this report because the study was not completed. No attached vegetation was recorded in Lake Maurepas although some floating species (duckweeds, coontail, horned pondweed, fanwort, frogbit, and naiad) were recorded near the shore during extremely high tides.

(20) All survey sites were revisited in the summer of 1973 to determine the effects, if any, on the submerged vegetation of the lake from the opening of the Bonnet Carre.

(21) Apparently this is the second attempt to survey the submerged vegetation in Lake Pontchartrain. The study, though, has several limitations. The distances between points (102 stations) were not randomly selected and no quantitative data were collected. Subjective estimations were used to evaluate the relative abundance of species in each area. Survey sites were, in general, chosen with approximately equal distances around the lake but emphasis was placed on distinct landmarks which could be relocated. Wooden stakes and willow poles placed during the winter-spring survey could not be found during the summer survey for about half of the sites and these runs were conducted without exact reference points to the presurvey. Wave action hampered normal boat operation on many runs which resulted in uneven transects being surveyed from the shore to the -6-foot contour. The survey conducted prior to the opening of the spillway was in the winter and spring, whereas, the postsurvey was conducted in the summer.

(22) The abundance of species noted in the two surveys reflects the grazing of migratory waterfowl and limited growth during the winter and early spring. Heavy grazing of vegetation by migratory waterfowl observed during the winter months tended to result in lower assigned abundance values than those assigned to the same species at the same survey site in the summer.

(23) The majority of plant samples containing widgeon-grass and eelgrass recorded during the winter and spring survey indicated some degree of grazing on the plants. In some areas, particularly along the north shore of Lake Pontchartrain between US Highway 11 and Mandeville, there was evidence of extremely heavy grazing, particularly on eelgrass. Large numbers of waterfowl were observed feeding over the vegetation. Birds observed feeding over the beds were the American coot (*Fulica americana*), lesser scaup (*Aythya affinis*) and bufflehead (*Bucephala albeola*). Coots are primarily grazers and are responsible for the majority of the grazing. The lesser scaup and bufflehead feed on small crustaceans and mollusks and their amount of grazing is minor.

(24) The plants were grazed to the roots and in some cases roots of eelgrass had been pulled above the surface of the

lake bottom. The widgeongrass was less heavily grazed and much more abundant than eelgrass during the winter and spring. Eelgrass was seldom found ungrazed.

(25) No birds were collected for inspection of crop contents. However, a recent conversation with Johnny Tarver, Louisiana Wild Life and Fisheries Commission biologist, indicates use of the brackish water clam (Rangia cuneata) by lesser scaup. The coots were observed grazing on eelgrass and widgeongrass.

(26) The vegetated portions of Lake Pontchartrain bottom are an important source of waterfowl (primarily coot) food. Diving ducks use mollusks and crustaceans wherever they are available throughout the lake. These vegetative areas of the lake are very important as nursery ground for many fishery species, especially the blue crab.

(27) Several authors have revealed information on submerged vegetation in Lake Pontchartrain. Perret (1971) notes that the only area in the Louisiana coastal zone that contains submerged vegetation extensive enough to be calculated and placed on maps is in the north shore area of Lake Pontchartrain. The report noted that this vegetation consists of widgeongrass and wild celery (eelgrass) and encompasses approximately 20,000 acres.

(28) Suttkus, Darnell, and Darnell (1954) noted a preliminary list of the vegetation of the lake. No submerged aquatics were encountered in water deeper than 6 feet although it was noted that small local concentrations may exist in the vicinity of Big Point and Goose Point along the north shore. Submerged aquatics in water 0 to 6 feet in depth were Eleocharis sp. (spikerush), Jussiaea sp. (water primrose), Ruppia maritima (widgeongrass), and Vallisneria americana (eelgrass).

(29) Haynes (1968) noted only one Louisiana specimen of Potamogeton perfoliatus: St. Tammany Parish, beach at Mandeville, Lake Pontchartrain, 1945, Clair A. Brown 5676 (LSU).

(30) Three transects were made from the shoreline to the -6-foot contour in the lake for each of the survey areas. These runs were approximately 50 feet apart. Stakes and willow poles were placed as markers in the winter-spring survey. Distances from the shoreline to the -6-foot contour ranged from

approximately 15 yards in Pass Manchac and North Pass to one-half mile plus along the north shore near Goose Point, Green Point, and Pointe Platte.

(31) A 14-prong garden rake (14 inches wide) with an attached pole for additional length was used to drag the bottom. One-foot intervals were marked on the rake for determining depths. Along the north shore, especially near Goose Point and Green Point, the runs were made by wading to -2 feet and proceeding from there by boat to the -6-foot contour. Species were recorded and given a value according to a rating scale: 3 (abundant), 2 (common), and 1 (infrequent). Most of the samples of species recorded were collected, dried, processed with herbarium labels, and sent to the Herbaria of Tulane University in New Orleans, Louisiana State University in Baton Rouge, and the University of Southwestern Louisiana in Lafayette.

(32) These surveys have resulted in an aquatic vegetation analysis of Lake Pontchartrain, Louisiana. The species recorded in the winter-spring and summer surveys are given in table 6. The number of sites which recorded each species for the two surveys and the total number of sites is noted. Appendix D illustrates the distribution, abundance, and depths of each species.

TABLE 6
AQUATIC VEGETATION OF LAKE PONTCHARTRAIN

Species	Presurvey	Postsurvey	Total Stations
Vallisneria americana	25	16	26
Ruppia maritima	23	20	29
Najas guadalupensis	23	7	27
Zannichellia palustris	3	0	3
Potamogeton perfoliatus	1	1	1

(33) The decrease in sites for *Vallisneria*, *Ruppia*, and *Najas* is partially reflected in the loss of wooden stakes and willow poles at half of the stations and also the fact that

only several plants were recorded at each station in the presurvey study for the nine stations recording Vallisneria, three recording Ruppia, and 13 recording Najas where these species were not found. Field notes indicate similar abundance values for species where survey sites had poles and stakes intact from the presurvey. Vallisneria was not recorded at three stations near the Rigolets and Point aux Herbes where poles and stakes could not be located, whereas Ruppia was completely absent from the three sites in the postsurvey where poles and stakes were found. In the postsurvey, Ruppia was relatively infrequent on the points (Green Point, Goose Point, and Pointe Platte) along the northeast shoreline compared to the areas between these points such as near Bayou LaCombe where the growth of Ruppia was luxuriant with Vallisneria. The decrease in stations for Najas was partially involved with the loss of all aquatic plants in North Pass and Pass Manchac (seven stations) and the fact that this species was only abundant in North Pass during the winter and spring and completely absent in midsummer in and near North Pass and the north shore of the lake. Zannichellia was found attached only in North Pass but was noted floating throughout the lake during the summer. Local fishermen and residents of camps along Pass Manchac and North Pass informed this author that this aquatic vegetation (Najas and Zannichellia) floats out of the passes every spring and always returns in the winter. Vallisneria, Ruppia, Najas, and Potamogeton were recorded in both surveys, while Zannichellia was recorded only in the winter-spring survey.

(34) Eleocharis parvula was noted along the shoreline in the tidal zone to depths of 6 inches during low tides. This species was quite abundant along the northeast shoreline in the zone between high and low tides. Bacopa monnieri and Sagittaria platyphylla were also noted in the zone between high and low tides, but not beyond the low tide zone similar to Eleocharis. These two species were noted along the northwest shoreline of the lake.

(35) Ceratophyllum demersum, Ceratophyllum echinatum, Cabomba caroliniana, Limnobium spongia, Pistia stratiodes, Eichhornia crassipes, Lemna minor, Utricularia sp., Wolffia columbiana, Wolffiella sp., Spirodela polyrhiza, and Chara vulgaris were noted floating in Lake Pontchartrain. These plants were noted mainly in early April 1973 when extremely high tides from southerly winds resulted in a flushing of the surrounding wetlands along with swamp species from the Bonnet Carre being swept into Lake Pontchartrain.

(36) Vallisneria was recorded at depths of 6 feet at Green Point, Goose Point, Pointe Platte, and Point aux Herbes. Najas was recorded at depths of 6 feet in North Pass and near the Techefuncta River in the lake. In all areas surveyed, Vallisneria was abundant between depths of 1 foot to 2.5 feet, while Ruppia was noted to be abundant closer to the shoreline between depths of 6 inches below the low tide zone to 1.5 feet.

(37) The vegetated zones along the north shore of Lake Pontchartrain have a soil composition basically of loam (mixture of varying proportions of clay, sand, and organic matter). Field notes indicate that loam type soils, in general, tend to support abundant submerged vegetation whereas, clay and sand did not. Abundant aquatic species were noted adjacent to marsh areas around the lake except for St. Charles Parish where excessive shoreline erosion may be a factor in the area being devoid of submerged, attached vegetation. Areas in the lake bordering swamps were, in general, not conducive to submerged, attached plants, possibly because of the clay composition.

(38) In general, the abundant species noted in the winter-spring survey were recorded again in the summer survey. Vallisneria, Ruppia, Najas, Eleocharis, and Potamogeton were recorded in both surveys. Zannichella was recorded only in the winter-spring survey. Sagittaria and Bacopa were noted only in the summer survey.

(39) These studies have revealed that abundant species recorded in certain areas in the winter-spring survey along the north shore of Lake Pontchartrain were, in general, recorded again in the same relative abundance in the summer survey. Results of these trips revealed that most of the rooted, submerged vegetation in the lake is between Green Point near Mandeville and Big Point near North Shore and Slidell, Louisiana.

(40) During the summer survey, areas were surveyed between stations along the shore of the lake. Information recorded on these runs from the shoreline to the -6-foot contour

was used to measure distances which were vegetated. These measurements were transferred to quadrangle maps and planimetered. The total acreage of vegetated water bottom in Lake Pontchartrain noted in this study consists of approximately 2,000 acres. The methodology utilized in determination of the 20,000 acres noted by Perret was similar to this study. It is not known if a loss of acreage of submerged attached vegetation has occurred between the interval of the two studies or if the surveys revealed different subjective techniques to determine if areas were vegetated sufficiently to be palimetered. This study has revealed present conditions of the lake. A report is currently being prepared on vegetational studies from effects of the Bonnet Carre opening on Lake Pontchartrain and the spillway proper.

(41) Much of the primary organic matter (detritus) by which consumers of the Lake Pontchartrain community are nourished apparently originates outside the lake (Darnell 1961 and 1962). The author notes that enormous quantities of detrital material enter in the form of humus and wave-dissected marshes and as plankton from adjacent fresh and saltwater passes. These studies note that those fishes and invertebrates in which organic detritus makes up a large percentage of the diet are among the most successful species inhabiting the lake.

(42) The major phytoplankton elements of Lake Pontchartrain include _Anabaena_ spp., _Chaetoceros_ spp., and _Coccinodiscus_ spp. The more freshwater genus, _Anabaena_, was found in all parts of the lake but with heaviest blooms in the western half of the lake. Thick scum covers can be observed during the late summer and early fall. _Chaetoceros_ spp. and _Coscinodiscus_ spp., typical marine diatoms, taper off in the fresher areas. It is probable that many of these forms were transported by currents from Lake Borgne. Of the many freshwater and marine adventitious species swept into the lake, most do not reproduce, but encounter a rapid or slow death depending upon their tolerances and the existing conditions (Suttkus _et al_. 1954).

(43) Phytoplankton collected in Lake Pontchartrain from November 1968 through July 1969 (Stern _et al_. 1969) included the following taxa.

TABLE 7
PHYTOPLANKTON IN LAKE PONTCHARTRAIN
(From Stern et al. 1969)

Cyanophyta	Chlorophyta (cont'd)
Anabaena sp.	*Scenedesmus denticulatus*
Merismopaedia sp.	*Schroederia* sp.
Oscillatoria sp.	*Sphaerocystis* sp.
Spiruline sp.	*Spirogyra* sp.
Chlorophyta	Chrysophyta
Actinastrum sp.	*Biddulphia mobiliensis*
Chlamydomonas sp.	*Campylodiscus echeneis*
Cladophora sp.	*Chaetoceros* spp.
Closterium sp.	*Coscinodiscus* spp.
Dictyospaerium sp.	*Fragilaria* sp.
Eudorina elegans	*Gomphonema* sp.
Euglena sp.	*Gyrosigma* sp.
Gonium pectorale	*Melosira* spp.
Hydrodictyon sp.	*Synedra* spp.
Micrasterias laticeps	*Tabellaria* sp.
Pandorina morum	
Pediastrum boryanum	Pyrrophyta
Pediastrum simples	*Ceratium* sp.
Rhizosolenia sp.	*Peridinium* sp.
Scenedesmus brasiliensis	

(44) The prairie terraces to the north and west of Lake Pontchartrain are covered mainly with longleaf, slash, spruce, and loblolly pines, oaks (several species), magnolias (several species), tulip tree, flowering dogwood, and sweetgum.

(45) A list of plants mentioned in this statement is included as appendix A.

e. ZOOLOGICAL ELEMENTS

(1) The aquatic life of Lake Pontchartrain is composed of typical brackish water species. The low salinity allows the invasion of freshwater species but also excludes many of the typical high salinity brackish water forms. As typical of the biota of other estuaries there is an abundance of a few species which can tolerate brackish water conditions.

(2) The zooplankton consists of large populations of a few brackish-water species dominated by the calanoid copepod *Acortia tonsa* and low densities of freshwater and littoral marine forms.

(3) Darnell (1962) noted that only four species maintain large endemic populations as year-round residents, a brackish water clam (*Rangia*), mud crab (*Rithropanopeus*), calanoid copepod (*Acortia*), and fish (*Anchoa*). According to Darnell, most of the remaining abundant species are migratory and spawn elsewhere, invading the lake as seasonal transients.

(4) Zooplankton collected in Lake Pontchartrain from November 1961 through July 1969 (Stern and Stern, 1969) included the following taxa:

TABLE 8
ZOOPLANKTON IN LAKE PONTCHARTRAIN
(From Stern and Stern, 1969)

Protozoa
- *Bursaria truncatella*
- *Centropyxis* sp.
- *Didinium nasutum*
- *Difflugia* sp.
- *Euplotes patella*
- *Paramecium* sp.
- *Stentor polymorphus*

Rotifera
- *Asplanchna* sp.
- *Brachionus calyciflorus*
- *Brachionus havanaensis*
- *Brachionus plicatilis*
- *Euchlanis parva*
- *Fillinia longiseta*
- *Hexarthra* sp.
- *Keratella valga*
- *Synchaeta* sp.

Nematoda
Mollusca
Annelida
Tardigrada

Arthropoda
- *Acartia tonsa*
- *Harpactacoid copepod*
- *Copepod nauplius*
- *Balanus* sp.
- *Bosmina longirostris*
- *Pentaneura* sp.

(5) Tarver and Dugas (1973) noted in Gillespie (1971) that analysis of plankton samples indicated that Lakes Pontchartrain and Maurepas were relatively nonproductive when compared to other Louisiana estuaries.

(6) The Waterborne Commerce of the United States (1972) report noted that 21 tons of fresh fish, except shellfish; 4,653 tons of shellfish, except prepared; and 4,546,082 tons of marine shells, unmanufactured were harvested in Lake Pontchartrain in 1972.

(7) "Analysis of 133 plankton, 462 otter trawl, and 124 shore seine samples from Lake Pontchartrain and adjacent waters of southeastern Louisiana suggests the following pattern for this history of the blue crab in the area, although details are in need of confirmation. Mating takes place in the fresher areas followed by migration of the mated females to more saline waters. After hatching, the young migrate in toward estuaries where most of the growth takes place. The first wave of young seems to arrive in Lake Pontchartrain in May and crabs spawned in the spring appear to reach a size of about 65 mm. by September of the first year. The relative absence of adults from winter collections suggests migration or hibernation. Food habits, parasites, and periodicity are discussed." (Darnell, 1965).

(8) The following species were collected from Lake Pontchartrain by Darnell (1959): portunid crabs (*Callinectes sapidus*), xanthid crabs (*Eurypanopeus depressus*, *Rithropanopeus harrisii*, and probably *Panopeus herbstii*), grapsoid crabs (*Sesarma reticulatum*), ocypodid crabs (*Uca* sp., probably *U. mordax*), and majid crabs (*Libinia erinacea*). The author noted only two of these species were abundant within the lake, the blue crab (*C. sapidus*) and the mud crab (*R. harrissii*).

(9) Tarver and Dugas (1973) sampled the brackish water clam, *Rangia cuneata*, in Lakes Pontchartrain and Maurepas to determine the occurrence, distribution, and density of clam populations. Clam population density was high in the western portion of Lake Pontchartrain. The highest clam density was 818 clam/M^2 (16 mm. and larger) in Lake Maurepas. The maximum density of this species less than 16 mm. in height was recorded along the south shoreline of Lake Pontchartrain near New Orleans East. Rangia populations were noted, in general, to exhibit a pattern of decreased density as water depth increased. The data

from this study demonstrated that *Rangia cuneata* reproduction, recruitment, and growth were occurring in Lakes Pontchartrain and Maurepas. Dredged clam shell production in Lakes Pontchartrain and Maurepas is 5 million cubic yards annually (Louisiana Wild Life and Fisheries Commission, 1968). The value of *R. cuneata* was reported by Suttkus *et al*. (1954) when they noted the clam in the stomach contents of two crustaceans and 14 of the 75 species of fishes reported in Lake Pontchartrain. Darnell (1958) reported three species of crustaceans and 14 species of fishes containing *R. cuneata* in the digestive system. Tarver and Dugas (1973) examined crops of several lesser scaup and found many small clams, many of which were identified as *R. cuneata*.

(10) Darnell (1958) noted stomach contents of the fishery species in Lake Pontchartrain. Diatoms, zooplankton, a flagellate, a mussel, calanoid copepod, plant material, gastropods, clams, annelids, and mud crabs were noted in the digestive tract of the fishes studied. These species, in addition to the bottom-dwelling organisms, inhabit Lake Pontchartrain. Tables 9 through 21 give the occurrence of food items in digestive tracts of 12 fish and shellfish species from Darnell (1958).

(11) Since most of the commercial species of fishes and invertebrates are omnivorous with organic detritus prominent in their diet, these species are dependent upon production which occurs in surrounding marshes and swamplands.

(12) Darnell (1958) carried out 1,399 quantitative and about 100 qualitative stomach analyses on the 35 most important species in Lake Pontchartrain. These included the following: blue shark, longnose gar, spotted gar, alligator gar, bigeye herring, gulf menhaden, gizzard shad, threadfin shad, Southern bay anchovy, gafftopsail catfish, sea catfish, blue catfish, channel catfish, Atlantic needlefish, striped mullet, silverside, yellow bass, largemouth bass, common jack, freshwater drum, silver perch, sand squeteague, spotted squeteague, spot, Atlantic croaker, black drum, red drum, gulf sheepshead, pinfish, Southern flounder, hog choker, common rangia (clam), white shrimp, river shrimp, and blue crab. These food studies revealed two primary food chains in Lake Pontchartrain. The first pathway proceeds from copepods (*Acartia*) through small fishes (*Anchoa* and *Brevoortia*) to larger predators. The second pathway proceeds from small benthic invertebrates through larger invertebrates and small bottom-dwelling fishes (catfishes) to the same large predators.

The second pathway proceeds from small benthic invertebrates through larger invertebrates and small bottom-dwelling fishes (catfishes) to the same large predators. Organic detritus, according to Darnell (1958) which was prominent in the food of fishes and larger invertebrates, probably also serves as an important source of nutrition for the copepods.

(13) The components of the major food groups in the Lake Pontchartrain community based upon stomach analysis of the chief consumer species from Darnell (1961) are listed in Table 22. The author noted that most consumers appear to ingest food on the basis of ecologic rather than taxonomic association.

(14) Tables 23 through 27 give the percentage of zooplankton, microinvertebrates, larger invertebrates, fishes, and organic detritus in the food of the consumer species with stage and size range, respectively. Darnell (1961) noted that the most conspicuous single food item in the diets of the consumers in the lake is organic detritus with its attendant bacteria. The abundant consumer species of Lake Pontchartrain, according to Darnell (1961), comprise two groups: those which feed heavily upon organic detritus and those which exhibit a broad range of food tolerance.

(15) The fishes of Lake Pontchartrain are mainly marine with the Atlantic croaker, Micropogon undulatus; the bay anchovy, Anchoa mitchilli; the gulf menhaden, Brevoortia patronus, the mullet, Mugil cephalus being particularly abundant. Other common species include the spot, Leiostomus xanthurus; the hogchoker, Trinectes maculatus; the sand squeteague, Cynoscion arenarius: the silver perch, Bairdiella chrysura; the sea catfish, Arius felis; and the silverside Menidia beryllina. Freshwater species such as the blue catfish, the channel catfish, blackbass, and other sunfish occur in the less saline areas.

(16) Sport and commercial fisheries exist for many species, including those mentioned above, but also the speckled trout, Cynoscion nebulosus; the black drum, Pogonias cromis; the channel bass locally called red fish, Sciaenops ocellate; the sheepshead, Archosargus probatocephalus; and the Southern flounder, Paralichthys lethostigma. A list of some species of freshwater and saltwater estuarine fishes from the study area is included in Appendix B.

TABLE 9

OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 92 ANCHOA MITCHILLI (From Darnell, 1958)

	30.0-44.0 mm. 15 examined 13 with food		45.0-49.0 mm. 25 examined 21 with food		50.0-54.0 mm. 22 examined 19 with food		55.0-59.0 mm. 19 examined 18 with food		60.0-74.0 mm. 11 examined 10 with food	
	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Rotifera	6.7	3.9	4.0	0.3	-	-	-	-	-	-
Ostracoda	-	-	4.0	0.8	-	-	5.3	T	-	-
Copepoda (undet.)	26.7	11.0	24.0	9.4	4.5	-	21.1	1.5	-	-
Calanoid	26.7	9.0	16.0	1.4	4.5	T	21.1	3.5	27.3	0.5
Cyelopoid	-	-	-	-	4.5	0.5	-	-	-	-
Harpacticoid	6.7	0.3	12.0	0.4	13.6	3.3	-	-	9.1	1.3
Mysid shrimp	20.0	28.1	48.0	52.0	50.0	43.8	42.1	34.5	45.5	40.3
Iopoda	-	-	8.0	5.4	4.5	8.5	10.5	7.3	-	-
Amphipoda	-	-	16.0	6.0	9.9	1.2	10.5	2.6	-	-
Insecta	6.7	1.0	4.0	0.8	-	-	-	-	-	-
Mollusca										
Rangia cuneata	-	-	4.0	0.2	4.5	0.6	5.3	2.9	-	-
Castropoda	-	-	4.0	2.3	-	-	15.8	3.4	9.1	2.7
Vertebrata										
Gobiosoma bosci	-	-	-	-	-	-	5.3	6.8	-	-
Fish larvae	-	-	-	-	-	-	5.3	7.3	9.1	13.4
Fish remains	-	-	-	-	-	-	-	-	27.3	19.3
Planktonic diatoms	-	-	4.0	0.4	-	-	-	-	-	-
Seeds	6.7	1.0	-	-	-	-	5.3	1.2	-	-
Eggs and cysts	13.3	3.2	4.0	T	4.5	0.2	5.3	0.5	-	-
Organic mat.(undet.)	73.3	34.7	48.0	6.9	68.2	33.7	68.4	22.8	72.7	19.2
Detritus	33.3	7.2	48.0	13.4	72.7	7.3	63.2	5.1	90.9	3.3
Sand	-	-	12.0	0.4	13.6	0.8	15.8	0.4	27.3	-
SUMMARY										
Copepods		20.3		11.2		3.8		5.0		1.8
Mysid shrimp		28.1		52.0		43.8		34.5		40.3
Isopoda and amphipoda		0.0		11.4		9.7		9.9		0.0
Fishes		0.0		0.0		0.0		14.1		32.7
Miscellaneous		9.1		4.8		0.8		8.0		2.7
Incidental and undet.		41.9		20.7		41.8		28.3		22.5

*Stomach and intestine included.

TABLE 10
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS
OF 40 GALEICHTHYS FELIS (From Darnell, 1958)

Food Items	90.0-169.0 mm. 19 examined 19 with food		170.0-229.0 mm. 21 examined 17 with food	
	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Copepoda-Harpacticoid	5.2	-	-	-
Mysid shrimp	10.5	1.9	4.8	1.3
Isopoda	42.1	1.8	23.8	2.1
Amphipoda	68.4	9.5	38.1	4.0
Palaemonidae	-	-	4.8	0.5
Crabs (undet.)	-	-	4.8	3.8
Rithropanopeus harrisii	47.4	15.7	61.9	27.8
Callinectes sapidus	-	-	9.5	2.3
Insecta (undet.)	5.2	0.1	-	-
Coleoptera	10.5	0.7	28.6	3.7
Diptera-larvae	89.5	10.6	61.9	10.3
Pupae, adults	26.3	2.0	14.3	0.6
Arachnida	-	-	4.8	0.4
Mollusca				
Rangia cuneata	15.8	1.3	4.8	-
Gastropoda	5.2	-	4.8	-
Hydroids	10.5	0.1	-	-
Vertebrata				
Fish remains	63.2	11.1	38.1	5.2
Vascular plants	10.5	-	-	-
Organic mat. (undet.)	78.9	31.6	76.2	27.3
Detritus, Sand	68.4	13.6	81.0	10.8
SUMMARY				
Mysid shrimp		1.9		1.3
Isopoda, Amphipoda		11.3		6.1
Insecta		13.4		14.6
Crabs		15.7		33.9
Miscellaneous		12.5		6.1
Detritus, undet.		45.2		38.1

*Stomach and intestine included.

TABLE 11

OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 78 ICTALURUS FURCATUS (From Darnell, 1958)

Food Items	60.0-129.0 mm. 18 examined 15 with food		130.0-199.0 mm. 18 examined 16 with food		200.0-229.0 mm. 17 examined 15 with food		230.0-411.0 mm. 25 examined 23 with food	
	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Ostracoda	-	-	11.1	T	17.6	0.2	-	-
Copepoda								
Calanoid	5.6	12.6	-	-	-	-	-	-
Harpacticoid	-	-	11.1	0.5	-	-	-	-
Mysid shrimp	27.8	36.0	16.7	1.5	11.8	0.4	24.0	0.2
Isopoda	22.2	4.2	11.1	-	23.5	0.4	16.0	4.8
Amphipoda	50.0	4.4	55.6	19.1	29.4	23.0	52.0	1.8
Palaemonetes sp.	-	-	-	-	5.9	-	8.0	2.6
Macrobrachium ohione	-	-	-	-	-	-	4.0	1.0
Penaeus setiferus	-	-	-	-	-	-	4.0	2.6
Callanassa sp.	-	-	-	-	5.9	5.1	4.0	1.3
Crabs								
Rithropaneopeus harrisii	-	-	44.4	10.9	47.1	2.4	20.0	6.4
Callinectes sapidus	5.6	-	5.6	1.0	5.9	0.8	24.0	3.0
Insecta								
Coleoptera	16.7	1.7	33.3	0.3	29.4	0.5	8.0	-
Diptera	27.8	0.5	27.8	1.3	52.9	0.8	40.0	0.6
Hemiptera	-	-	5.6	-	5.9	-	-	-
Homoptera	-	-	-	-	-	-	4.0	-
Hymenoptera	-	-	5.6	-	11.8	-	4.0	-
Orthoptera	-	-	5.6	-	5.9	-	4.0	-
Arachnida	-	-	-	-	5.9	-	-	-
Annelida	5.6	-	5.6	1.3	-	-	12.0	0.7
Mollusca								
Rangia cuneata	5.6	-	72.2	25.3	76.5	36.0	52.0	9.9
Mytilopsis leucophaeata	-	-	5.6	-	23.5	6.7	16.0	2.1
Gastropoda	-	-	5.6	-	35.3	0.5	4.0	-
Hydroids	-	-	-	-	5.9	0.1	4.0	-
Vertebrata								
Anchoa mitchilli	-	-	-	-	11.8	9.9	4.0	0.5
Citharichthys spilopterus	-	-	-	-	-	-	8.0	7.3
Menidia beryllina	-	-	-	-	-	-	4.0	0.4
Micropogon undulatus	-	-	-	-	5.9	0.7	12.0	8.3
Syngnathus sp.	-	-	-	-	-	-	4.0	0.4
Fish remains	-	-	11.1	3.5	2.3	24.0	13.5	
Algae-filamentous	-	-	5.6	3.3	-	-	32.0	25.7
Vascular plants	5.6	0.2	5.6	-	5.9	-	24.0	0.5
Eggs and cysts	-	-	5.6	-	-	-	-	-
Organic mat. (undet.)	88.9	26.3	66.7	25.5	76.5	10.1	52.0	3.3
Detritus	33.3	10.6	27.8	6.2	23.5	0.3	32.0	1.1
Sand and silt	11.1	3.8	16.7	0.4	17.6	0.1	40.0	2.3
SUMMARY								
Copepoda, Ostracoda, Mysids		48.6		2.0		0.6		0.2
Isopoda, Amphipoda		8.6		19.1		23.4		6.6
Macrocrustacea		0.0		11.9		8.3		16.9
Mollusks		0.0		25.3		43.2		12.0
Fishes		0.0		3.5		12.9		30.4
Vegegation		0.2		3.3		0.0		26.2
Misc. invertebrates		2.2		2.9		1.4		1.3
Incidental and undet.		40.7		32.1		10.5		6.7

*Stomach and intestine included

TABLE 12
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 60 MENIDIA BERYLLINA (From Darnell, 1958)

	40.0-54.0 mm. 21 examined 19 with food		55.0-61.0 mm. 20 examined 20 with food		65.0-79.0 mm. 19 examined 16 with food	
Food Items	Percentage of tract* containing item	Percentage of total stomach volume	Percentage of tract* containing item	Percentage of total stomach volume	Percentage of tract* containing item	Percentage of total stomach volume
Ostracoda	-	-	5.0	T	5.3	-
Copepoda						
Calanoid	9.5	5.5	5.0	0.4	-	-
Mysid shrimp	4.5	3.0	15.0	10.5	10.5	2.5
Isopoda	38.1	42.3	30.0	12.4	10.5	0.3
Amphipoda	42.9	18.9	70.0	58.7	73.7	61.0
Insecta (undet.)	9.5	0.5	20.0	2.8	21.1	0.5
Coleoptera	-	-	-	-	5.3	-
Diptera-larvae	4.8	1.5	10.0	0.4	-	-
Pupae. adults	9.5	3.0	15.0	4.4	21.1	15.4
Hymenoptera	14.3	5.3	10.0	4.5	5.3	9.9
Arachnida	-	-	-	-	5.3	0.1
Annelida	4.8	-	-	-	-	-
Hydroids	4.8	-	-	-	-	-
Vertebrata						
Fish remains	9.5	-	5.0	T	10.5	-
Algae-filamentous	4.8	-	15.0	0.1	10.5	0.2
Vascular plants	4.8	0.6	5.0	-	-	-
Eggs and cysts	-	-	5.0	-	-	-
Organic mat. (undet.)	47.6	17.0	70.0	5.0	73.7	9.5
Detritus	33.3	2.5	35.0	0.3	15.8	0.5
Sand	9.5	-	5.0	0.7	-	-
SUMMARY						
Copepoda		5.5		0.4		0.0
Mysid shrimp		3.0		10.5		2.5
Isopoda		42.3		12.4		0.3
Amphipoda		18.9		58.7		61.0
Insect pupae, adults		8.8		11.7		25.8
Misc. invertebrates		2.1		0.5		0.3
Incidental undet.		19.5		6.0		10.0

*Stomach and intestine included.

TABLE 13
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS
OF 27 MORONE INTERRUPTA (From Darnell, 1958)

Food Items	430.0-195.0 mm. 27 examined 18 with food	
	Percentage of tract* containing item	Percentage of total stomach volume
Copepoda (Arguloid)	3.7	0.1
Mysid shrimp	18.5	18.2
Isopoda	7.4	0.3
Amphipoda	22.2	2.1
Palaemonid shrimp (undet.)	7.4	0.1
Palaemonetes sp.	3.7	4.8
Macrobrachium ohione	3.7	1.1
Crabs		
Rithropanopeus harrisii	22.2	18.0
Callinectes sapidus	18.5	9.7
Insecta (undet.)	3.7	-
Diptera	7.4	-
Odonata	3.7	0.1
Annelida	3.7	0.3
Hydroids	3.7	T
Sponge	7.4	-
Vertebrata		
Cynoscion sp.	3.7	7.7
Cyprinodon variegatus	3.7	0.5
Gobiosoma bosci	3.7	4.8
Micropogon undulatus	3.7	1.1
Mollienesia latipinna	3.7	4.3
Fish remains	29.6	16.5
Algae-filamentous	3.7	0.1
Organic mat. (undet.)	63.0	6.8
Detritus	18.5	3.5
SUMMARY		
Microcrustacea		20.7
Macrocrustacea		33.7
Fishes		34.9
Miscellaneous, undet.		10.8

*Stomach and intestine included.

TABLE 14
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS
OF 41 BAIRDIELLA CHRYSURA (From Darnell, 1958)

	70.0-143.0 mm. 41 examined 20 with food	
Food Items	Percentage of tracts* containing item	Percentage of total stomach volume
Copepoda	4.8	-
Mysid shrimp	14.6	24.3
Isopoda	7.3	8.3
Amphipoda	2.4	0.8
Palaemonid shrimp	7.3	19.8
Penaeid-shrimp	12.2	6.1
Crabs		
Rithropanopeus harrisii	7.3	1.0
Callinectes sapidus	2.4	2.4
Vertebrata		
Anchoa mitchilli	7.3	12.1
Fish remains	12.2	12.3
Vascular plants	2.4	0.2
Organic mat. (undet.)	53.7	12.5
Sand	9.8	-
SUMMARY		
Mysid shrimp		24.3
Palaemonid, Penaeid shrimp		25.9
Isopoda. Amphipoda		9.1
Crabs		3.4
Fishes		24.4
Incidental, undet.		12.7

*Stomach and intestine included.

TABLE 15

OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 64 CYNOSCION ARENARIUS (From Darnell, 1958)

	40.0-99.0 mm. 22 examined 18 with food		100.0-149.0 mm. 29 examined 21 with food		150.0-225.0 mm. 13 examined 8 with food	
Food Items	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Mysid shrimp	45.5	31.9	3.4	1.0	-	-
Amphipoda	9.1	0.2	-	-	-	-
Palaemonetes sp.	4.5	2.7	-	-	-	-
Penaeus sp.	-	-	-	-	7.7	7.7
Crabs (undet.)	4.5	2.7	-	-	-	-
Annelida	-	-	3.4	T	-	-
Mollusca						
Rangia cuneata	4.5	-	-	-	-	-
Gastropoda	-	-	3.4	0.4	-	-
Hydroids	-	-	3.4	-	-	-
Vertebrata						
Anchoa mitchilli	4.5	10.2	37.9	54.1	30.8	56.7
Fish remains	45.5	44.1	37.9	28.9	53.8	34.1
Algae-filamentous	-	-	3.4	0.1	-	-
Organic mat. (undet.)	68.2	7.7	72.4	15.3	23.1	1.5
Detritus	40.9	0.4	6.9	-	15.4	-
Sand	-	-	3.4	0.1	-	-
SUMMARY						
Microcrustacea		32.1		1.0		0.0
Macrocrustacea		5.4		0.0		7.7
Fishes		54.3		83.0		90.8
Misc. and undet.		8.1		15.9		1.5

*Stomach and intestine included.

TABLE 16

OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 66 CYNOSCION NEBULOSUS (From Darnell, 1958)

Food Items	40.0-99.0 mm. 10 examined 9 with food		100.0-119.0 mm. 17 examined 14 with food		150.0-199.0 mm. 10 examined 8 with food		200.0-406.0 mm. 29 examined 17 with food	
	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Copepoda (Arguloid)	10.0	T	-	-	-	-	-	-
Mysid shrimp	50.0	19.9	-	-	-	-	-	-
Isopoda	40.0	2.1	5.9	0.2	-	-	-	-
Amphipoda	50.0	16.2	-	-	10.0	-	-	-
Palaemonetes sp.	10.0	6.1	-	-	10.0	17.2	3.4	0.1
Penaeus sp.	-	-	11.8	14.2	-	-	6.9	4.9
Crabs	-	-	5.9	2.8	-	-	3.4	0.1
Insecta	-	-	-	-	10.0	-	-	-
Hydroids	-	-	5.9	-	-	-	-	-
Vertebrata								
Anchoa mitchilli	10.0	12.1	11.8	28.4	30.0	62.1	10.3	40.9
Micropogon undulatus	-	-	5.9	14.2	10.0	9.3	3.4	6.5
Fish larvae	10.0	12.1	-	-	-	-	-	-
Fish remains	40.0	24.1	35.3	32.1	20.0	1.4	51.7	40.8
Algae-filamentous	-	-	-	-	-	-	3.4	0.8
Vascular plants	-	-	11.9	1.5	10.0	1.7	3.4	2.7
Seeds	-	-	5.9	-	-	-	-	-
Organic mat. (undet.)	60.0	8.0	58.8	6.6	60.0	6.6	24.1	2.0
Detritus	30.0	-	11.9	T	50.0	1.7	20.7	0.8
Sand	-	-	11.9	0.3	10.0	-	6.9	0.3
SUMMARY								
Microcrustacea		38.2		0.2		0.0		0.0
Macrocrustacea		6.1		17.0		17.2		5.4
Fishes		48.3		74.7		72.8		88.2
Misc. and undet.		8.0		8.4		10.0		6.6

*Stomach and intestine included.

TABLE 17
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 88 LEIOSTOMUS XANTHURUS (From Darnell, 1958)

Food Items	10.0-99.0 mm. 22 examined 18 with food		100.0-119.0 mm. 38 examined 26 with food		150.0-203.0 mm. 28 examined 20 with food	
	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Rotifera	9.1	2.0	-	-	-	-
Ostracoda	40.9	13.2	15.8	0.6	3.6	0.3
Copepoda (undet.)	13.6	6.2	2.6	-	3.6	T
Harpacticoid	63.6	11.3	13.2	0.7	-	-
Mysid shrimp	4.5	1.0	7.9	0.3	-	-
Isopoda	31.8	7.6	44.7	9.0	35.7	11.8
Amphipoda	31.8	7.8	42.1	10.3	32.1	7.0
Cirripedia	-	-	-	-	3.6	-
Insecta						
Coleoptera	-	-	13.2	0.5	-	-
Diptera	22.7	1.3	44.7	1.3	50.0	9.0
Arachnida	4.5	1.0	2.6	-	-	-
Annelida	4.5	2.0	-	-	-	-
Mollusca						
Rangia cuneata	68.2	13.5	60.5	23.7	46.4	29.7
Mytilopsis leucopheata	-	-	2.6	-	-	-
Castropoda	50.0	4.0	31.6	5.5	30.0	1.9
Hydroids	4.5	-	2.6	0.1	-	-
Foraminifera	27.3	0.5	7.9	0.1	-	-
Vertebrata						
Fish remains	-	-	15.8	8.4	3.6	-
Algae-filamenton	4.5	-	5.3	-	14.3	0.3
Vascular plants	4.5	-	7.9	4.5	14.3	0.6
Organic mat. (undet.)	63.6	26.5	52.6	20.6	67.8	19.0
Detritus	68.2	0.5	47.4	6.7	35.7	19.2
Sand	31.8	1.5	39.5	8.4	10.7	0.6
SUMMARY						
Rotifera, Copepoda, Ostracoda Mysid shrimp		33.7		1.6		0.3
Gastropoda Foraminifera		4.5		5.6		1.9
Isopoda Amphipoda		15.4		19.3		18.8
Rangia cuneata		13.5		23.7		29.7
Misc. Invetebrates, Vertebrates		4.3		10.3		9.0
Vegetation		0.0		4.5		0.9
Incidental undet.		28.5		35.7		38.8

*Stomach and intestine included.

TABLE 18
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 176 MICROPOGON UNDULATUS (From Darnell, 1958)

Food Items	10.0-24.0 mm. 17 examined 15 with food: Percentage of tracts* containing item	Percentage of total stomach volume	25.0-49.0 mm. 26 examined 26 with food: Percentage of tracts* containing item	Percentage of total stomach volume	50.0-74.0 mm. 20 examined 20 with food: Percentage of tracts* containing item	Percentage of total stomach volume	75.0-99.0 mm. 14 examined 10 with food: Percentage of tracts* containing item	Percentage of total stomach volume
Ostracoda	-	-	15.4	0.1	10.0	0.1	-	-
Copepoda (undet.)	-	-	3.8	-	-	-	-	-
Calanoid	82.3	52.3	69.2	24.4	35.0	4.5	7.1	0.1
Harpacticoid	29.4	0.2	50.0	2.1	20.0	0.2	-	-
Mysid shrimp	23.5	16.9	19.2	12.2	30.0	16.1	21.4	10.5
Isopoda	5.9	5.1	11.5	1.9	30.0	0.6	21.4	2.1
Amphipoda	17.6	1.8	57.7	23.2	50.0	9.9	7.1	1.3
Palaemonid shrimp	-	-	-	-	-	-	-	-
Penaeus sp.	-	-	-	-	-	-	-	-
Crabs (undet.)	-	-	-	-	-	-	21.4	1.8
Rithropanopeus harrisii	-	-	-	-	-	-	-	-
Callinectes sapidus	-	-	-	-	-	-	-	-
Insecta	-	-	3.8	-	-	-	7.1	0.3
Coleoptera	-	-	-	-	5.0	0.2	-	-
Diptera	5.9	-	50.0	15.1	65.0	9.8	50.0	1.5
Annelida	-	-	-	-	-	-	-	-
Mollusca								
Rangia cuneata	-	-	7.7	-	10.0	0.6	42.9	4.2
Mytilopsis leucopheata	-	-	-	-	-	-	7.1	-
Gastropoda	-	-	-	-	5.0	0.2	-	-
Hydroids	-	-	-	-	-	-	-	-
Sponges	-	-	-	-	-	-	-	-
Foraminifera	5.9	0.1	7.7	0.3	-	-	-	-
Vertebrata								
Anchoa mitchilli	-	-	-	-	-	-	-	-
Cyprinodon variegatus	-	-	-	-	-	-	-	-
Gambusia affinis	-	-	-	-	-	-	-	-
Gobiosoma bosci	-	-	-	-	-	-	7.1	9.1
Micropogon undulatus	-	-	-	-	-	-	-	-
Myrophis sp.	-	-	-	-	-	-	-	-
Syngnathus sp.	-	-	-	-	-	-	-	-
Fish remains	-	-	-	-	5.0	3.3	14.2	T
Algae-Filamentous	-	-	-	-	-	-	-	-
Vascular plants	-	-	-	-	-	-	-	-
Eggs and cysts	5.9	0.3	3.8	-	-	-	-	-
Organic mat. (undet.)	58.8	23.2	61.5	16.3	80.0	43.3	85.7	40.5
Detritus	11.8	-	65.4	4.3	90.0	8.7	71.4	26.5
Sand	-	-	26.9	0.2	15.0	2.2	35.7	1.8
SUMMARY								
Copepoda		52.5		26.5		4.7		0.1
Mysid shrimp		16.9		12.2		16.1		10.5
Isopoda, Amphipoda		6.9		25.1		10.5		3.4
Insecta		0.0		15.1		10.0		1.8
Mollusca		0.0		0.0		0.8		4.2
Fishes		0.0		0.0		3.3		9.1
Crabs, shrimp		0.0		0.0		0.0		1.8
Miscellaneous		0.1		0.4		0.1		0.0
Incidental, undet.		23.5		20.8		54.2		68.8

*Stomach and intestine included

TABLE 18 (cont'd)

Food Items	100.0-124.0 mm. 30 examined 28 with food — Percentage of tracts* containing item	Percentage of total stomach volume	125.0-149.0 mm. 25 examined 24 with food — Percentage of tracts* containing item	Percentage of total stomach volume	150.0-199.0 mm. 21 examined 18 with food — Percentage of tracts* containing item	Percentage of total stomach volume	200.0-325.0 mm. 23 examined 19 with food — Percentage of tracts* containing item	Percentage of total stomach volume
Ostracoda	6.7	-	12.0	T	4.8	-	-	-
Copepoda (undet.)	16.7	0.2	-	-	-	-	-	-
Calanoid	6.7	0.1	4.0	0.1	-	-	-	-
Harpacticoid	10.0	0.2	-	-	-	-	-	-
Mysid shrimp	40.0	3.3	24.0	1.4	14.3	1.8	8.7	T
Isopoda	30.0	2.4	24.0	0.1	28.6	2.2	-	-
Amphipoda	43.3	2.3	40.0	3.7	23.8	4.3	-	-
Palaemonid shrimp	3.3	2.4	4.0	-	4.8	-	-	-
Penaeus sp.	-	-	-	-	4.8	0.4	-	-
Crabs (undet.)	-	-	4.0	0.2	14.3	1.7	8.7	4.2
Rithropanopeus.	20.0	7.3	24.0	8.2	28.6	11.4	26.1	11.8
harrisii	3.3	0.6	16.0	9.5	-	-	21.7	8.2
Callinectes sapidus	20.0	0.4	4.0	-	-	-	4.3	-
Insecta	23.3	2.5	32.0	1.0	-	-	-	-
Coleoptera	56.7	5.8	56.0	11.6	19.0	2.5	13.0	0.2
Diptera	40.0	15.0	8.0	0.5	4.8	0.2	4.3	0.8
Annelida								
Mollusca	30.0	0.1	52.0	0.3	42.9	5.5	52.2	29.4
Rangia cuneata	3.3	-	12.0	0.3	19.0	20.3	39.1	9.7
Mytilopsis leucopheata	-	-	-	-	4.8	-	8.7	0.8
Gastropoda	-	-	8.0	-	-	-	4.3	-
Hydroids	3.3	0.2	-	-	-	-	-	-
Sponges	-	-	-	-	-	-	-	-
Foraminifera								
Vertebrata	-	-	4.0	2.7	4.8	1.3	4.3	2.0
Anchoa mitchilli	3.3	1.6	-	-	-	-	-	-
Cyprinodon variegatus	3.3	1.1	-	-	-	-	-	-
Gambusia affinis	-	-	4.0	4.5	-	-	-	-
Gobiosoma bosci	-	-	-	-	-	-	4.3	9.2
Micropogon undulatus	-	-	-	-	-	-	4.3	9.4
Myrophis sp.	-	-	4.0	1.8	4.8	1.3	-	-
Syngnathus sp.	13.3	3.5	12.0	6.5	14.3	1.5	4.3	1.4
Fish remains								
Algae-Filamentous	3.3	0.2	8.0	-	9.5	0.4	13.0	0.2
Vascular plants	16.7	1.9	20.0	0.4	28.6	2.3	8.7	T
Eggs and cysts	-	-	-	-	-	-	-	-
Organic mat. (undet.)	83.3	35.1	88.0	41.9	71.4	36.0	52.2	8.9
Detritus	43.3	14.1	60.0	4.7	47.6	6.6	65.2	2.8
Sand	-	-	12.0	0.2	14.3	-	8.7	-
SUMMARY								
Copepoda		0.5		0.1		0.0		0.0
Mysid shrimp		3.3		1.4		1.8		0.0
Isopoda, Amphipoda		4.7		3.8		6.5		0.0
Insecta		8.7		12.6		2.5		0.2
Mollusca		0.1		0.6		25.8		39.9
Fishes		6.2		15.5		4.1		22.0
Crabs, shrimp		10.3		17.9		13.5		24.2
Miscellaneous		17.3		0.9		2.9		1.0
Incidental, undet.		49.2		46.8		42.6		12.9

*Stomach and intestine included

TABLE 19
OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACKS OF 24 POGONIAS CROMIS
(From Darnell, 1958)

	116.0-218.0 mm. 24 examined 20 with food	
Food Items	Percentage of tracts* containing item	Percentage of total stomach volume
Isopoda	8.3	0.1
Amphipoda	4.2	-
Crabs		
Rithropanopeus harrisii	20.8	12.2
Insecta		
Dipter-larvae	16.7	0.1
Mollusca		
Rangia cuneata	75.0	55.5
Mytilopsis leucopheata	12.5	9.9
Gastropoda	20.8	0.1
Fish scales	4.2	-
Algae-filamentous	4.2	-
Organic mat. (undet.)	41.7	21.7
Detritus	41.7	T
Sand	12.5	-
SUMMARY		
Crabs		12.2
Mollusks		65.5
Misc. invertebrates		0.5
Organic mat. (undet.)		21.7

*Stomach and intestine included.

TABLE 20

OCCURRENCE OF FOOD ITEMS IN DIGESTIVE TRACTS OF 101 LAGODON THOMBODES (From Darnell, 1958)

Food Items	40.0-64.0 mm. 20 examined 20 with food Percentage of tracts* containing item	Percentage of total stomach volume	65.0-74.0 mm. 21 examined 21 with food Percentage of tracts* containing item	Percentage of total stomach volume	75.0-99.0 mm. 25 examined 24 with food Percentage of tracts* containing item	Percentage of total stomach volume	100.0-124.0 mm. 20 examined 19 with food Percentage of tracts* containing item	Percentage of total stomach volume	125.0-150.0 mm. 15 examined 15 with food Percentage of tracts* containing item	Percentage of total stomach volume
Ostracoda	-	-	-	-	-	-	5.0	-	-	-
Copepoda (undet.)	-	-	4.8	0.1	4.0	0.2	-	-	-	-
Arguloid	5.0	0.3	4.8	0.3	-	-	-	-	-	-
Calanoid	-	-	4.8	0.3	-	-	5.0	-	-	-
Harpacticoid	10.0	0.1	4.8	0.1	-	-	20.0	1.6	33.3	2.0
Mysid shrimp	5.0	2.1	19.0	1.6	28.0	5.8	10.0	1.8	13.3	0.6
Isopoda	25.0	0.3	42.9	2.2	48.0	2.7	40.0	2.8	60.0	3.2
Amphipoda	90.0	64.5	81.0	47.6	60.0	24.3	45.0	17.7	40.0	13.0
Palaemonetes sp.	-	-	-	-	-	-	5.0	3.4	-	-
Macrobrachium ohione	5.0	4.1	-	-	-	-	-	-	-	-
Crabs (undet.)	-	-	4.8	2.8	1.0	-	10.0	1.4	-	-
Rithropanopeus harrisii	5.0	2.4	9.5	2.5	20.0	10.5	20.0	8.6	26.7	6.4
Callineetes sapidus	-	-	9.5	0.3	-	-	-	-	-	-
Insecta (Diptera)	50.0	12.0	33.3	10.6	20.0	0.5	15.0	0.3	20.0	0.9
Annelida	10.0	2.7	4.8	0.1	8.0	1.9	10.0	0.9	-	-
Mollusca										
Rangia cuneata	-	-	-	-	8.0	-	-	-	-	-
Mytilopsis leucopheata	-	-	-	-	4.0	-	-	-	6.7	0.5
Gastropoda	-	-	-	-	4.0	-	-	-	-	-
Hydroids	-	-	-	-	16.0	1.1	-	-	-	-
Vertebrata										
Gobiosoma bosci	-	-	4.8	5.7	-	-	-	-	6.7	-
Fish remains	10.0	-	23.8	3.3	40.0	5.8	10.0	-	-	-
Bottom diatoms	5.0	0.1	-	-	-	-	10.0	0.1	6.7	0.2
Algae-filamentous	15.0	5.8	14.3	14.2	28.0	14.1	70.0	40.3	66.7	34.5
Vascular plants	-	-	4.8	0.2	16.0	2.3	40.0	8.0	53.3	11.4
Organic mat. (undet.)	80.0	2.8	90.5	6.9	84.0	20.0	40.0	7.8	40.0	18.9
Detritus	25.0	2.7	47.6	3.3	60.0	40.1	45.0	4.0	40.0	8.5
Sand	10.0	-	9.5	-	32.0	0.6	45.0	1.3	13.3	0.1
SUMMARY										
Microcrustacea (excl.Amphipoda)		3.1		4.6		8.7		6.2		5.8
Amphipoda		61.5		47.6		24.3		17.7		13.0
Diptera		12.0		10.6		0.5		0.3		0.9
Macrocrustacea		6.5		5.6		10.5		13.4		6.4
Fishes		0.0		9.0		5.8		0.0		0.0
Vegetation		5.8		11.4		16.4		48.3		45.6
Misc. invertebrates		2.7		0.1		3.0		0.9		0.5
Incidental and undet.		5.6		10.2		30.7		13.2		27.7

*Stomach and intestine included.

TABLE 21

OCCURRENCE OF FOOD ITEMS IN STOMACHS OF 124 CALLINECTES SAPIDUS (From Darnell, 1958)

Food Items	30.0-74.0 mm. 29 examined 24 with food		75.0-124.0 mm. 31 examined 27 with food		125.0-147.0 mm. 24 examined 23 with food		148.0-197.0 mm. 40 examined 29 with food	
	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume	Percentage of tracts* containing item	Percentage of total stomach volume
Crabs (undet.)	13.8	2.7	12.9	4.9	16.7	5.7	12.5	4.3
Rithropanopeus harrisii	-	-	16.1	15.6	4.2	0.2	5.0	0.1
Callinectes sapidus	10.3	1.4	3.2	2.5	8.3	13.0	7.5	5.0
Cirripedia	-	-	6.5	0.1	-	-	-	-
Crustacea (undet.)	31.0	31.7	9.7	2.0	20.1	3.5	10.0	1.0
Odonata	-	-	3.2	0.2	4.2	0.2	-	-
Annelida	-	-	6.5	0.1	4.2	T	-	-
Mollusca								
Rangia cuneata	41.4	32.4	45.2	20.2	70.8	30.0	57.5	46.5
Mytilopsis leucopheata	-	-	6.5	0.3	25.0	19.4	20.0	11.9
Gastropoda	13.8	1.9	12.9	9.0	29.2	5.5	25.0	5.0
Hydroids	3.4	0.3	6.5	0.2	8.3	0.5	2.5	T
Vertebrata								
Fish remains	3.4	0.5	6.5	0.4	16.7	1.6	17.5	5.4
Bottom diatoms	-	-	3.2	0.1	-	-	-	-
Algae-filamentous	-	-	12.9	3.0	4.2	T	2.5	0.3
Vascular plants	6.9	0.4	25.8	8.1	20.8	0.8	10.0	2.0
Organic mat. (undet.)	17.2	7.7	35.5	13.9	25.0	5.9	17.5	8.8
Detritus	37.9	12.1	32.3	12.8	33.3	12.7	15.0	9.7
Sand	37.9	9.1	41.9	6.4	29.2	1.7	2.5	T
SUMMARY								
Crabs, undet. Crusts		35.8		25.0		22.4		10.4
Mollusks		34.3		29.5		54.9		63.4
Fish remains		0.5		0.4		1.6		5.4
Vegetation, misc.		0.7		11.8		1.5		2.3
Detritus, undet.		19.8		26.7		18.6		18.5
Sand		9.1		6.4		1.7		T

*Stomach only.

TABLE 22

COMPONENTS OF THE MAJOR FOOD GROUPS IN THE LAKE PONTCHARTRAIN COMMUNITY BASED UPON STOMACH ANALYSIS OF THE CHIEF CONSUMER SPECIES (From Darnell, 1961)

Major Food Groups	Primary Components	Secondary Components
Fishes	Largescale menhaden (Brevoortia patronus) Bay anchovy (Anchoa mitchilli) Atlantic croaker (Micropogon undulatus) Striped mullet (Mugil cephalus)	Lady fish (elops saurus), threadfin shad (Dorosoma petenense), "Young dupeids" (mostly Brevoortia patronus), sea catfish (Galeichthys felis), speckled worm eel (Myrophis sp.), pipefish (Syngnathus sp.), sheepshead minnow (Cyprinodon variegatus), mosquitofish (Gambusia affinis), sailfin molly (Mollienesia latipinna), tide-water silverside (Menidia beryllina), seatrout (Cynoscion sp.), black drum (Pogonias cromis), naked goby (Gobiosoma bosci), bay whiff (Citharichthys spilopterus)
Macro-bottom animals	Subadult bule crabs (Callinectes sapidus) Adult mud crabs (Rithropanopeus harrisii)	Adult clams (Rangia cuneata), adult penaeid shrimp (Penaeus aztecus, P. setiferus), grass shrimp (Palaemonetes spp.), river shrimp (Macrobrachium ohione), mud shrimp (Callianassa jamaicense), adult blue crabs (Callinectes sapidus)
Micro-bottom animals	Small rangia clams (Rangia cuneata) Mussels (Mytilopsis leucopheata) Isopods and amphipods (many species) Small crabs (blue crabs and mud crabs) Insect larvae (Chironomidae)	Benthic protozoans (esp. foraminiferans), sponge (Spongilla lacustris), hydroid (Bimeria franciscana), small gastropods (Amnicolidae), ostracods, harpacticoid copepods, polychaetous annelids

TABLE 22 (contd)

Major Food Groups	Primary Components	Secondary Components
Zooplankton	Calanoid copepods (Acartia tonsa) Adult schizopods (Mysidopsis sp.) Larval penaeid shrimp(Penaeus spp.)	Protozoans (esp. tintinnids), rotifers, cyclopoid and calanoid copepods, larval forms (mollusks, annelids, crustaceans, and fishes
Phytoplankton	Anabaena spp.	Microcystis sp., Chaetoceros spp., Coscinodiscus spp., Melosira sp., & others
Vascular plant material	None	Ruppia maritima, Vallisneria spiralis, and some filamentous algae also included in this category (Cladophora sp., Oedogonium sp., Rhizoclonium sp., and Spirogyra sp.)
Organic detritus	Autochthonous: Phytoplankton (esp. Anabaena spp.)	Autochthonous: Marginal submerged vegetation (vascular plants, filamentous algae, benthic diatoms) Animal matter from various sources
	Allochthonous: Marginal marsh vegetation [reeds (Phragmites communis), sedges (Scirpus spp.), cord grasses (Spartina cynosuroides, and probably S. alterniflora and S. patens), and cat tails (Typha domingensis)] Phytoplankton (from fresh- and salt-water passes) Mississippi River overflow, material	Allochthonous: Some marginal marsh vegetation [water hyssop (Brammia monnieri), galingale (Cyperus ochraceus), spikerush (Eleocharis sp.), smartweed (Polygonum sp.), and arrowhead (Sagittaria lancifolia)] Floating aquatics [alligator weed (Alternanthera philoxcroides) and water hyacinth (Eichhornia crassipes)] Woody swamp vegetation [tupelo gum (Nyssa biflora) and bald cypress (Taxodium distichum)] Wind-blown material

TABLE 23
FISH SPECIES IN WHICH ZOOPLANKTON WAS FOUND TO MAKE UP AT LEAST 5 PERCENT OF THE FOOD OF SOME STAGE OF THE LIFE HISTORY. ALTHOUGH SCHIZOPODS AND LARVAL PENAEID SHRIMP ARE INCLUDED HERE AS ZOOPLANKTON, THEY MAY AT TIMES BELONG TO THE MICROBENTHIC FAUNA (From Darnell, 1961)

Species	Stage and Size Range (mm)	Percentage of Zooplankton in Food
Bay anchovy (Anchoa mitchilli)	Juvenile (30-49)	58
	Adult (50-74)	43
Atlantic croaker (Micropogon undulatus)	Young (50-124)	54
	Juvenile (125-325)	12
Sand seatrout (Cynoscion arenarius)	Juvenile (40-99)	32
Threadfin shad (Dorosoma petenense)	Juvenile (69-103)	29
Blue catfish (Ictalurus furcatus)	Juvenile (60-199)	25
Silver perch (Bairdiella chrysura)	Adult (70-143)	24
Spotted seatrout (Cynoscion nebulosus)	Juvenile (40-99)	20
Yellow bass (Roccus mississippiensis)	Adult (130-195)	18
Tidewater silverside (Menidia beryllina)	Adult (40-79)	7

TABLE 24
FISH AND INVERTEBRATE SPECIES IN WHICH MICROINVERTEBRATES*
WERE FOUND TO MAKE UP AT LEAST 5 PERCENT OF THE
FOOD OF SOME STAGE OF THE LIFE HISTORY
(From Darnell, 1961)

Species	Stage and Size Range (mm)	Percentage of Microinvertebrates* in Food
Spot	juvenile (40-99)	69
(*Leiostomus xanthurus*)	adult (100-203)	63
Tidewater silverside	adult (40-79)	69
(*Menidia beryllina*)		
Channel catfish	juvenile (76-119)	62
(*Ictalurus punctatus*)		
Pinfish	juvenile (40-99)	57
(*Lagodon rhomboides*)	adult (100-150)	24
Blue crab	juv. and ad. (30-197)	52
(*Callinectes sapidus*)		
Hogchoker	adult (64-74)	50
(*Trinectes maculatus*)		
Gizzard shad	adult (101-278)	48
(*Dorosoma cepedianum*)		
Freshwater drum	juvenile (211-347	48
(*Aplodinotus grunniens*)		
Blue catfish	juvenile (60-199)	29
(*Ictalurus furcatus*)	adult (200-411)	44
Atlantic croaker	young (10-49)	24
(*Micropogon undulatus*)	juvenile (50-124)	21
	adult (125-325)	35
Sea catfish	juvenile (90-169)	26
(*Galeichthys felis*)	adult (170-229)	21
Sheepshead	adult (218-410)	20
(*Archosargus probatocephalus*)		
River shrimp	adult (48-81)	19
(*Macrobrachium ohione*)		
Spotted seatrout	juvenile (40-99)	18
(*Cynoscion nebulosus*)		
White shrimp	adult (91-142)	17
(*Penaeus setiferus*)		
Bay anchovy	juvenile (30-49)	9
(*Anchoa mitchilli*)	adult (50-74)	10
Silver perch	adult (70-143)	9
(*Bairdiella chrysura*)		

*Includes inhabitants of benthos and of vegetation.

TABLE 25

FISH AND INVERTEBRATE SPECIES IN WHICH LARGER INVERTEBRATES WERE FOUND TO MAKE UP AT LEAST 5 PERCENT OF THE FOOD OF SOME STAGE OF THE LIFE HISTORY

(From Darnell, 1961)

Species	Stage and Size Range (mm)	Percentage of Microinvertebrates* in Food
Black drum (*Pogonias cromis*)	juvenile (116-218)	99
Largemouth bass (*Micropterus salmoides*)	adult (175-209)	97
Spotted gar (*Lepisosteus oculatus*)	adult (405-555)	71
Alligator gar (*Lepisosteus spatula*)	adult (903-1472)	65
Red drum (*Sciaenops ocellata*)	adult (184-625)	63
Freshwater drum (*Aplodinotus grunniens*)	juvenile (211-347)	42
Yellow bass (*Roccus mississippiensis*)	adult (130-195)	34
Sea catfish	juvenile (90-169)	16
(*Galeichthys felis*)	adult (170-229)	34
Silver perch (*Bairdiella chrysura*)	adult (70-143)	29
Sheepshead (*Archosargus probatocephalus*)	adult (218-410)	20
Atlantic croaker (*Micropogon undulatus*)	adult (125-325)	19
Blue crab (*Callinectes sapidus*)	juv. and ad. (30-197)	14
Spotted seatrout	juvenile (40-99)	6
(*Cynoscion nebulosus*)	adult (100-406)	13
Blue catfish	juvenile (60-199)	6
(*Ictalurus furcatus*)	adult (200-411)	13
Ladyfish (*Elops saurus*)	juvenile (161-280)	10
Channel catfish (*Ictalurus punctatus*)	juvenile (76-119)	10
Pinfish	juvenile (40-99)	8
(*Lagodon rhomboides*)	adult (100-150)	10
Southern flounder (*Paralichthys lethostigma*)	adult (113-380)	8
Bull shark (*Carcharhinus leucas*)	adult (780-805)	5
Sand seatrout (*Cynoscion arenarius*)	juvenile (40-99)	5

TABLE 26
FISH AND VERTEBRATE SPECIES IN WHICH FISHES WERE FOUND
TO MAKE UP AT LEAST 5 PERCENT OF THE FOOD
OF SOME STAGE OF THE LIFE HISTORY
(From Darnell, 1961)

Species	Stage and Size Range (mm)	Percentage of Fishes in Food
Longnose gar (*Lepisosteus osseus*)	adult (706-1180)	98
Crevalle jack (*Caranx hippos*)	juvenile (79)	98
Bull shark (*Carcharhinus leucas*)	adult (780-805)	95
Southern flounder (*Paralichthys lethostigma*)	adult (113-380)	89
Sand seatrout (*Cynoscion arenarius*)	juvenile (40-99)	54
	adult (100-225)	87
Ladyfish (*Elops saurus*)	juvenile (161-280)	82
Spotted seatrout (*Cynoscion nebulosus*)	juvenile (40-99)	48
	adult (100-406)	79
Atlantic needlefish (*Strongylura marina*)	adult 357-457)	63
Alligator gar (*Lepisosteus spatula*)	adult (903-1472)	35
Yellow bass (*Roccus mississippiensis*)	adult (130-195)	35
Spotted gar (*Lepisosteus oculatus*)	adult (405-555)	24
Silver perch (*Bairdiella chrysura*)	adult (70-143)	24
Blue catfish (*Ictalurus furcatus*)	adult (200-411)	22
Red drum (*Sciaenops ocellata*)	adult (184-625)	17
Atlantic croaker (*Micropogon undulatus*)	juvenile (50-124)	6
	adult (125-325)	14
Pinfish (*Lagodon rhomboides*)	juvenile (40-99)	5

TABLE 27
FISH AND INVERTEBRATE SPECIES IN WHICH ORGANIC DETRITUS*
WAS FOUND TO MAKE UP AT LEAST 5 PERCENT OF THE FOOD
OF SOME STAGE OF THE LIFE HISTORY
(From Darnell, 1961)

Species	Stage and Size Range (mm)	Percentage of Organic Detritus* in Food
Largescale menhaden	young (38-48)	11
(*Brevoortia patronus*)	juvenile (85-103)	99
Striped mullet (*Mugil cephalus*)	juv. and ad. (97-327)	79
Common rangia (*Rangia cuneata*)	adult (35-38)	73
Atlantic croaker	young (10-49)	22
(*Micropogon undulatus*)	juvenile (50-124)	57
	adult (125-325)	31
White shrimp (*Penaeus setiferus*)	adult (91-142)	58
Sea catfish	juvenile (90-169)	56
(*Galeichthys felis*)	adult (170-229)	44
River shrimp (*Macrobrachium ohione*)	adult (48-81)	55
Gizzard shad (*Dorosoma cepedianum*)	adult (101-278)	50
Hogchoker (*Trinectes maculatus*)	adult (61-74)	50
Blue catfish	juvenile (60-199)	36
(*Ictalurus furcatus*)	adult (200-411)	8
Bay anchovy	juvenile (30-49)	33
(*Anchoa mitchilli*)	adult (50-74)	34
Spot	juvenile (40-99)	29
(*Leiostomus zanthurus*)	adult (100-203)	34
Atlantic needlefish (*Strongyura marina*)	adult (357-457)	32
Channel catfish (*Ictalurus punctatus*)	juvenile (76-119)	28
Blue crab (*Callinectes sapidus*)	juv. and ad. (30-197)	26
Pinfish	juvenile (40-99)	16
(*Lagodon rhomboides*)	adult (100-150)	20
Threadfin shad (*Dorosoma petenense*)	juvenile (69-103)	15

TABLE 27 (Cont'd)

Species	Stage and Size Range (mm)	Percentage of Organic Detritus* in Food
Red drum (*Sciaenops ocellata*)	adult (184-625)	15
Tidewater silverside (*Menidia beryllina*)	adult (40-79)	14
Silver perch (*Bairdiella chrysura*)	adult (70-143)	14
Yellow bass (*Roccus mississippiensis*)	adult (130-195)	11
Freshwater drum (*Aplodinotus grunniens*)	juvenile (211-347)	10
Sand seatrout	juvenile (40-99)	9
(*Cynoscion arenarius*)	adult (100-225)	8
Ladyfish (*Elops saurus*)	juvenile (161-280)	8
Spotted seatrout	juvenile (40-99)	8
(*Cynoscion nebulosus*)	adult (100-406)	8

*Some nondetritic organic matter may also be included.

(17) Large commercially important invertebrates include the blue crab, Callinectes sapidus; the white shrimp, Panaenus setiferus; the brown shrimp, Penaeus aztecus; and the brackish-water clam, Rangia cuneata. While small oysters and spat currently occur in areas of highest salinity, there is no fishery for this species.

(18) The ecology of Lake Pontchartrain is highly dependent upon an exchange of nutrients, producers, and consumers with surrounding marshes, swamps, and adjacent bodies of water. Since many of the organisms present in Lake Pontchartrain do not breed in the lake, populations of these species depend upon the seasonal movement of larvae, young and adults, through the passes from neighboring estuaries and the gulf.

(19) The principal inflow of freshwater into Lake Pontchartrain is from the nutrient-poor acid soils of the pinelands to the north. Because of this, Lake Pontchartrain does not support the biomass and commercial fisheries of other low salinity Louisiana estuaries which receive drainage from richer land areas.

(20) Lake Pontchartrain is considered a nursery area for many marine species of the Gulf of Mexico with the upper lake areas of exceptional importance to such species as menhaden and white shrimp. These nursery stocks, in addition to contributing to the harvest elsewhere when they mature, also provide food to desirable sport and commercial fish species in the lower areas of the lake. Table 28 gives the average annual fisheries harvest in pounds in Lakes Pontchartrain and Borgne.

(21) The Lake Pontchartrain area offers a variety of recreational opportunities in the form of fishing, hunting, boating, waterskiing, swimming, sailing, picnicking, and camping.

(22) Lake Pontchartrain receives a considerable degree of pollution from metropolitan New Orleans on the southern shore. The pollutants are introduced in storm-water runoff from outfall drainage canals of Orleans and Jefferson Parishes. These pollutants consist of untreated sewage in runoff waters and materials from the streets of New Orleans. Low dissolved oxygen concentrations and increased ammonia, nitrite, nitrate, and phosphate concentrations occur offshore. The untreated sewage, as evidenced by high plate counts for fecal and coliform bacteria, prohibits swimming along the south shore of the lake after periods

TABLE 28

AVERAGE ANNUAL FISHERIES HARVEST (POUNDS) IN LAKES BORGNE AND PONTCHARTRAIN (1968-70 COMPILED FROM STATISTICS SUPPLIED BY NATIONAL MARINE SERVICE, WASHINGTON, DC) (IN REPORT ON GULF COAST DEEP WATER PORT FACILITIES, TEXAS, LOUISIANA, MISSISSIPPI, ALABAMA, AND FLORIDA)

Species	Lake Borgne	Lake Pontchartrain
Catfish and bullheads		32,667
Croaker	3,700	
Drum, black	16,967	14,067
Drum, red	45,233	15,633
Flounder	7,133	2,833
Gar	733	18,000
King whiting	11,833	
Mullet	3,400	
Sea catfish	967	13,167
Seatrout, spotted	37,901	15,766
Seatrout, sand	933	2,400
Sheepshead, freshwater		600
Sheepshead	8,633	
Total finfish	137,433	115,133
Crabs	1,763,766	514,367
Shrimp	698,967	180,866
Oysters	1,283,433	
Total shellfish	3,746,166	695,233
Total nonfinfish	3,746,166	695,233
Total harvest	3,883,599	810,366

of heavy rainfall. Low dissolved oxygen concentrations and high ammonia concentrations cause periodic fish kills, and the increased concentrations of nutrients have produced considerable eutrophication.

(23) Lake Pontchartrain and the extensive marshes, swamplands, and bottomlands in the project area contribute to and important seafood industry and trapping industry. The marsh and water areas provide varied and highly productive habitats for game and furbearing animals and waterfowl.

(24) Crabs and crayfish are plentiful in the project area and are a favorite food of the New Orleans populace. Some amphibians and reptiles include the salamanders, frogs (many species), lizards, snakes (many species), turtles (many species), and alligators. The alligator is included on the rare and endangered list by the US Fish and Wildlife Service, but an open season in Cameron Parish in Louisiana was established by the Louisiana Wild Life and Fisheries Commission for a short period of time.

(25) The forested swamp areas are used primarily by the raccoon, opossum, white-tailed deer, squirrels, turkey, and waterfowl. Portions of the wooded swamp are useful to waterfowl, mostly wood ducks and mallards. The marsh areas are used by rabbits, nutria, muskrat, mink, and migratory waterfowl. Mottled ducks nest in the marshes and inhabit them year-round. Other birds present include snipe, rails, gallinules, dowitches, ibises, egrets, herons, and hawks. Migratory waterfowl using the area include gadwalls, widgeons, blue-winged teal, green-winged teal, lesser scaup, redheads, pintails, canvasbacks, coots, mallards, shovelers, and a few blue and snow geese. Principal furbearing animals are nutria, muskrat, raccoon, mink, otter, and opossum.

(26) Primary game species on the upland area are the grey and fox squirrels, cottontail and a few swamp rabbits, white-tailed deer, wild turkey, and bobwhite quail. Grey and red fox, raccoon, opossum, skunk, and numerous small mammals such as the wood rats, shrew, cotton rat, and hispid pocket mouse are found in the area. The uplands are used by migratory woodcock as well as resident and migratory mourning doves. Numerous songbirds are present including sparrows, vireos, warblers, bluejays, and cardinals. The red-cockaded woodpecker is present in the pine forests and is listed as a rare and endangered species by the United States Department of the Interior,

Bureau of Sport Fisheries and Wildlife. Reptiles and amphibians are represented including the upland terrapin, pygmy rattlesnake, canebrake rattlesnake, coachwhip, and numerous species of leopard frog, spring peeper, lizards, salamanders, and toads. A list of amphibians and reptiles in the study area has been compiled from Conant (1957) and is included in Appendix B. A list of animals known from the project area is included in Appendix B.

(27) The importance of marshes and shallow water areas is not limited to coastal species. Estuaries are utilized by the entire spectrum of organisms from freshwater species to those considered entirely oceanic.

(28) Tables 29 to 35 list the salamanders, frogs, and toads, crocodilians and turtles, lizards, serpents, birds, and mammals in the project area.

2.02 ACREAGE AFFECTED BY THE PROJECT

a. The project area consists of about 780 square miles of land area. None of the existing facilities would provide full protection against hurricane flooding.

b. The barrier levee along with the barrier structures, when closed, will substantially reduce the inflow of hurricane tides into Lake Pontchartrain providing varying degrees of flood protection to 700 square miles of land. The St. Charles Parish area located between Jefferson Parish and the Bonnet Carre' Spillway has 29,600 acres subject to hurricane flooding from Lake Pontchartrain. There is no existing protection from storm tides from Lake Pontchartrain. Approximately 24,770 acres of St. Charles Parish are swamp and marsh and shallow water. The Jefferson Parish area contains 21,500 acres which are subject to hurricane flooding from Lake Pontchartrain. The existing levee will be adequate after construction of the barrier structures. The New Orleans area consists of 16,800 acres located between the IHNC and the Jefferson Parish line. The area is protected on the east and west by levees and on the north by a seawall and adjacent back levee. The Citrus area consists of 14,800 acres bounded by New Orleans East, the IHNC, the MR-GO, and Lake Pontchartrain. This area has been drained for about 40 years and is protected from normal flooding by levees on the west, south, and east, and by a railroad embankment and levee along Lake Pontchartrain on the north. In New Orleans East 22,375 acres are partially drained marsh protected from normal flooding on the south, east, and west by levees along the GIWW

TABLE 29

A CHECKLIST AND AN ESTIMATION OF THE PROBABILITY OF OCCURRENCE OF THE SALAMANDERS ALONG THE MISSISSIPPI RIVER BATTURE

Common Name	Scientific Name	New Orleans, Louisiana
Marbled salamander	Ambystoma opacum	H
Small-mouthed salamander	Ambystoma texanum	a
Tiger salamander	Ambystoma tigrium	H[b]
Two-toed amphiuma	Amphiuma means	H
Three-toed amphiuma	Amphiuma tridactylum	H
Southern dusky salamander	Desmognathus auriculatus	H
Dusky salamander	Desmognathus fuscus	d
Dwark salamander	Eurycea quadridigitata	H
Gulf coast waterdog	Necturus beyeri	a
Newt (Eft)	Notophthalmus viridescens	H
Lesser siren	Siren intermedia	H

H = High

[a]Unknown probability
[b]High but no recent records
[d]Uncertain because of taxonomic problems involving specius fuscus and auriculatus.

Source: Gulf South Research Institute, In Environmental Inventory for the Mississippi River-Cairo Illinois, to Venice, Louisiana (information north of Baton Rouge has been deleted).

TABLE 30
A CHECKLIST AND AN ESTIMATION OF THE PROBABILITY OF OCCURRENCE OF THE FROGS AND TOADS ALONG THE MISSISSIPPI RIVER BATTURE

Common Name	Scientific Name	New Orleans, Louisiana
Cricket frog	*Acris crepitans*	H
Cricket frog	*Acris gryllus*	H[a]
Gulf coast toad	*Bufo valliceps*	H
Fowler's toad	*Bufo woodhousei*	H
Eastern narrow-mouthed toad	*Gastrophyrne carolinensis*	H
Bird-voiced treefrog	*Hyla avivoca*	b
Southern gray treefrog	*Hyla chrysoscelis*	b
Green treefrog	*Hyla cinerea*	H
Spring peeper	*Hyla crucifer*	H
Squirrel treefrog	*Hyla versicolor*	H
Chorus frog	*Pseudacris triseriata*	H
Bullfrog	*Rana catesbeiana*	H
Bronze frog	*Rana clamitans*	H
Pig frog	*Rana palustris*	H
Leopard frog	*Rana pipens*	H

H = High

[a]Tinkle (1959)
[b]Not recorded as of yet

Source: Gulf South Research Institute, In Environmental Inventory for the Mississippi River-Cairo, Illinois, to Venice, Louisiana (information north of Baton Rouge has been deleted).

TABLE 31
A CHECKLIST AND AN ESTIMATION OF THE PROBABILITY OF OCCURRENCE OF THE CROCODILIANS AND TURTLES ALONG THE MISSISSIPPI RIVER BATTURE

Common Name	Scientific Name	New Orleans, Louisiana
American alligator	*Alligator mississipiensis*	H
Common snapping turtle	*Chelydra serpentina*	H
Mobile cooter or slider	*Chrysemys concinna*	H
Missouri slider	*Chrysemys floridana*	H
Painted turtle	*Chrysemys picta*	H
Red-eared turtle	*Chrysemys scripta*	H
Chicken turtle	*Deirochelys reticularis*	H
Mississippi map turtle	*Graptemys kohni*	H
Mud turtle	*Kinosternon subrubrum*	H
Alligator snapping turtle	*Macroclemys temmincki*	H
Diamondback terrapin	*Malaclemys terrapin*	H
Razor-backed musk turtle	*Sternotherus odoratus*	H
Stinkpot	*Sternotherus odoratus*	H
Box turtle	*Terrapene carolina*	H
Smooth softshell turtle	*Trinonyx muticus*	H
Spiny softshell turtle	*Trionyx spinifer*	H

H = High

Source: Gulf South Research Institute, *In* Environmental Inventory for the Mississippi River - Cairo, Illinois, to Venice, Louisiana (information north of Baton Rouge has been deleted.

TABLE 32
A CHECKLIST AND AN ESTIMATION OF THE PROBABILITY OF OCCURRENCE OF THE LIZARDS ALONG THE MISSISSIPPI RIVER BATTURE

Common Name	Scientific Name	New Orleans, Louisiana
Green anole	Anolis carolinenesis	H
Six-lined racerunner	Cnemidophorus sexlineatus	a
Five-lined skink	Eumeces fasciatus	H
Southeastern five-lined skink	Eumeces inexpectatus	H[c]
Broad-headed skink	Eumeces laticeps	H
Mediterranean gecko	Hemidactylus turcicus	H
Slender glass lizard	Ophisaurus attenuatus	e
Eastern glass lizard	Ophisaurus ventralis	H
Ground skink	Scincella laterale	H

[a] Very restricted in southern part of alluvial plan.

[c] According to range maps available.

[e] Lafourche Parish Records.

H = High

Source: Gulf South Research Institute, In Environmental Inventory for the Mississippi River - Cairo, Illinois, to Venice, Louisiana (information north of Baton Rouge has been deleted).

TABLE 33
A CHECKLIST AND AN ESTIMATION OF THE PROBABILITY OF OCCURRENCE OF THE SERPENTS ALONG THE MISSISSIPPI RIVER BATTURE

Common Name	Scientific Name	New Orleans, Louisiana
Copperhead	Agkistrodon contortrix	H
Western cottonmouth	Askistrodon piscivorus	H
Racer	Coluber constrictor	H
Canebrake rattlesnake	Crotalus horridus	H
Ringneck snake	Diadophis punctatus	H
Corn snake	Elaphe guttata	H
Rat snake	Elaphe obsoleta	H
Mud snake	Farancia abacura	H
Rainbos snake	Farancia erytrogramma	[a]
Eastern hognose snake	Heterodon platyrhinos	H
Common kingsnake	Lampropeltis getulus	H
Milk snake	Lampropeltis triangulum	H
Coral snake	Micrurus fulvius	M
Green water snake	Natrix cyclopion	H
Yellow-bellied water snake	Natrix erythrogaster	H
Diamond-backed water snake	Natrix rhombifera	H
Broad-banded water snake	Natrix fasciata	H
Rough green snake	Opheodrys acstivus	H
Graham's water snake	Regina grahami	H
Glossy water snake	Regina rigida	H
Pigmy rattlesnake	Sistrurus miliarius	H
Brown snake	Storeria dekayi	H
Red-bellied snake	Storeria occipitonaculata	M
Western ribbon snake	Thamnophis proximus	H
Eastern garter snake	Thamnophis sirtalis	H
Smooth earth snake	Virginia verleriae	H

[a]Either low or absent
H = High
M = Medium

Source: Gulf South Research Institute, In Environmental Inventory for the Mississippi River-Cairo, Illinois, to Venice, Louisiana, (information north of Baton Rouge has been deleted).

TABLE 34
SEASONAL AND GEOGRAPHIC DISTRIBUTION OF THE AVIFAUNA
OF THE MISSISSIPPI ALLUVIAL PLAIN

Common Name	Distribution
Common loon	Transient (winter resident in coast)
Red-throated loon	Accidental (False River - December 1945)
Horned grebe	Transient (winter resident)
Eared grebe	Accidental (winter resident, False River; Baton Rouge)
Least grebe	Accidental (Baton Rouge - December 1947)
Western grebe	Accidental (Mississippi River at New Orleans, November 1971)
Pied-billed grebe	Permanent resident (uncommon in south in summer)
White pelican	Transient (permanent resident north to St. Francisville, but rare in summer)
Brown pelican	Permanent resident (coast only - north to Baton Rouge twice - presently rare or extirpated in area. Probable re-entry from Florida imports in Barataria Bay may be expected)
Brown booby	Accidental (50 miles below New Orleans on Mississippi River - September 1884; Red Pass near Venice - January 1901. No recent records)
Red-footed booby	Accidental (near Buras, Louisiana, November 1940 - possibly only record for continental United States)
Double-crested cormorant	Winter resident
Olivaceous cormorant	Accidental (New Orleans - March to April 1959)
Anhinga	Winter resident (rare on coast)
Magnificent frigate-bird	Summer resident (nonbreeding - Mississippi River Delta only)
Great blue heron	Permanent resident
Green heron	Summer resident (permanent resident on coast - rare in winter)
Little blue heron	Permanent resident
Cattle egret	Summer resident (Old World immigrant - first appearance in area about 1956)

TABLE 34 (Cont'd)

Common Name	Distribution
Reddish egret	Summer resident (coast only - largely nonbreeding; rare in winter)
Common egret	Permanent resident (southern Louisiana)
Snowy egret	Permanent resident (coast)
Louisiana heron	Permanent resident (coast only)
Black-crowned night heron	Permanent resident
Yellow-crowned night heron	Summer resident (permanent resident on coast)
Least bittern	Summer resident (permanent resident on coast but rare in winter)
American bittern	Winter resident (discontinuous; Louisiana)
Wood ibis	Summer resident (nonbreeding - formerly nested in Louisiana)
Glossy ibis	Accidental (coast - winter)
White-faced ibis	Permanent resident (coast only)
White ibis	Permanent resident (southern Louisiana only)
Roseate spoonbill	Accidental (formerly nested near St. Francisville - 1887; 5 miles south of New Orleans on Mississippi River - December 1884; no recent records)
Whistling swan	Accidental (winter resident, coast only)
Trumpeter swan	Accidental (winter resident on coast - non since early 1900's)
Canada goose	Winter resident (rare south of Venice)
Brant	Accidental (New Orleans, November 1960)
Snow goose	Transient (winter resident - mainly coast)
Blue goose	Transient (winter resident - mainly coast)
Fulvous tree duck	Accidental (coast only)
Mallard	Winter resident
Black duck	Winter resident
Mottled duck	Permanent resident (coast only)
Gadwall	Winter resident

TABLE 34 (Cont'd)

Common Name	Distribution
Pintail	Winter resident
Green-winged tail	Winter resident
Blue-winged teal	Transient (winter resident mainly on coast; summer resident - rare)
Cinnamon teal	Winter resident (rare - coast only)
American widgeon	Winter resident
Shoveler	Winter resident
Wood duck	Permanent resident
Redhead	Transient (winter resident - mainly coast)
Ring-necked duck	Winter resident
Canvasback	Transient (winter resident - mainly southern Louisiana)
Greater scaup	Transient (winter resident - rare - coast)
Lesser scaup	Winter resident
Common goldeneye	Winter resident
Bufflehead	Winter resident
Oldsquaw	Winter resident (rare - southern Louisiana only)
Harlequin duck	Accidental (April, 1837 - Mississippi River Delta)
Surf scoter	Accidental (winter resident, New Orleans and Lake Borgne, Louisiana)
Common scotes	Accidental (winter resident, Bonnet Carre Floodway and Lake Borgne)
Ruddy duck	Winter resident
Hooded merganser	Permanent resident
Common merganser	Winter resident (rare, except extreme north)
Red-breasted merganser	Winter resident
Turkey vulture	Permanent resident
Black vulture	Permanent resident
White-tailed kite	Accidental (Mississippi River opposite Kenner, Louisiana - October 1890)
Swallow-tailed kite	Summer resident (rare)
Mississippi kite	Summer resident
Sharp-shinned hawk	Mainly winter resident south of Vicksburg)

TABLE 34 (Cont'd)

Common Name	Distribution
Cooper's hawk	Permanent resident
Red-tailed hawk	Permanent resident (rare in south in summer)
Harlan's hawk	Winter resident (casual)
Red-shouldered hawk	Permanent resident
Broad-winged hawk	Winter resident - rare south of Natchez
Rough-legged hawk	Winter resident - (rare in south)
Ferruginous hawk	Accidental (New Orleans)
Golden eagle	Winter resident (rare)
Bald eagle	Winter resident
Marsh hawk	Winter resident
Osprey	Transient (formerly rare, summer resident on coast)
Peregrine falcon	Winter resident (rare)
Pigeon hawk	Transient (rare, winter resident in southern part)
Sparrow hawk	Permanent resident (rare in summer in southern part)
Bobwhite	Permanent resident
Turkey	Permanent resident
King rail	Permanent resident
Clapper rail	Permanent resident (coastal salt marshes only)
Virginia rail	Winter resident in extreme southern part
Sora	Transient (winter resident in extreme southern part)
Yellow rail	Transient (winter resident in extreme southern part)
Black rail	Transient (winter resident - rare - in coastal salt marshes)
Purple gallinule	Permanent resident on coast
Common gallinule	Permanent resident on coast
American coot	Permanent resident (rare in summer)
Semipalmated plover	Transient (winter resident on coast)
Piping plover	Transient (rare winter resident on coast)
Snowy plover	Winter resident (rare - only on coast)
Wilson's plover	Permanent resident (coast only)
Killdeer	Permanent resident

TABLE 34 (Cont'd)

Common Name	Distribution
American golden plover	Transient (winter resident - rare on coast)
Black-bellied plover	Transient (rare permanent resident - nonbreeding on coast)
Ruddy turnstone	Transient (fall only; permanent resident on coast nonbreeding)
American woodcock	Summer resident (except coast; winter resident, mainly southeastern Arkansas southward)
Common snipe	Winter transient (spring only, nearly extinct)
Eskimo curlew	Formerly transient (spring only, nearly extinct)
Upland plover	Transient
Spotted sandpiper	Permanent resident on coast - nonbreeding
Solitary sandpiper	Transient (winter resident in coast - rare)
Willet	Permanent resident (only on coast)
Greater yellowlegs	Transient (winter resident on coast)
Lesser yellowlegs	Transient (winter resident on coast)
Knot	Transient (coast only)
Pectoral sandpiper	Transient
White-rumped sandpiper	Transient (spring only)
Baird's sandpiper	Transient (fall only - uncommon)
Least sandpiper	Transient (winter resident Natchez south)
Dunlin	Transient (winter resident on coast)
Short-billed dowitcher	Transient (winter resident on coast)
Long-billed dowitcher	Transient (winter resident on coast)
Stilt sandpiper	Transient
Semipalmated sandpiper	Transient (winter resident on coast)
Western sandpiper	Transient (fall; winter resident on coast)
Buff-breasted sandpiper	Transient (coast only)
Marbled godwit	Transient (coast only)
Sanderling	Transient (permanent resident on coast - nonbreeding)
American avocet	Transient (mainly coast)
Black-necked stilt	Permanent resident (coast only)

TABLE 34 (Cont'd)

Common Name	Distribution
Red phalarope	Accidental (Baton Rouge - October 1950)
Parasitic jaeger	Accidental (New Orleans - September 1961)
Glaucous gull	Accidental (New Orleans, March 1961)
Herring gull	Winter resident
Ring-billed gull	Winter resident
Laughing gull	Permanent resident (coast only)
Franklin's gull	Accidental (False River, Louisiana - winter)
Bonaparte's gull	Transient (winter resident - St. Francisville southward)
Gull-billed tern	Permanent resident (coast only - rare in summer)
Forster's tern	Transient (permanent resident on coast)
Common tern	Transient (winter resident on coast)
Sooty tern	Summer resident (near mouth of Mississippi River only)
Bridled tern	Accidental (Baton Rouge - September 1965)
Least tern	Summer resident
Royal tern	Permanent resident (coast only)
Sandwich tern	Permanent resident (coast only - rare in winter)
Caspian tern	Transient (permanent resident on coast)
Black tern	Transient (summer resident on coast - nonbreeding)
Black skimmer	Permanent resident (coast only)
Ancient murrelet	Accidental (New Orleans, May 1954)
Rock dove	Permanent resident
White-winged dove	Permanent resident (coast only - rare)
Mourning dove	Permanent resident
Ground dove	Permanent resident (southern Louisiana only)
Yellow-billed cuckoo	Summer resident
Black-billed cuckoo	Transient
Smooth-billed ani	Accidental (south of New Orleans - winter and July)
Groove-billed ani	Winter resident (casual, St. Francisville southward)
Barn owl	Permanent resident
Screech owl	Permanent resident

TABLE 34 (Cont'd)

Common Name	Distribution
Flammulated owl	Accidental (Mississippi River at Baton Rouge - January 1949)
Great horned owl	Permanent resident
Snowy owl	Winter resident (casual - as far south as New Orleans, 1878, and Newellton, Louisiana, February 1972)
Burrowing owl	Winter resident (New Orleans southward; questional breeding record, Baton Rouge - April 1935)
Barred owl	Permanent resident
Long-eared owl	Winter resident (Paradis, Louisiana near New Orleans, December 1931)
Short-eared owl	Winter resident
Chuck-will's widow	Summer resident (rare winter resident on coast)
Whip-poor-will	Transient south of Arkansas; rare winter resident on coast
Common nighthawk	Summer resident (winter resident, New Orleans - rare)
Lesser nighthawk	Accidental (New Orleans - December, 1959)
Chimney swift	Summer resident
Vaux's swift	Winter resident (casual Baton Rouge)
Ruby-throated hummingbird	Summer resident (winter resident Baton Rouge and New Orleans - rare)
Black-chinned hummingbird	Accidental (Baton Rouge - October to December 1955)
Broad-tailed hummingbird	Accidental (Baton Rouge - December to January 1952-1953)
Rufous hummingbird	Winter resident (casual, Baton Rouge southward)
Buff-bellied hummingbird	Accidental (New Orleans - November and December 1965)
Belted kingfisher	Permanent resident (rare on coast in summer)
Yellow-shafted flicker	Permanent resident
Red-shafted flicker	Winter resident (casual Memphis south to Venice)

TABLE 34 (Cont'd)

Common Name	Distribution
Pileated woodpecker	Permanent resident
Red-bellied woodpecker	Permanent resident
Red-headed woodpecker	Permanent resident
Yellow-bellied sapsucker	Winter resident
Hairy woodpecker	Permanent resident
Red-cockaded woodpecker	Permanent resident (endangered species; rare or absent in most of area)
Eastern kingbird	Summer resident (winter resident, Natchez - December 1971)
Gray kingbird	Accidental (Mississippi Delta - May 1948)
Western kingbird	Transient (mainly fall near coast)
Scissor-tailed flycatcher	Summer resident (winter resident, Natchez southward - rare)
Wied's crested flycatcher	Accidental (winter resident, Reserve, New Orleans, and Venice, Louisiana)
Ash-throated flycatcher	Accidental (winter resident, False River, Baton Rouge, New Orleans, and Venice, Louisiana)
Eastern phoebe	Winter resident
Say's phoebe	Accidental (Reserve and New Orleans - fall and winter 1957-1958)
Yellow-bellied flycatcher	Transient
Acadian flycatcher	Summer resident
Traill's flycatcher	Transient
Least flycatcher	Transient
Eastern wood pewee	Summer resident (winter resident, New Orleans - December 1968)
Olive-sided flycatcher	Transient (uncommon in southern portion)
Vermillion flycatcher	Winter resident
Horned lark	Permanent resident
Tree swallow	Transient (winter resident mainly on coast)
Bank swallow	Transient
Rough-winged swallow	Summer resident (permanent resident on coast)

TABLE 34 (Continued)

Common Name	Distribution
Barn swallow	Summer resident (transient on coast - rare)
Cliff swallow	Transient
Purple martin	Summer resident (winter resident, rare, New Orleans December, 1956 and 1962)
Blue jay	Permanent resident
Common crow	Permanent resident
Fish crow	Permanent resident
Carolina chickadee	Permanent resident
Tufted titmouse	Permanent resident
White-breasted nut-hatch	Permanent resident (absent on coast)
Red-breasted nuthatch	Winter resident
Brown-headed nuthatch	Permanent resident
Brown creeper	Winter resident
House wren	Winter resident
Bewick's wren	Winter resident
Carolina wren	Permanent resident
Long-billed marsh wren	Permanent resident on coast
Short-billed marsh wren	Winter resident on coast
Mockingbird	Permanent resident
Catbird	Winter resident, south of Baton Rouge
Brown thrasher	Permanent resident
Sage thrasher	Accidental (Venice - December 1957)
Robin	Permanent resident (winter resident only south of New Orleans)
Wood thrush	Summer resident (winter resident, rare on coast)
Hermit thrush	Winter resident
Swainson's thrush	Transient (winter resident, rare, Venice)
Gray-cheeked thrush	Transient
Veery	Transient
Eastern bluebird	Permanent resident
Wheatear	Accidental (New Orleans, September 1888)
Blue-gray gnatcatcher	Summer resident
Golden-crowned kinglet	Winter resident
Ruby-crowned kinglet	Winter resident
Water pipet	Winter resident

TABLE 34 (Cont'd)

Common Name	Distribution
Sprague's pipit	Winter resident (Natchez southward)
Bohemian waxwing	Accidental (Baton Rouge - January 1960)
Cedar waxwing	Winter resident
Loggerhead shrike	Permanent resident
Starling	Permanent resident
White-eyed vireo	Summer resident (permanent resident, southern Louisiana)
Bell's vireo	Summer resident (transient, Baton Rouge - April 1933; winter resident, Reserve - January 1959)
Yellow-throated vireo	Summer resident (winter resident New Orleans - December 1962)
Solitary vireo	Winter resident (Memphis southward)
Red-eyed vireo	Summer resident (winter resident, Venice - December 1964)
Philadelphia vireo	Transient
Warbling vireo	Summer resident
Black-and-white warbler	Summer resident (winter resident on coast)
Prothonotary warbler	Summer resident
Swainson's warbler	Summer resident
Worm-eating warbler	Transient (winter resident, Venice - December 1971)
Golden-winged warbler	Transient
Blue-winged warbler	Transient
Bachman's warbler	Summer resident (very rare)
Tennessee warbler	Transient
Orange-crowned warbler	Transient (winter resident north to Natchez)
Nashville warbler	Transient (rare in southern part in spring; winter resident, Baton Rouge - December 1938)
Lucy's warbler	Accidental (Triumph, Louisiana - December 1959)
Parula warbler	Summer resident
Yellow warbler	Summer resident
Magnolia warbler	Transient (winter resident New Orleans - December 1962; Venice, December 1959, 1964, 1969)

TABLE 34 (Cont'd)

Common Name	Distribution
Cape May warbler	Transient (casual, spring only)
Black-throated blue warbler	Transient (casual, winter resident, Venice - December 1964)
Myrtle warbler	Winter resident
Audubon's warbler	Accidental (Baton Rouge - November 1952; New Orleans - December 1969; Venice - December 1965)
Black-throated gray warbler	Accidental (winter resident, New Orleans, Venice, and Pass-a-Loutre)
Black-throated green warbler	Transient (winter resident, New Orleans - December 1958, 1959, 1962; Venice - December 1965, 1969, 1971)
Cerulean warbler	Summer resident (transient on coast)
Blackburnian warbler	Transient (winter resident, Venice - December, 1964)
Yellow-throated warbler	Summer resident (winter resident, New Orleans, and Venice)
Chestnut-sided warbler	Transient
Bay-breasted warbler	Transient (winter resident, New Orleans - December 1967)
Blackpoll warbler	Transient (rare or absent in southern portion in fall)
Pine warbler	Permanent resident
Prairie warbler	Summer resident (winter resident, Venice - December 1964)
Palm warbler	Transient
Overbird	Transient
Northern waterthrush	Transient
Louisiana waterthrush	Transient
Kentucky warbler	Summer resident
Mourning warbler	Transient (rare to uncommon)
McGillivray's warbler	Accidental (New Orleans - November 1959)
Yellowthroat	Summer resident (permanent resident north to St. Francisville)
Yellow-breasted chat	Winter resident
Hooded warbler	Summer resident
Wilson's warbler	Transient
Canada warbler	Transient

TABLE 34 (Cont'd)

Common Name	Distribution
American redstart	Summer resident
Painted redstart	Accidental (New Orleans - November, December 1952)
House sparrow	Permanent resident
Bobolink	Transient (chiefly in spring)
Eastern meadowlark	Permanent resident
Western meadowlark	Winter resident
Yellow-headed blackbird	Accidental (winter resident Octave Pass, Mississippi Delta; spring transient, Baton Rouge and Natchez)
Red-winged blackbird	Permanent resident
Orchard oriole	Summer resident
Baltimore oriole	Summer resident
Painted bunting	Summer resident
Dickcissel	Summer resident
Purple finch	Winter resident
Pine siskin	Winter resident (uncommon south to New Orleans)
American goldfinch	Winter resident
Rufous-sided towhee	Permanent resident
Savannah sparrow	Winter resident
Grasshopper sparrow	Winter resident
Leconte's sparrow	Winter resident
Henslow's sparrow	Transient (winter resident, Natchez southward)
Sharp-tailed sparrow	Transient (winter resident, St. Francis-ville southward)
Seaside sparrow	Permanent resident (New Orleans south-ward)
Bullock's oriole	Winter resident (casual, south Louisiana)
Rusty blackbird	Winter resident
Brewer's blackbird	Winter resident
Boat-railed grackle	Permanent resident (New Orleans southward, rarely north to Natchez)
Great-tailed grackle	Permanent resident (Reserve, Louisiana - rare)
Common grackle	Permanent resident
Brown-headed cowbird	Permanent resident
Bronzed cowbird	Accidental (Port Allen, Louisiana - March 1964)

TABLE 34 (Cont'd)

Common Name	Distribution
Western tanager	Accidental (spring transient, St. Francisville and New Orleans; winter resident, Baton Rouge and New Orleans)
Scarlet tanager	Transient
Summer tanager	Summer resident (winter resident, Baton Rouge and New Orleans - rare)
Cardinal	Permanent resident
Rose-breasted grosbeak	Transient
Black-headed grosbeak	Winter resident (casual, Natchez, Baton Rouge, Reserve, New Orleans, and Venice)
Blue grosbeak	Summer resident (south to St. Francisville; transient south of St. Francisville; winter resident, New Orleans and Venice - rare)
Indigo bunting	Summer resident (winter resident, Baton Rouge, New Orleans and Venice - rare)
Vesper sparrow	Winter resident
Lark sparrow	Summer resident
Bachman's sparrow	Permanent resident
Slate-colored junco	Winter resident
Oregon junco	Accidental (winter resident, Baton Rouge)
Tree sparrow	Winter resident (rare)
Chipping sparrow	Permanent resident (winter resident south of Baton Rouge)
Clay-colored sparrow	Accidental (False River and New Orleans - October and November)
Field sparrow	Permanent resident
Harris's sparrow	Accidental (Baton Rouge - November through December)
White-crowned sparrow	Winter resident
White-throated sparrow	Winter resident
Fox sparrow	Winter resident
Lincoln's sparrow	Transient
Swamp sparrow	Winter resident
Song sparrow	Winter resident
Lapland longspur	Winter resident (occasionally south to New Orleans)

TABLE 34 (Cont'd)

Permanent resident: A fair number present year-round, not necessarily the same individuals.
Winter resident: Mainly present only in winter months.
Summer resident: Maiinly present only in summer months but not necessarily breeding.
Transient: Move through area only during spring and/or fall migration.
Accidental: Out of normal range.

Source: Gulf South Research Institute, In, Environmental Inventory for the Mississippi River-Cairo, Illinois, to Venice, Louisiana (modified for project area).

TABLE 35
A CHECKLIST AND RELATIVE ABUNDANCE OF THE MAMMALS OF THE BATTURE LANDS IN THE MISSISSIPPI RIVER STUDY AREA

Common Name	Scientific Name	New Orleans, Louisiana
Opossum	Didelphis virginiana	P
Least shrew	Cryptotis parva	P
Southeastern myotis	Myotic austroriparius	P
Eastern pipistrelle	Pipistrellus subflavus	P
Big brown bat	Epresicus fuscus	P
Red bat	Lasiurus borealis	P
Seminole bat	Lasiurus seminolus	P
Florida yellow bat	Lasiurus intermedius	P
Evening bat	Nycticeius humeralis	P
Rafinesques big-eared bat	Plecotus rafinesquii	P
Free-tailed bat	Tadarida cynocephala	P
Nine-banded armadillo	Dasypus novemcinctus	2
Eastern cottontail rabbit	Sylvilagus floridanus	P
Swamp rabbit	Sylvilagus aquaticus	P
Gray squirrel	Sciurus carolinensis	1
Fox squirrel	Sciurus niger	1
Southern flying squirrel	Glaucomys volans	P
Fulvous harvest mouse	Reithrodontomys fulvescens	P
White-footed mouse	Peromyscus leucopus	P
Cotton mouse	Peromyscus gossypinus	P
Rice rat	Oryzomys palustris	P
Cotton rat	Sigmodon hispidus	P
Eastern woodrat	Neotoma floridana	P
Muskrat	Ondatra zibethicus	P
Nutria	Myocaster coypus	P
Norway rat	Rattus norvegicus	P
Black rat	Rattus rattus	P
House mouse	Mus musculus	P
Raccoon	Procyon lotor	3
Mink	Mustela vison	P
Otter	Lutra canadensis	P
Bobcat	Lynx rufus	P

TABLE 35 (Cont'd)

Common Name	Scientific Name	New Orleans, Louisiana
White-tailed deer	Odocoileus virginianus	P
Bottle-nosed dolphin	Tursiops truncatus	P

1 = Rare
2 = Scarce
3 = Common
P = Probably present - no data available

Source: Gulf South Research Institute, In Environmental Inventory for the Mississippi River-Cairo, Illinois, to Venice, Louisiana, (information north of Baton Rouge has been deleted).

and across the marsh and on the north by the Southern Railroad embankment.

c. About 348,000 acres of remaining land around Lake Pontchartrain subject to flooding from hurricane tides will have a reduction of flood stages as a result of construction of the barrier structures at The Rigolets and Chef Menteur Pass.

d. The Chalmette area consists of 49,050 acres subject to hurricane tidal overflow from the IHNC on the west and from Lake Borgne on the east. It is located in Orleans and St. Bernard Parishes along the left descending bank of ths Mississippi River. Approximately 17,150 acres are partially protected at present.

e. The Chalmette study area, consisting of that part of St. Bernard Parish downriver from Bayou Dupre, is rural in nature. It is characterized by several small communities located along the state highways extending into the marsh areas along the alluvial banks of former distributaries of the Mississippi River. These communities include Violet, Poydras, Caernarvon, Toca, Verret, Yscloskey, Hopedale, Reggio, and Delacroix.

f. Developments in the Chalmette area are generally limited to retail type businesses and those developments associated with the petroleum industry and commercial and sport fishery. Two large petroleum processing plants are located at Toca and one near Yscloskey. Several small boat-launching facilities exist on Bayous LaLoutre, Yscloskey, and Terre aux Boeufs. Storage facilities for small boats have been constructed at Hopedale and Shell Beach. A large part of the existing developments along Bayous LaLoutre, Yscloskey, and Terre aux Boeufs is based on recreational fishing.

2.03 EFFECT OF HURRICANES

a. This area has experienced many severe hurricanes and lesser storms which caused loss of life and extensive damage to property by floodwater inundation.

(1) The hurricane of September 1909 caused damage exceeding $6 million and a loss of 353 lives. The railroad between Frenier and Ruddock (St. John the Baptist Parish) was washed out. The stage at New Orleans reached 6.2 feet and the western portion of the city was flooded to depths of 1 to 2 feet.

Stages were 8 feet at the west shore of Lake Pontchartrain, 7 feet on the north shore, and 6 feet in the area near The Rigolets.

(2) The storm of September-October 1915, which had a central pressure of 27.87 inches and winds at New Orleans of 75 m.p.h., caused considerable damage. New Orleans reported a total of 8.2 inches of rain with a maximum of 1.59 inches in 1 hour. Maximum stages around Lake Pontchartrain were 13 feet at Frenier, 6.1 feet at West End, New Orleans, 7.2 to 11 feet on the east shore, and 7.7 feet on the north shore. The south shore of Lake Borgne had stages up to 11.6 feet and the marshland had stages of 9.0 feet. In New Orleans, 25,000 buildings were destroyed or damaged. The city was flooded to depths of from 1 to 8 feet. Total property losses exceeded $13 million and the death toll was 275.

(3) The hurricane of September 1947 struck the Louisiana coast just south of Lake Borgne and continued westward just south of Lake Pontchartrain. Water surface elevations in Lake Pontchartrain were 6.8 feet at Mandeville and 5.5 feet at New Orleans. Water flowed over the seawall at New Orleans lakefront inundating approximately 8.9 square miles of lakefront area, of which 2.7 square miles were covered by sheet flow 2 feet or more in depth. Sheet flow over the low protective embankment along the lakeshore caused flooding in Jefferson Parish of approximately 31 square miles, making the drainage pumps inoperative for a considerable period of time. Water stood 6 feet deep in some sections. New Orleans International Airport, Moisant Field, had one-half foot of water on the runways and could not operate. Stages around the lake were 4.2 feet on the west shore, 8 to 10 feet in The Rigolets, and 2.4 to 5 feet in the marsh west of the lake. On the south shore of Lake Borgne the stage was 11.2 feet at the shore and 7.4 to 7.8 feet inland near the Chalmette back levee. Wind was reported as high as 98 m.p.h. with gusts to 112 m.p.h. from the northeast at Moisant Field. The barometer reading at New Orleans was 28.57 inches. Total storm damage was estimated at $110 million with 51 lives lost, of which 12 were in Louisiana.

(4) Hurricane Flossy, September 1956, passed over the mouth of the Mississippi River on a northeasterly track. Heavy rains, varying from 4 to 10 inches, fell along the path of the storm from Florida to Louisiana. Shell Beach, on the south shore of Lake Borgne, had a tide of 10.9 feet. Flooding in the

surrounding marshland ranged from 6.4 to 8.6 feet. Lake Pontchartrain had stages of 7.3 at Frenier, 7.1 at Little Woods, and 5.4 feet at New Orleans. The seawall was overtopped by waves, flooding an area of approximately 2.5 square miles, in the eastern part of the city. Jefferson Parish was protected by the levee built since the 1947 storm. Total deaths reported on the coast were 15 and damage was estimated at $20 million.

(5) The most destructive storm of record on the Louisiana coast and one of the great hurricanes of this century was Betsy which struck in September 1965. Betsy crossed the coast just west of Grand Isle with tides up to 16 feet above sea level and a barometer reading of 28.00 inches. The US Coast Guard station on Grand Isle reported winds of 70 to 105 m.p.h. with gusts better than 160 m.p.h. Storm tides swept over Grand Isle and practically all buildings except the church, US Coast Guard Station, and a housing development owned by one of the major oil companies were either swept away, demolished, or severely damaged by the onrushing surge and waves. Just to the east of Grand Isle, a combination of storm surges entering the Mississippi River from the south and east overtopped both east and west river levees, inundating the Venice-Buras-Empire and Port Sulphur areas with water depths up to 11.5 feet. The storm surges overtopped the back levee in the Bohemia-Pointe a la Hache-Phoenix area flooding and heavily damaging all structures located within the area. Many homes were washed off foundations and were driven upon the landside slopes of the Mississippi River levees by the combination of floodwaters and wind. Further north, practically all communities were flooded and suffered heavy damage. Notably among those were Delacroix, Reggio, Hopedale, Yscloskey, Alluvial City, Shell Beach, and Verret. Again, in addition to flooding, many structures were washed off foundations and floated some distance away. Some flooding was evidenced in the Violet to Verret area when the back protection levee was overtopped.

(6) The eastern portion of New Orleans and the adjacent Chalmette area of St. Bernard Parish suffered severe damage from floodwaters and winds. The waters overtopped and poured in from breaks in the IHNC levees and the Chalmette back levee. The Citrus and New Orleans East back levees, located along the GIWW, were also overtopped. Many camps and homes located along Chef Menteur, Rigolets, Lake Catherine, and on the south shore of Lake Pontchartrain in the Citrus-Little

woods area were completely demolished or heavily damaged by the combination of floodwaters, wind, and waves. Serious flooding occurred in the areas mentioned above with the depth of flooding ranging up to 9 feet. Waves caused overtopping of the New Orleans seawall on Lake Pontchartrain, but a secondary levee constructed by the local levee board prevented serious overflow into the city proper.

(7) Damages and expenditures related to Hurricane Betsy were estimated at over $2 billion. More than 2 1/2 million acres of land were flooded; approximately 300,000 persons were evacuated or changed living quarters; and more than 27,000 homes were destroyed or flooded. In addition, offshore and coastal oil installations and public utilities reported unprecedented damage. Sugarcane, pecan, and fall crops were heavily damaged and much livestock drowned. Severe damage resulted to all types of fish and wildlife. Deaths in Louisiana resulted from Hurricane Betsy are listed at 81 persons. The residents of the low-lying areas heeded the warnings of the National Weather Service and local responsible agencies and evacuated promptly. Otherwise, it is conceivable that the death toll may have exceeded the record high of more than 556 persons caused by Hurricane Audrey in June 1957 which struck southwest Louisiana.

(8) Hurricane Camille, August 1969, one of the most intense and destructive hurricanes ever recorded, struck the coast of Mississippi just east of the Louisiana state line and caused widespread destruction and serious loss of lives. Camille went inland in the Waveland-Bay St. Louis area. Camille's top winds were estimated at nearly 200 m.p.h. and the barometric pressure in her calm eye dropped as low as 26.61 inches of mercury, second lowest of all recorded hurricanes. While the hurricane of September 1935 which struck the Florida Keys had a minimum pressure of 0.35 higher than the minimum considered possible for that latitude, Camille's minimum pressure at landfall was actually 0.05 inch lower than what had previously been considered possible for the Mississippi coast latitude.

(9) A reliable highwater mark of 22.6 feet m.s.l. was found at Pass Christian. Maximum hurricane surges of 15.0 feet or more extended from Waveland to Ocean Springs, Mississippi, with tidal surges of 20 feet or more above m.s.l. concentrated in an area from Bay St. Louis eastward to Mississippi City. Camille then moved inland and blanketed parts of Mississippi,

Louisiana, Tennessee, Kentucky, Virginia, and West Virginia with torrential rains, high winds, and tornadoes before moving out into the Atlantic Ocean. While Camille was in the Gulf of Mexico, a central barometric pressure of 26.61 inches was recorded, second only to the Labor Day hurricane of 1935, which developed a central pressure of 26.35 inches. Monetary damages as a result of Camille were in excess of $1 billion, while at least 262 lives were lost. Of this total, 137 persons perished along the Mississippi Gulf Coast and nine deaths were reported in Louisiana, while deaths were reported at 114 and two in Virginia and West Virginia, respectively.

(10) The most devastating damage wrought by Camille was in the coastal area of Mississippi and the Mississippi River Delta area in Louisiana. Almost total destruction occurred in these areas. As Camille passed near the Mississippi River Delta, hurricane tides overwhelmed the protective systems and inundated protected areas located along the west bank of the Mississippi River from Venice to Empire. The area from Venice to Buras was almost completely destroyed. Oil, sulphur, and fishing industries suffered severe damages inside and outside the protected area. As the hurricane moved toward landfall, heavy damage was sustained by all types of installations in and near The Rigolets-Chef Menteur-Lake Catherine area. In addition, camps and homes located on both the north and south shores of Lake Pontchartrain were damaged heavily. As the hurricane approached landfall, record high tides engulfed the entire Mississippi coast, which suffered damages far in excess of that caused by any hurricane in history.

(11) The occurrence of an SPH wind tide for any location in the study area would produce maximum wind tides of 11.5 feet along the south shore of Lake Pontchartrain, 12.8 feet at Mandeville, 13.0 feet in the Chalmette area, along the Citrus and New Orleans East back levees, and at the Chef Menteur and The Rigolets areas. The SPH would inundate a land area of approximately 700,000 acres to depths of up to 16 feet in the study area in the absence of the proposed project. The estimated damage within the study area that would result from an occurrence of the SPH under preproject conditions is between one-half and three-quarters of a billion dollars. A prolonged inundation would cause enormous damage to private and public property, create serious hazards to life and health, disrupt business and community life, and require immense expenditure of public and private funds for evacuation and subsequent rehabilitation of local residents.

2.04 ECONOMIC AND SOCIAL CONDITIONS

a. Introduction. The study area is located in southeastern Louisiana in the vicinity of New Orleans and includes St. Charles Parish and the four parishes which compose the New Orleans Standard Metropolitan Statistical Area (SMSA), Orleans, Jefferson, St. Tammany, and St. Bernard. Economic data, as reported herein, represent compilations of statistics recorded for these five parishes. The dominant topographic feature is Lake Pontchartrain, a shallow landlocked tidal basin approximately 640 square miles in area and averaging 12 feet in depth. Connecting with lesser Lake Maurepas to the west and through Lake Borgne and Mississippi Sound to the Gulf of Mexico on the eastward side, Lake Pontchartrain drains approximately 4,700 square miles of tributary area. Located within the portion of the study area on the south shore of Lake Pontchartrain are the IHNC, the GIWW, and the MR-GO. The principal tributaries in St. Tammany Parish on the north shore of Lake Pontchartrain which drain directly into the lake are the Tchefuncte River and Bayous Lacombe, Liberty, Bonfouca, and Castine.

b. General economy. The economy of Lake Pontchartrain Basin is based primarily on oil and gas production, manufacturing, and trade. In 1969 the total value of mineral production for the five-parish area was $450.3 million; the value added by manufacture in 1967 was $976.6 million.

(1) Waterborne commerce is of major importance to the area affected by the Lake Pontchartrain project. Commerce statistics for the waterways in the study area are presented in table 36.

(2) The principal products transported over these waterways in 1970 were as shown below in table 37.

(3) Table 38 displays the total tonnage of the principal products transported over all waterways in the study area in 1970.

(4) The mineral industry has been of primary importance to the five parishes in the study area. Accruing $450 million to the economy in 1969, the production of minerals increased 295 percent between 1960 and 1969. Complete data on the value of mineral production for the five parishes are found in table 39.

TABLE 36
WATERBORNE COMMERCE STATISTICS (1960 and 1970)[1]

	Maximum Draft (feet)	1960 Tonnage	1970 Tonnage	Increase 1960 to 1970
Port of New Orleans[2]		56,700,000	123,700,000	118.2%
Tchefuncte River	10	70,890	20,820	-70.6%
Bayou Bonfouca	8	18,223	21,787	19.6%
Lake Pontchartrain	10	3,100,000	4,800,000	54.8%
Bayou Lacombe	8	48,009	167,838	249.6%
Total		59,900,000	128,700,000	114.9%

[1]Waterborne Commerce of the U. S., 1970, Part 2, U. S. Army Corps of Engineers.

[2]Includes the Mississippi River (40 ft. draft), Inner Harbor Navigation Canal (28 ft. Draft), Mississippi River-Gulf Outlet (36 ft. draft), and Harvey Canal (12 ft. draft).

TABLE 37
PRINCIPAL PRODUCTS (1970)[1]

Waterway	Major Products	Percent of Total 1970 Tonnage Per Waterway
Port of New Orleans[2]	Crude Petroleum	23.7
	Corn	10.7
	Soybeans	8.4
	Coal and lignite	6.5
	Gasoline	5.3
	Sulfur, liquid	2.9
	Grain mill products	2.6
	Wheat	1.8
	Remaining products less than 1.5% of total	33.3
	Total	100.0
Tchefuncte River	Marine shells, unmanufactured	88.0
	Remaining products	12.0
	Total	100.0
Bayou Bonfouca	Marine shells, unmanufactured	61.0
	Remaining products	39.0
	Total	100.0
Lake Pontchartrain	Marine shells, unmanufactured	83.0
	Misc. nonmetallic mineral products	7.0
	Sand, gravel, and crushed rock	7.0
	Building cement	1.5
	Remaining products	1.5
	Total	100.0
Bayou Lacombe	Sand, gravel, and crushed rock	100.0

[1]Waterborne Commerce of the U. S., 1970, Part 2, U. S. Army Corps of Engineers.

[2]Includes the Mississippi River (40 ft. draft), Inner Harbor Navigation Canal (28 ft. draft), Mississippi River-Gulf Outlet (36 ft. draft), and Harvey Canal (12 ft. draft).

TABLE 38
PRINCIPAL PRODUCTS TRANSPORTED (1970)[1]

Product	Tons	Percent of Total Tonnage
Crude petroleum	35,300,000	27.4
Corn	13,200,000	10.3
Soybeans	10,400,000	8.1
Coal and Lignite	8,000,000	6.2
Gasoline	6,600,000	5.1
Marine shells, unmanufactured	4,000,000	3.1
Total	77,500,000	60.2

[1]Waterborne Commerce of the U.S., 1970, Part 2, U.S. Army Corps of Engineers.

TABLE 39
MINERAL PRODUCTION (1960, 1968, and 1969)[1]

Parish	Value (X1000) 1960	1968	1969	Primary Minerals Produced In Order of Value
Jefferson	$65,349	$220,804	$303,743	Petroleum,sulfur,natural gas,salt,sand,and gravel, natural gas liquid.
Orleans	9,130	15,372	17,128	Cement,lime,shell,natural gas,sand,and gravel.
St. Bernard	2,818	32,225	27,659	Natural gas,petroleum, natural gas liquid,sand and gravel,clays.
St. Charles	34,612	74,516	84,852	Petroleum,natural gas, natural gas liquid.
St. Tammany	2,098	7,837	6,875	Shell,sand, and gravel, natural gas,petroleum, clays.
Total	$114,007	$350,754	$540,257	

[1]The Mineral Industry of Louisiana, 1960, 1968, and 1969, U. S. Department of the Interior.

(5) The New Orleans SMSA is a primary wholesale distribution point and a retail trade center for much of the deep south. The economic impact of these sectors of the economy may be seen by examination of table 40 which displays wholesale and retail trade statistics.

TABLE 40
WHOLESALE AND RETAIL TRADE (1963 and 1967)[1]
New Orleans SMSA and St. Charles Parish

	Number of Establishments		Number of Employees		Annual Payroll (X1000)		Annual Sales (X1000)	
	1963	1967	1963	1967	1963	1967	1963	1967
Wholesale	1,816	1,935	23,476	27,344	$32,571	$44,059	$2,673,847	$3,606,681
Retail	6,342	7,958	43,736	53,903	137,999	194,220	1,133,089	1,591,015

[1]Wholesale Trade, Retail Trade, Census of Business, 1963 and 1967, US Department of Commerce.

(6) The primary wholesale products are groceries and related products (19 percent of sales), motor vehicles and related equipment (13 percent of sales), and machinery, equipment, and supplies (13 percent of sales). In the retail trade sector, the primary establishments are eating and drinking establishments, food stores, miscellaneous retail stores, and gasoline service stations. Wholesale and retail trade establishments are supported by a vast transportation network including highways leading to all parts of the country, railway service in all directions, and water and air transportation facilities which link the area with the rest of the world.

(7) In 1970, the labor force in the Lake Pontchartrain study area comprised 36.4 percent of the area's total population; this represented a 1.4 percent increase above the 1960 figure.

(8) Table 41 presents data for the population, the labor force, and the unemployed in the study area during 1960 and 1970.

TABLE 41
LABOR FORCE DATA (1960 and 1970)[1]

	Population	Labor Force	Unemployed
1960	928,342	325,137	16,621
1970	1,075,369	391,272	19,338
Change (1960-1970)	15.8%	20.3%	16.3%

[1]General Social and Economic Characteristics, Louisiana, 1960 and 1970, US Department of Commerce.

c. Land use. As is seen in table 42, only the parishes of St. Tammany and St. Charles have large agricultural acreages, both in absolute figures and as a percentage of total land area. In Orleans, Jefferson, and St. Bernard Parishes, where urban-type development has not occurred, the land has either been dedicated for urban-type usage or is low and marshy or semimarshy and not well suited to cultivation. Industrial acreagres have been constantly increasing in Jefferson, Orleans, St. Bernard, and St. Charles Parishes. (Industrial figures are not available for St. Tammany Parish.) With this increased industrial activity, there is also a greater need for land devoted to urban-type development. As is seen in table 43, the area has experienced a positive inmigration; population densities have increased.

d. Population. Between 1940 and 1970 the annual rate of growth of United States population was 1.5 percent while the annual rate for the Lake Pontchartrain study was 2.1 percent. During the last decade, 1960-1970, this differential decreased to a 1.3 percent annual rate of growth for the nation and a 1.5 percent rate for the study area. Population data by urban-rural mix is shown in table 43 along with net migration rates and population densities.

e. Industrial development. Industrial development in St. Charles and St. Bernard Parishes is located primarily along the banks of the Mississippi River. In Jefferson Parish, industry is situated along the river and the Harvey Canal. The majority of industrial sites in Orleans Parish are highly concentrated

TABLE 42
LAND-USE PATTERN (1970)

	TOTAL LAND[1] ACREAGE	INDUSTRIAL[2] ACREAGE	PERCENT OF TOTAL	AGRICULTURAL[3] ACREAGE	PERCENT OF TOTAL	URBAN-TYPE[4] ACREAGE	PERCENT OF TOTAL
Jefferson	211,840	1,500	0.7	8,951	4.2	33,000	15.6
Orleans	131,200	813	0.6	nil	nil	38,000	29.0
St. Bernard	328,960	704	0.2	7,112	2.2	7,000	2.1
St. Charles	184,320	10,111	5.5	33,653	18.3	5,500	3.0
St. Tammany	592,000	NA	NA	80,206	13.5	14,200	2.4
TOTAL	1,448,320	13,128	0.9%	129,922	9.0%	97,700	6.7%

NA - Not applicable.

[1] County and City Data Book, 1967, U. S. Department of Commerce.

[2] Survey of Industry from Baton Rouge to Venice, Louisiana, 1971, U. S. Corps of Engineers, New Orleans District; Industrial acreage shown includes only those sites lying immediately adjacent to the river and is not indicative of parish totals.

[3] Statistical Abstract of Louisiana, 1971, Louisiana State University in New Orleans.

[4] Estimates by the U. S. Corps of Engineers, New Orleans District; does not include industrial acreages shown elsewhere on this table.

TABLE 43
POPULATION DATA

PARISH	YEAR	POPULATION: TOTAL[1] (X1000)	POPULATION: PERCENT URBAN-RURAL[2]: URBAN	POPULATION: PERCENT URBAN-RURAL[2]: RURAL	NET MIGRATION RATE[3] (IN PERCENT): 1950-1960	NET MIGRATION RATE[3] (IN PERCENT): 1960-1970	POPULATION DENSITY (PER LAND ACRE)[4]: 1960	POPULATION DENSITY (PER LAND ACRE)[4]: 1970
Jefferson	1960	208.77	94.1	5.9				
	1970	337.57	95.8	4.2	65.2	30.9	0.99	1.59
Orleans	1960	627.53	100.01	0.0				
	1970	593.47	100.0	0.0	-7.2	-14.6	4.78	4.52
St. Bernard	1960	32.19	66.0	34.0				
	1970	51.19	91.6	8.4	141.0	31.8	0.10	0.16
St. Charles	1960	21.22	22.1	77.9				
	1970	29.55	27.2	72.8	23.2	13.2	0.12	0.16
St. Tammany	1960	38.64	33.9	66.1				
	1970	63.59	36.6	63.4	18.6	48.9	0.07	0.11
TOTAL	1960	928.35	93.0	7.0				
	1970	1,075.37	92.5	7.5	7.2	1.41	0.64	0.74

[1] General Population Characteristics, Louisiana, 1960 and 1970, U.S. Department of Commerce.
[2] Number of Inhabitants, Louisiana, 1970, U. S. Department of Commerce.
[3] Net migration rates compiled by U. S. Army Corps of Engineers, New Orleans District.
[4] Land area from County and City Data Book, 1967, U. S. Department of Commerce. Densities shown are based on gross land acreages, including vast swamp and/or marsh areas. Actual densities in developed areas are considerably higher.

along the banks of the river, the IHNC, and the GIWW. In St. Tammany, industry is in the early stages of development. The number of manufacturing establishments in the five-parish study area decreased slightly between 1963 and 1967, from 924 to 921. However, the number of employess, the total payroll, and the value-added by manufacture all increased, as is seen in table 44.

f. Agricultural development. The production of agricultural products does not contribute significantly to the economy of the study area. In St. Charles Parish, approximately 18 percent of the total land area is devoted to agricultural pursuits, with the principal crop being hay. In St. Tammany Parish, 13.5 percent of the land area is in agricultural development with soybeans, hay, and orchard crops being the principal products. Production in Orleans Parish is almost nonexistent. A presentation of agricultural statistics for the study area is found in table 45.

2.05 MISCELLANEOUS

Fifteen hunting clubs lease hunting rights in the marsh in St. Charles Parish. Seven clubs have approximately 40 members each and the remaining eight are of lesser membership. Activities include hunting ducks, deer, turtles, frogs, and squirrels, and fishing and crabbing. Nutria, coon, mink, and otter are trapped. A number of hunting clubs lease hunting rights in the wetlands on the north shore of Lake Pontchartrain. A state game preserve is located along the north shore of Lake Pontchartrain from the Fontainebleau State Park to Bayou Lacombe. Indigenous and endangered species are protected from hunting in this area. Two bayous in the project area are in the Louisiana Natural and Scenic Rivers System. Bayou Trepagnier and Bayou LaBranche, both in St. Charles Parish, were added to the system by Act No. 85 of the legislature during the regular session of 1973.

TABLE 44
MANUFACTURING, 1963 and 1967[1]

	Number of Manufacturing Establishments		Number of Employees (X1000)		Total Annual Payroll (In Millions)		Value Added By Manufacture (In Millions)	
	1963	1967	1963	1967	1963	1967	1963	1967
SMSA[2]	916	906	49.1	55.5	$282.9	$380.0	$618.4	$860.1
St. Charles Parish	8	15	1.6	2.2	W	21.1	W	116.5
TOTAL	924	921	50.7	57.7	$282.9	$401.1	$618.4	$976.6

W = Withheld to avoid disclosure of confidential data.
[1]Census of Manufacture, 1963 and 1967 editions, US Department of Commerce.
[2]Includes Jefferson, Orleans, St. Bernard, and St. Tammany Parishes.

TABLE 45
AGRICULTURAL ACREAGES AND VALUES[1]

Parish[2]	Number of Farms	Acres in Farms	Average Acres per Farm	Acres in Cropland	Average Cropland Acres per Farm	Value of all Farm Products Sold	Value of Crops	Value of Forest Products	Value of Livestock & Products	Principal Crops
Jefferson	54	8,951	165.8	2,974	55.1	$450,627	$319,375	$1,000	$130,252	Vegetables, orchards, hay
St. Bernard	27	7,112	263.4	651	24.1	380,206	258,639	0	21,567	Vegetables, orchards
St. Charles	71	33,653	474.0	12,165	17.3	1,135,845	702,886	0	432,959	Hay
St. Tammany	526	80,206	152.5	37,251	70.8	3,817,407	1,273,407	69,255	2,474,745	Soybeans, hay, orchards
TOTAL	678	129,922	191.6	53,941	78.2	$5,684,085	$2,554,307	$70,355	$3,059,523	

[1]Census of Agriculture, 1969, U. S. Department of Commerce.
[2]Statistics not available for Orleans Parish.

SECTION 2A--LAND-USE PLANS

The project features were planned and designed to protect areas currently planned for present and future urban development and human occupation.

SECTION 3--THE PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

3.01 GENERAL

Lake Pontchartrain is only a part of the total interrelated estuarine environmental complex of the southeastern Louisiana coastal area. It must be recognized that changes effected in the lake can result in changes within other segments of the complex. In model studies, existing lake salinities were not altered significantly by control structures in Chef Menteur and Rigolets passes. The model studies showed that the Seabrook complex will control saltwater intrusion in Lake Pontchartrain via the MR-GO. The installation of the hurricane surge control structures in the Chef Menteur and Rigolets passes would reduce the cross-sectional area of the present natural passes by 75 percent. However, because the channels and control structures were designed to be hydraulically equal to the natural passes, their effects on the salinity regimen and tidal heights of Lake Pontchartrain would be negligible.

3.02 MODEL STUDIES

a. The entire hurricane protection project was preconstructed on a scaled hydraulic model of the project area at the US Army Engineer Waterways Experiment Station in Vicksburg, Mississippi. The design of the barrier control structures was based on detailed hydraulic testing of the model.

b. The following report gives the schedule of data collection, describes the instrumentation and testing methods employed in the program, and summarizes pertinent data collected: Prototype Data Collection Program for Model Study of Lake Pontchartrain, Louisiana, and Vicinity, 1962, US Army Engineer District, New Orleans. The following report give information on the hydraulic and salinity regimen of major waters of the project area: Effects on Lake Pontchartrain, Louisiana, of Hurricane Surge Control Structures and Mississippi River-Gulf Outlet, 1963. Technical Report No. 2-636, US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

c. The results of the model tests demonstrated four facts: (1) that the effects of the proposed hurricane surge control structures in Chef Menteur and Rigolets passes on both salinities and tidal heights in Lake Pontchartrain and Lake Borgne would be negligible; (2) the connection of the MR-GO to Lake Pontchartrain would increase salinities in Lake Pontchartrain to such an extent that a salinity control structure would be needed at the Lake Pontchartrain terminus of the IHNC; (3) complete closure of all structures during periods of hurricane conditions would not produce any serious adverse salinity conditions; (4) the operation of the Bonnet Carre' Spillway discharging at design flow with structures installed would raise the high-water elevation in Lake Pontchartrain to a maximum of 1.4 feet.

3.03 IMPACTS

a. Since the control structures will not seriously affect the existing flow pattern or salinity gradient in Lake Pontchartrain, the control structures will not cause any appreciable change in its environmental aspects. The general nursery habitat for marine fisheries including the extensive menhaden and white shrimp nursery in the upper areas of the lake should not be affected.

(1) The ecology of Lake Pontchartrain depends upon the seasonal migration of larval, young, and adult organisms from neighboring estuaries and from the Gulf of Mexico, and the exchange of food materials and other nutrients with these habitats. The gated control structures should not interfere with these movements except during hurricane conditions. The sill elevations of the control structures at the Chef Menteur Pass and at The Rigolets are -25.0 feet and -30.0 feet, respectively. These sill elevations are sufficient to allow the free passage of organisms and nutrient substances. The eight bays with 46-foot wide openings at the Chef Menteur Pass and 16 bays with 46-foot wide openings at The Rigolets will not interfere with the movements of organisms and nutrient substances.

(2) It is difficult to state the natural or most desirable salinity range for Lake Pontchartrain because of the seasonal and yearly fluctuations in salinity gradients and the conflict of interest associated with the desirable and nondesirable aspects of these conditions. As predicted by the model studies, the salinity of Lake Pontchartrain has increased by two to three times since the opening of the MR-GO to Lake Pontchartrain. These increased salinities have produced changes in the ecologic character of the lake and surrounding swamps and marshes, some of

which may or may not prove to be desirable. The Seabrook control structure has the capacity to be variably regulated allowing the management of a beneficial salinity regimen.

(3) The Seabrook lock outlet structure will be operated to provide a desirable salinity regimen in Lake Pontchartrain to the end that deleterious alterations in lake ecology will be avoided. This complex will allow salinities in Lake Pontchartrain to be adjusted as may be necessary for the maintenance of fish and wildlife resources. Since the outlet gates are of the vertical lift type and since the available flow area far exceeds the flow area needed for riparian users and for salinity control, the gates could be regulated to satisfy any flow requirements as would be necessary to satisfy these purposes.

(4) The plan will provide for maintenance of the brackish water circulatory system. The openings in the Chef Menteur and Rigolets will not impede the movements of organisms between the Lake Pontchartrain-Lake Borgne complex. The hurricane protection project will not affect fish and wildlife resources to any major degree and sport and commercial fish species will not experience extensive losses. Those fish species that have tolerated the increased saline conditions in Lake Pontchartrain may decrease in numbers due to saltwater intrusion control at the Seabrook complex.

(5) All of the marsh and swampland made available by the project for conversion to urban use will be lost when local interests choose to drain and fill these areas. A decrease in release of detrital materials from the leveed marshes will affect the secondary productivity of the Lake Pontchartrain area. Organisms which utilize detritus will decrease in numbers, but this loss will not be extensive.

(6) Environmental changes that will occur at the Chef Menteur and Rigolets construction sites will be the destruction of brackish marsh by the contruction of protection levees, new channels, and control structures. At the Chef Menteur site, 1,656 acres of marshland will be affected. The Rigolets control structure and Rigolets lock will affect 400 acres. Natural channels will be modified and many small channels will be closed and replaced with manmade channels. Navigation through the project area will be diverted to the new navigation

canals. Turbid water conditions with associated silting, due to dredging, pumping, and levee construction, will occur only during construction periods. Unwanted dredge materials will be deposited in spoil-disposal areas and construction materials removed from select borrow areas.

(7) Spoil from the Chef Menteur control channel and navigation channel will be spread over the area bounded by the existing GIWW, the relocated GIWW, and the Chef Menteur Pass. Spoil from the Chef Menteur control channel will be used as levee construction material. Spoil from the new GIWW will be restricted to a 500-foot strip on the Lake Borgne side of the channel. Spoil areas are also provided adjacent to all channels and spoil shall be retained to a minimum distance from the channel.

(8) Fill materials for the construction of the Chef Menteur protection levees and closure dam will be obtained from land within the existing GIWW channel and Chef Menteur Pass and from the bottom of the existing GIWW channel and the Chef Menteur Pass.

(9) Borrow materials for The Rigolets construction site will be obtained from the bottom of Lake Pontchartrain along the north shore and will be used for the construction of levees and for the cover for the closure of the Fort Pike Canal. Sandfill will be removed from The Rigolets channel for use in the construction of The Rigolets channel closure dam and the closure of the Fort Pike Canal.

(10) Historic Fort McComb and Fort Pike will not be affected by the project. Fort Pike is located on the western shoreline of The Rigolets channel and is presently subject to littoral currents. Although current velocities through The Rigolets will increase over those in the natural channel, computations from a computer analysis of two-dimensional flow patterns indicate that current velocities near Fort Pike and the US Highway 90 bridge will decrease slightly rather than increase. The Chalmette National Historical Park in St. Bernard Parish will not be affected by the project.

(11) Beneficial aspects of The Rigolets and Chef Menteur construction on and near the construction area are the formation of ponds for duck hunting and fishing in land area

borrow excavations, and the formation of deep fishing holes by removing borrow materials from the bottom of Lake Pontchartrain and other waterways. Spoil deposit results in higher ground elevations necessary for construction in this area. Higher elevations in spoil areas will lead to the invasion of these areas by trees, shrubs, and other upland plants. This increased elevation with associated vegetation will provide habitat in the form of food, shelter, and breeding sites for upland wildlife including game species. The removing of bottom materials with the formation of deep holes creates desirable fishing spots for croakers, drum, and speckled trout.

(12) Detrimental aspects of The Rigolets and Chef Menteur construction on and near the construction area will be the direct destruction of areas of natural brackish marsh by protection levees, channels, borrow and spoil areas, and the very turbid water conditions that will occur during construction. Navigation through the project area will be diverted to the navigation channel provided by the project because of the closure of small natural canals.

(13) Temporary turbid water conditions during construction will decrease the amount of primary production in the disturbed area by decreasing the light available to phytoplankton and other aquatic plants. Shading and silting will result in the destruction of rooted shoreline vegetation which provides habitats for commercial species and organisms which provide food for commercial species. Silting may result in the direct destruction of bottom organisms including clams, worms, and other important food organisms in the disturbed area.

(14) Construction plans and specifications at The Rigolets and Chef Menteur complexes will include provisions to minimize the accidental spillage of harmful materials and the sanitary disposal of domestic wastes.

(15) The construction of the dual-purpose navigation lock and gated hurricane control structure at Seabrook, the lakeward terminus of the IHNC, would not have any significant impact on surrounding land areas since only 0.15 acre of land will be affected. A navigation lock is necessary because of the hazards of the high current velocities which currently affect IHNC marine users.

(16) The gated control structure at Seabrook will allow the interchange of water, organisms, and nutrient substances between Lake Pontchartrain and the MR-GO. This structure will be closed on the approach of a hurricane to prevent hurricane tides from entering Lake Pontchartrain. The control structure will also serve to provide flood surge relief to industries along the IHNC, to guarantee adequate flow for riparian users along the canal, and to regulate the saline water exchange between the MR-GO and Lake Pontchartrain through the IHNC.

(17) The breakwater, boat launching, and swimming area to the west of the lock site will not be affected by the project. Current velocities near the breakwater will be reduced by the navigation lock and this will enhance boating in this area. Water presently discharged from the canal into Lake Pontchartrain tends to carry the eastward drift of polluted materials from outfall canals in Jefferson Parish and eastern Orleans Parish away from the shoreline and into the open waters of the lake. This produces areas which are free from pollution and always safe for swimming east of the canal. This effect will not exist during times when gates are closed prior to a hurricane.

(18) Since the completion of the MR-GO in 1963, salinities have increased in Lake Pontchartrain. The saline water intrusion coupled with the movements of fishes and other marine organisms from the gulf via the MR-GO has resulted in increased fishing activity in Lake Pontchartrain particularly near the Seabrook area. Increased catches of speckled trout, white trout, sheepshead, flounder, and croaker have been reported by local sports fishermen. These beneficial aspects of more saline waters will be adversely affected if gates are closed in order to prevent saline waters from entering. The increased salinity in Lake Pontchartrain may have produced many undesirable effects. The bottom of Lake Pontchartrain is dominated by *Rangia cuneata*, the common brackish-water clam that inhabits low-salinity estuaries in the gulf states. This clam is of considerable commercial value in Louisiana and neighboring states because the shells are extensively used as fill for construction of roads, as an additive to concrete, and for other industrial purposes. Increased salinities in Lake Pontchartrain may have produced conditions less favorable for the production of this species. Increased salinities may also produce many other long-term changes that are undesirable. Among these would

be the change in streams north of the lake and associated swamps and marshes. An increase in salinity in these areas would possibly kill cypress trees and gradually convert fresh-water marsh to salt marsh.

(19) The pollution along the southern shore of Lake Pontchartrain will not be increased by the barriers at the tidal passes because the control structures are designed with hydraulic characteristics equalling those of the natural passes. The lakeward current from the IHNC near the New Orleans Lakefront Airport tends to carry the eastward drift of pollutants from Jefferson and Orleans Parishes away from shore and into the open waters of the lake. This tends to reduce pollution in metropolitan swimming areas and keeps areas east of the airport safe for swimming at all times. Closure of the gated structure to regulate the inflow of saline waters from the MR-GO will reduce this effect while the structure is closed, but this structure will also limit the lakeward flow of the industrial pollutants from the IHNC.

(20) The destruction of marshes by the construction of levees in some areas along the lakefront will decrease the amount of marsh which produces and releases detritus into Lake Pontchartrain thereby decreasing the amount of secondary production of organic material in Lake Pontchartrain. The levees will protect large areas of marshland which will enable land development and urban expansion.

(21) Lake Pontchartrain has a total of 119 miles of shoreline. Levees are now constructed on 29.2 miles of shore. The project would encompass 5.5 miles of new levee or a 6 percent decrease in existing marsh shoreline. The new levee which would be located in St. Charles Parish, is currently in a deferred status.

(22) The St. Charles Parish area consists of 29,600 acres subject to hurricane flooding from Lake Pontchartrain (see table 47). This area is bounded on the west by the Bonnet Carre' Spillway east guide levee, on the south by the Mississippi River, and on the east by the St. Charles-Jefferson Parish boundary, and on the north by Lake Pontchartrain. This land area is currently afforded no protection from tidal flooding from Lake Pontchartrain.

(23) The construction of a hurricane protection levee along the lakefront in St. Charles Parish would alter the terrain. Total lands and improvements utilized as right-of-way include 916 acres. Essentially, all borrow material required for levee fill would be taken from Lake Pontchartrain by hydraulic dredge. Semicontrolled flow of dredging effluent and temporary turbidity would have an impact on the environment of the construction area. Plant and animal communities in the immediate areas of borrow and effluent would be destroyed. Increased turbidity and disruption of the aquatic habitat during construction would have a temporary and minor effect on the total area flora and fauna.

(24) The esthetic value of the marsh and swamplands in St. Charles Parish would be irretrievably altered after construction of the proposed levee, and the urbanization which will follow.

(25) The Bayou Piquant Drainage Structure would be constructed approximately 600 feet west of Bayou Piquant which is one of the principal natural drainage channels for the area. Records for the period 1962 to 1968 reveal that salinity observations made in the vicinity of the proposed site show chloride concentrations varying from 0.05 to 6 p.p.t. The samples obtained exceeded 1.0 p.p.t. 50 percent of the time. Chloride concentrations in this area of the lake vary according to the volume of freshwater inflow, increasing during periods of drought and decreasing with heavy rain over the basin. Therefore, it is anticipated that the water landside of the gates would be fresh since the structure and connecting levees would curtail the influx of saline water into the project area.

(26) The conversion of aquatic/marsh areas to swamp environment would result in the loss of aquatic/marsh habitats and associated organisms and a gain in swamp organisms. The loss of marsh in St. Charles Parish would result in the conversion of open marsh to cypress-gum-maple swamp.

(27) Plant succession would occur after levee construction with the open marsh being invaded at a more rapid pace by the cypress swamp. The protection levee would not allow extensive tidal overflow of the marsh. Cypress is not tolerant to salinity but has invaded the open marsh since construction of the Illinois Central Railroad embankment in St. Charles Parish

prior to the Civil War. Without the salinity factor, the open marsh would be changed more rapidly into a cypress swamp. This succession would only be temporary since accelerated urban and industrial growth will be stimulated by the project.

(28) The Shell Oil Refinery in Norco, Louisiana, pumps treated waste materials into Bayou Trepagnier which flow into Bayou LaBranche and then into Lake Pontchartrain. A drainage canal south of the levee would allow this material to flow into Lake Pontchartrain at Bayou Piquant instead of Bayou LaBranche. This would result in a greater diffusion of these treated waste materials into surrounding swamps, marshes, and canals instead of the present rapid discharge into Lake Pontchartrain. A 12-acre impoundment area holds water for approximately 3.5 days and a floating aeration pump is utilized in treating effluent. Oil skimming booms are employed before the effluent is passed into Bayou Trepagnier. The Shell Oil Refinery regularly tests the water in Bayou Trepagnier and has noted no detrimental concentrations of materials. At present the effluent has no visible effect on the marsh and swamp habitat.

(29) Shoreline erosion in St. Charles Parish has increased the size of Lake Pontchartrain at the expense of existing marsh and swamp. Construction of the St. Charles Parish levee would reduce this erosion, but it would also directly lead to the elimination and permanent alteration of the lands protected from erosion.

(30) Nutrient flow composed of decayed organic matter would be somewhat restricted by the proposed levee to flow readily from the marsh into Lake Pontchartrain during normal high tides. Limited nutrient flow from the marsh would be allowed to drain into Lake Pontchartrain at the drainage structure at Bayou Piquant. The levee system would completely eliminate the broad interface between the marsh and the lake which is important to nutrient and organisms interchange in both directions. The canal and drainage structure would provide opportunity for limited tidal overflow of the marsh, but only until local interests choose to install a pumping station to drain the area.

(31) Provisions relative to water quality degradation during construction, control of accidental spillages, and maintenance of adequate sanitary facilities by construction

contractors would be incorporated into the construction plans and specifications. Trees, shrubs, and grasses would be planted on a special landside planting berm adjacent to the levee.

(32) The weedy vegetation on the Bonnet Carre' Spillway east guide levee would be destroyed with enlargement of the levee 500 feet south of Lake Pontchartrain. Dallis grass, smut grass, Santa Maria, pigweed and mimosa are common components of the levee in this area. The levee has been disturbed by activities of man and new weed species would appear on the raised levee.

(33) Approximately 24,770 of the total 29,600 acres in the St. Charles Parish area are now marsh and swamp. Only 1,370 acres are currently developed for residential, commercial, and industrial use. Construction of the levee along the lakeshore would permit development of this large inland marsh and swamp area for urban uses. Several thousand jobs would be created by the construction industry during the development period.

(34) Two streams in the St. Charles Parish Area have recently been added to the Natural and Scenic River System of Louisiana. Construction of the St. Charles Parish levee, as currently planned, would involve alteration of either or both of these bayous. Because this would contravene state law, this feature of the project is currently in a deferred status.

(35) The Jefferson Parish area consists of 21,500 acres which are subject to hurricane flooding from Lake Pontchartrain. This area has experienced a rapid growth since about 1946 and its steady growth will continue. The existing levee will be adequate with construction of the barrier structures. No acreage for lands and improvements utilized as right-of-way will be required. No environmental changes are anticipated in this area.

(36) About 65 percent of the Orleans Parish area, or 16,800 acres, between the IHNC and the Orleans-Jefferson parish line is subject to inundation. Lands and improvements required for project right-of-way include about 20 additional acres. The area is presently protected on the east and west by levees and on the north by a seawall and back levee. Enlargement of the levee along the lakeshore and construction of a

floodwall along the IHNC will protect this area from flooding. Approximately 55 acres of lands and improvements are required for right-of-way along the IHNC. Essentially all of this feature area is developed with streets and utilities and about 95 percent of the area is occupied with residences and other improvements. Only those areas occupied by the levee and floodwall will be affected. No other environmental changes are expected to occur in this area.

(37) The entire Citrus area, or 14,800 acres, is subject to floodwater inundation. In 1960 about 3,360 acres were developed. Since that time development of residential and commercial facilities has accelerated. The Citrus area is bounded by New Orleans East, the IHNC, the MR-GO, and Lake Pontchartrain.

(38) Rights-of-way required for the Citrus Back Levee include 340 acres. The lakefront levee from the IHNC to Paris Road will require 30 additional acres of lands and improvements for rights-of-way. In the reach from the IHNC to South Point, the New Orleans Lakefront Airport is fronted by a vertical seawall and the Southern Railway embankment extends along the remainder of the south shore for approximately 11.5 miles.

(39) The Citrus area has been drained for over 40 years and afforded a degree of protection by existing levees on the west, south, and east, and by a railroad embankment along Lake Pontchartrain on the north. The Citrus area drains through a system of open canals with pumping stations. The Paris Road and Michoud slip separates this area into two segments, Citrus and New Orleans East.

(40) The terrain along the lakefront will be altered only to the extent that the levee will be built south of the existing railroad embankment. Excavation of lake materials for borrow of the Citrus lakefront levee will cause temporary excessive turbidity and may disrupt sport and commercial fishing and commercial crabbing. No permanent damages are anticipated. Excavation of a hole in the lake bottom normally creates a desirable fishing spot for croakers, drum, and speckled trout. Plant and animal communities in the immediate vicinity of the lakeshore levee will be destroyed.

(41) The improvements of levees along the west and south sides of the Citrus area will not cause appreciable environmental change. Elevation and drainage changes in the immediate area of the levees will support arboreal and shrub vegetation.

(42) The Citrus area is partially protected from tidal overflow. The area south of US Highway 90 in the Citrus area is composed generally of low-lying undeveloped swamp, woodland, and marsh with an average elevation of about 1.5 feet, and is largely undrained. The area north of the highway, drained by pumping for many years, has subsided as much as 9 feet below mean sea level in some areas. The project will change only those areas occupied by levees. No other environmental change is expected.

(43) Levee construction and improvement in the Citrus area along the west and south sides and along the lakeshore will provide protection from flooding by hurricanes. Development patterns within the area will not be altered as a result of the project.

(44) The entire area of New Orleans East, approximately 29,770 acres, is subject to overflow by failure and/or overtopping of the existing protective system. Lands and improvements necessary as rights-of-way for the New Orleans East back levee include 602 acres. The lakefront levee from Paris Road to South Point will require 140 total acres as lands and improvements for rights-of-way. The levee from South Point to the GIWW will require 30 additional acres as lands and improvements for rights-of-way.

(45) Most of the area in New Orleans East is partially drained marsh protected from normal flooding on the south, east, and west by levees along the GIWW and across the marsh, and on the north by the Southern Railway embankment. It is partially protected from tidal overflow and consists of low-lying undeveloped marshland, with an average elevation of about 1.5 feet.

(46) The New Orleans East area has no major drainage system at this time, but plans for the development of an adequate system for the area are well advanced. Some small units are in operation.

(47) The Southern Railway embankment currently prevents detrital flow into Lake Pontchartrain. The proposed levee should have no effect on this environ. Willow thickets will continue to become abundant on the margins of the marsh, and conversion of wetland habitats and associated organisms to terrestrial environments will continue.

(48) Excavation of borrow material from Lake Pontchartrain will result in temporary turbidity which will cause some damage. The submerged aquatic plants which grow in the South Point area between the shoreline and about 6-foot depths are excellent habitat for fish, shrimp, crab, and the food organisms which support these sport and commercial animals. The temporary turbidity caused by the dredging process will shade the bottom so that the desirable vegetation will be destroyed in the disturbed area.

(49) Enlargement of the levees on the south and east of New Orleans East and construction of a levee along the lakeshore on the north will protect the people moving into this area from flooding by hurricanes. Development for residential, commercial, and industrial use will continue, and the rate of development will be somewhat increased.

(50) On the north shore of Lake Pontchartrain, about 600 acres within the town of Mandeville, Louisiana, are subject to overflow. No acreage for lands and improvements utilized as rights-of-way will be needed because of the existing seawall. A vertical seawall with a height of 6.0 feet and a length of 1.5 miles presently protects the town.

(51) Approximately 590 acres are covered by residences and the park behind the seawall and 10 acres are occupied by commercial establishments. The section of the town subject to flooding has been essentially developed for many years and future growth is expected to be moderate.

(52) The Mandeville project plan includes strengthening of the existing seawall throughout its length and repairing deteriorated sections of the wall. The barrier structures will reduce stages in the lake and significantly add to the protection afforded by the seawall. No changes in land use other than normal growth are anticipated.

(53) About 348,000 acres of land outside of the subareas previously described above are subject to overflow. Of this area, 2,025 acres are residential and 95 acres are commercial development, the major part of which is in and near Slidell, Louisiana. Seven thousand six hundred acres are open land, and 338,280 acres are marsh and swamp. Open land is used primarily as range pasture. Substantial residential and commercial growth is indicated for the areas around Slidell. About 5,700 acres of marsh situated between the New Orleans East levee, the shore of Lake Pontchartrain, and Chef Menteur Pass are planned for the so-called Florida-type private development consisting of numerous dredged waterways with the dredged material being utilized as land fill. About 2,400 acres of this area will be residential; 1,900 acres will be commercial and other development; and 1,500 acres will be for industrial use. Developmental patterns will be little altered by the project.

(54) The total Chalmette area in Orleans and St. Bernard Parishes consists of 49,050 acres. In this area, about 17,150 acres of the higher lands along the Mississippi River are protected by a locally built levee with a net grade of 10 to 10.5 feet. Partial protection is afforded the remaining area by a spoilbank with an elevation of approximately 8 feet along the south bank of the MR-GO between the IHNC and Bayou Dupre. The leveed portion of the Chalmette area in St. Bernard Parish, east and west of Paris Road and south to Violet Canal, is drained by pumping stations. From Violet to Verret, runoff is conveyed to the marshes by floodgates. Lands and improvements utilized as right-of-way for this area include 1,865 acres. Five additional acres will be utilized as right-of-way on the IHNC adjoining the Chalmette area. The IHNC floodwall will only affect the immediate area of the existing levee. Yscloskey, Oakdale, Hopedale, and Delacroix Island in St. Bernard Parish are not protected by the project levees.

(55) Alteration of four water and 10 gas pipelines, and four telephone cable crossings will be required along the IHNC. Alteration of 12 gas pipeline crossings and two aerial electric power transmission lines will be required to clear the levee through the remainder of the alinement.

(56) Approximately 5,050 acres of the area currently protected are developed for residential, commercial, or industrial uses. The remaining 12,100 acres of protected area plus 31,900 acres of unprotected land are largely marshes and swamps.

(57) Arboreal and shrub vegetation in the immediate zone of the levee will appear in the marsh areas after construction. This change in elevation will result in cypress and black willow slowly invading the margins of the marsh.

(58) In the Chalmette area within the confines of the protection levees, a minor reduction and restriction of tidal interchange will have an effect on the salinity of the open marshes.

(59) Construction of the proposed Chalmette levee will allow for future installation of pumping facilities and development of the area for urban uses. During the development, several thousand jobs will be created by the construction industry.

(60) The Bayou Bienvenue structure will be constructed about 400 feet north of the bayou and Bayou Dupre structure about 1,700 feet south of Bayou Dupre. Due to the locations of the floodgate structures at Bayou Bienvenue and Bayou Dupre, it will be necessary to relocate the outfall reaches of these two streambeds into the new drainage structures. Initial excavated material will be pumped and wasted out on the MR-GO channel spoil area. Upon completion of the floodgates and access channels, the closure of Bayou Bienvenue and Bayou Dupre will be made. Excess excavation spoil and access channel spoil will be placed in spoil areas adjacent to the structure and new channel.

(61) The floodgates in Bayou Bienvenue and Bayou Dupre will normally remain in the fully open position to permit tidal interchange, provide outlet for drainage flows from the protected area and permit passage of marine traffic on the waterways.

(62) Construction of the gated structures referred to above will result in destruction of plant and animal communities near the two floodgates and near the drainage structure

between Verret and Caernarvon. If there is some delay in opening the gates after a hurricane, increased organic materials and the impounded water level could become a problem.

(63) When a hurricane threatens, the gated structures will be closed to exclude the hurricane surge. An abnormal condition might occur where there would be a reverse head resulting from closure of the gates for hurricane approach with abnormal rainfall ponded within the area, delay in reopening of the gates, and a rapid drop in tide in the MR-GO. In cases such as this, eroding velocities could occur.

(64) Turbidity of surrounding waters will be temporary and floral and faunal communities on and near the construction areas will be adversely affected. Siltation from construction work will destroy rooted aquatic vegetation and may cover and kill many bottom organisms such as clams, worms, and other organisms in the disturbed area. This action will be temporary and should not have far-reached effects on the surrounding communities which will inhabit this area when conditions again become favorable.

(65) Four Indian middens in the project area will be affected by the hurricane protection project. One midden at the junction of the Intracoastal Waterway and MR-GO has been covered with spoil from the MR-GO. This site will be further covered by the Chalmette hurricane protection levee. This site has been previously studied (Gagliano and Saucier, 1963). Three middens in St. Charles Parish would be affected by the protection levee and drainage structure at Bayou Piquant. One site is located east of Bayou LaBranche approximately onefourth of a mile south of the lakeshore and the remaining two sites are at the mouth of Bayou Piquant. These three sites have not been studied by a qualified archeologist.

(66) Table 46 gives acreages of lands affected by the project as rights-of-way.

(67) The anticipated increase in rate of urban development in areas being afforded a higher degree of protection will be accompanied by an increase in quantities of solid and liquid wastes to be disposal of and a corresponding increase in environmental stresses incident to such disposal will occur.

TABLE 46
ACREAGE OF LANDS AFFECTED BY THE PROJECT
AS RIGHT-OF-WAY

	Acres
Chef Menteur	1,656
Rigolets	400
Seabrook	0.15
St. Charles	916
Jefferson	0
Orleans	75
Citrus back levee	340
Citrus lakefront levee	30
New Orleans East lakefront levee	140
New Orleans East back levee	602
New Orleans South Point to GIWW	30
Chalmette	1,865

SECTION 4--ANY PROBABLE ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

4.01 GENERAL

a. Implementation of the project would involve the following types of adverse environmental impacts:

(1) Utilization and commitment of lands and water bottoms for project features.

(2) Conversion of natural habitats, including marshes, swamps, and woods to urban type uses.

(3) Loss of detrital input to the surrounding ecosystem and attendant loss in natural productivity of that ecosystem.

(4) Loss of recreation opportunities.

(5) Loss of esthetic values.

(6) Loss of, or damage to, archeological resources.

(7) Deleterious alterations in water quality.

4.02 ADVERSE IMPACTS

a. Adverse environmental impacts associated with the project are described, on a feature-by-feature basis, in the following paragraphs:

(1) <u>Lake Pontchartrain barrier</u>. Construction, operation, and maintenance of the barrier will require the commitment of 2,056 acres of land in construction rights-of-way and spoil and borrow areas. The lands committed, which are predominantly marsh, will be permanently altered and the alteration will imply a loss of habitat and detrital impact to the associated estuarine ecosystem, and a minor loss in the overall productivity of that system. Since the Seabrook complex will be operated to establish a fresher salinity regimen in Lake Pontchartrain than that which currently exists, there may be a

TABLE 47
TOTAL AMOUNTS AND TYPES OF LANDS AFFECTED BY THE PROJECT ACRES

	Total	Leveed				Unleveed			
		Marsh	Swamp	Water	Other(1)	Marsh	Swamp	Water	Other(1)
St. Charles Parish	29,600					6,600	15,210	2,960	4,830
Jefferson Parish	21,500				21,500				
New Orleans	16,800				16,800				
Citrus	14,800		1,230		13,570				
New Orleans East	22,375	14,009	630	1,265	6,471				
Chalmette	49,050				17,150	16,312	12,386	2,322	880
TOTAL	154,125	14,009	1,860	1,265	75,491	22,912	27,596	5,282	5,710

(1) Other includes: Industrial, residential, commercial, agricultural, and nonswamp wooded lands.

reduction in those species of euryhaline fishes more tolerant of the higher salinities. Construction and maintenance operations will induce temporary increases in turbidity in surrounding water areas, with minor impact on water quality and flora and fauna. The imposition of structures, in particular, the locks and control structures on the existing landscape will alter natural vistas.

(2) St. Charles Parish levee. This feature is currently in a deferred status; however, the adverse impacts associated with its construction are presented herein for information. The major adverse impacts resulting from this feature would derive from the alteration of 24,770 acres of marsh, swamp, and open-water bodies, inclusive of a total of 916 acres of rights-of-way which would be required for construction and maintenance of the levee. The levee would interdict tidal interchange in this area, and establish the base conditions necessary for conversion of the area to urban type uses. The loss of habitat, coupled with the drastic reduction in detrital input to Lake Pontchartrain implies a significant loss in the natural productivity of the estuarine complex associated with Lake Pontchartrain. The natural esthetics of this large area would be permanently altered. Increased turbidity during construction and maintenance of the levee and associated drainage structure would disrupt the aquatic habitat and have temporary and minor effects on flora and fauna. Existing recreational opportunities in the area landward of the levee would be reduced. The area is extensively used for private hunting with 15 clubs having 250 members engaged in hunting ducks, deer, and squirrels. Annually, 18,000 ducks and coots are bagged. The area is extensively fished and crabbed. About 220,000 pelts of nutria, raccoon, mink, and otter are taken in the area each year. These activities would decline rapidly after completion of the levee. Three Indian middens would be affected and require salvage. Two streams in the project area are included in the Natural and Scenic Rivers System of Louisiana - Bayous LaBranche and Trepagnier. Construction of the levee would necessitate closure of Bayou LaBranche near its mouth, and rerouting of drainage flows therein to the outlet structures at Bayou Piquant, substantially altering the flow regimen in both Bayous LaBranche and Trepagnier. The project will result in development in the area and conversion to urban type use. This, in turn, will cause a corresponding increase in environmental stresses associated with such use.

(3) Orleans Parish-West of IHNC. Levee and floodwall construction will require the commitment of 75 acres of developed land-to-project use.

(4) Orleans Parish-Citrus area. Levee and floodwall construction and maintenance will require the commitment of 370 acres of developed land to project use. Construction and maintenance activities will induce temporary increases in turbidity in Lake Pontchartrain, the MR-GO, and the GIWW with attendant minor disruption to sport and commercial fishing and crabbing.

(5) Orleans Parish-New Orleans East. Construction of levees and floodwalls will require the commitment of about 600 acres of leveed marsh for project use. Because tidal interchange in the area has already been interdicted by the existing system of embankment, the implications of this commitment to the overall natural productivity will be nominal. Excavation of borrow material from Lake Pontchartrain and the GIWW will result in temporary increases in turbidity in these water bodies with attendant minor disruption to sport and commercial fishing and crabbing. Provisions of higher degree of hurricane protection as a result of the project will tend to increase the rate of development in this area, engendering a corresponding increase in those environmental stresses associated with urban-type development.

(6) Chalmette area. Construction, operation, and maintenance of the various features of the Chalmette Area Plan will require the commitment of 1,865 acres of lands for project use. Construction of the project will alter the condition of 16,312 acres of swamp and 2,322 acres of open water within the area to be protected. Initially, tidal interchange will be maintained. Conversion to urban-type uses will occur, however, and as it does, habitat will be lost as will detrital input to the associated estuarine ecosystem. These losses will impact adversely on the natural productivity of the estuarine complex. Construction and maintenance activities will induce temporary increases in turbidity in the MR-GO with minor impact on the commercial and sport fishery. Loss in recreational opportunity will result from the loss in natural productivity previously referred to. One Indian midden located south of the junction of the MR-GO and the GIWW already covered with spoil deposits, will be covered with additional spoil. The midden has been studied previously by archeologists.

b. Should the anticipated increase in rate of development in the protected areas occur, an increase in the quantities of solid and liquid wastes cannot be avoided. Disposal of these wastes will be accompanied by corresponding environmental stresses.

SECTION 5--ALTERNATIVES TO THE PROPOSED ACTION

5.01 GENERAL

Alternatives to the proposed action fall into three broad classes as follows:

a. Fully responsive alternatives, or those which would meet all major objectives of the proposed action.

b. Partially responsive alternatives or those which would meet some, but not all, major objectives of the proposed action.

c. No-action.

5.02 ALTERNATIVES

The available alternatives to the proposed action are discussed in the following paragraphs:

a. Lake Pontchartrain Barrier Plan fully responsive alternatives

(1) Combine the Lake Pontchartrain Barrier Plan and the Chalmette Area Plan. (See Figure 4.) Under such a plan, a controlling system of embankments and structures would be provided between Caernarvon and the Lake Pontchartrain barrier west of Chef Menteur Pass. (See map.) This system would include a navigation gate in the MR-GO and a navigation lock in the GIWW. The navigation gate in the MR-GO would be operated in conjunction with the Lake Pontchartrain barrier, i.e., it would be closed only when it was necessary to close the barrier. The plan would permit reduced grades on the existing levee system along the MR-GO and the IHNC since these levees would no longer be required to confine hurricane surges, but only nonhurricane generated high tides. The plan would impede shallow-draft traffic in the GIWW during those periods when currents in the open lock would make passage hazardous or impossible. In addition, the restricted width of the lock would result in some delay to all traffic, even when the lock remained open, since it would be necessary to proceed slowly and with caution when

transiting the open lock. Seagoing traffic in the MR-GO would be interrupted during periods when the barrier was closed. The plan would alter a 8,100-acre tract of prime estuarine marsh located between the western shore of Lake Borgne and the intersection of the MR-GO and the GIWW. Because of its severe impact on navigation, the plan would produce little incremental economic benefit over the proposed action, while the additional costs involved would be substantial - about four times as great as the additional benefits. Beyond this, the plan would have negated any credit to local interests for the substantial expenses incurred by them in improving existing levee systems along the IHNC, MR-GO, and GIWW.

(2) Eliminate the Lake Pontchartrain barrier and modify the levee system to retain the same extent and degree of protection provided by the proposed action. Under this plan, the barrier system would not be constructed and Lake Pontchartrain would remain open to the ingress of tidal surges. The grades of the levees included in the proposed action would be increased and new levee systems along the shores of Lake Pontchartrain would be included to provide protection to unleveed areas equivalent to that which they would receive from the reduction in hurricane stages in Lake Pontchartrain which the barrier would produce. Such a plan would cost on the order of three times as much as the proposed plan without any increase in economic benefits. The environmental disruption attendant to providing the additional levee systems along the shores of Lake Pontchartrain would be of major proportions.

b. Lake Pontchartrain Barrier Plan partially responsive alternatives. The following partial alternatives are available:

(1) High levee plan. Under this plan, the barrier would be eliminated and the grades of the levees included in the proposed plan raised sufficiently to accommodate the higher surge heights in Lake Pontchartrain which would result therefrom. Because of the extreme height of levees required and generally adverse foundation conditions, construction would have to be extended over a very long period of time to prevent failure by excessive subsidence. The high-level plan would be more costly than the recommended barrier plan and, in addition, was strongly opposed by local interests due to esthetic reasons. In addition, the proposed plan would lower the flood stages for all areas around the lake, thus providing some protection to many unleveed areas around the lakeshore.

(2) Eliminate St. Charles Parish levee. Under this alternative, all of the features of the proposed action other than the St. Charles Parish levee would be constructed. The environmental disruption attendant to construction of the levee and alteration of 23,770 acres of marsh and swamp habitat would be avoided. Conversely, the opportunity to develop that marsh and swamp for urban type uses would be foregone. All impacts on those streams included in the Louisiana Natural and Scenic Rivers System, Bayous Trepagnier and LaBranche, would be avoided. As indicated elsewhere herein, the present state of knowledge will not permit a highly definitive determination of the overall impact of the alteration of the large area of marsh and swamp on the associated ecosystem.

(3) Relocate St. Charles Parish levee to vicinity of Airline Highway (US Highway 61). Under this alternative the proposed action would be modified by locating the St. Charles levee from the lakefront to near the Airline Highway. This action would provide protection from tidal flooding to presently developed areas. It would approach the effectiveness of the alternative discussed previously in avoiding adverse environmental impacts. It would greatly reduce the opportunities for additional urban-type development as compared with the proposed action, and would, as a result, lack economic justification. It would eliminate any direct impact on Trepagnier and LaBranche.

(4) Eliminate New Orleans East levees. Unlike St. Charles Parish, the New Orleans East area currently has a substantial degree of protection from tidal flooding, hence the environmental impact of the proposed action in this area would be minor. Elimination of those features of the proposed action intended to increase the protection extant - the New Orleans East lakefront levee, improvements to the New Orleans East back levee, and the South Point to GIWW levee - would avoid the commitments of land necessary for providing those features. It would probably lead to some reduction in the rate of development of the area. It would leave the area subject to massive overflow by major hurricane occurrences, and the development now located therein subject to major hurricane damage.

(5) Eliminate all features of the proposed action except the Lake Pontchartrain barrier. Under this alternative, areas now protected by levees would have increased degrees

of protection. Areas not protected by levees would have increased degrees of protection. Areas not protected by levees would sustain a reduction of the incidence of hurricane overflow. The existing protected areas would remain under a substantial threat of massive overflow by major tidal storms which would cause major damage and probable loss of life: This alternative would, since the barrier involves only minor adverse impacts, approach the alternative of no action in this regard.

c. Chalmette Area Plan fully responsive alternatives. Other than the combined Lake Pontchartrain Barrier-Chalmette Area Plan previously described, there are no practicable alternatives which would meet all of the major objectives of the proposed action.

d. Chalmette Area Plan partially responsive alternatives

(1) Locate the levees to follow alinements of existing levees wherever practicable. This alternative would involve essentially the improvement of existing levee systems from the IHNC to near Caernarvon. It would avoid the potential alteration of 31,000 acres of swamp and estuarine marsh inherent in the proposed action and preserve the contribution that the area makes to the productivity of the associated estuarine ecosystem. Conversely, it would forego the opportunity for converting the area to urban type use.

e. No action. The alternative of no action would preserve, for a time, the existing environmental dynamics of the area. It would leave the area subject to massive overflow from hurricanes, with attendant major economic loss, social disruption, and a potential for extensive loss of human life.

The project area has experienced many severe hurricanes and lesser storms which have caused loss of life and damage to property. Official National Weather Service meteorological records are not available prior to 1893 and most accounts of storms prior to 1893 are obtained from newspapers and historical documents. Because a large portion of the area was relatively uninhabited, it can be assumed that some historical flooding went unobserved.

The project area surrounding Lake Pontchartrain is susceptible to flooding from wind-driven hurricane tides from the lake. This condition is aggravated by increases in lake level resulting from the influx of surges from Lake Borgne and the Gulf of Mexico that accompany hurricanes from the southeast, south, and southwest. Historical hurricanes have produced recorded stages up to 13 feet on the southwest shore of the lake, 6.2 feet on the south shore, 7.1 feet at the southeast shore, and 7.7 feet at the north shore. Overtopping of protective works and flooding of developed areas have occurred several times during recent hurricanes. On several occasions, the marsh area between Lake Pontchartrain and Lake Borgne has been flooded by stages up to 11 feet. Much of the developed area in Orleans and Jefferson Parishes is below lake level, some land being as low as -7 feet, with a considerable portion lower than -2 feet. In some areas, flooding as deep as 16 feet above ground level could result from severe overtopping. Stages attending an SPH would cause overtopping of all existing areas. The pumping system on which removal of all flood waters is dependent would be partially inoperable for an extended period of time. Auxilliary pumping equipment would be required. While the area pumping stations are not designed to handle floodwaters resulting from inundation of the entire area, most stations are designed to operate independently without outside power sources. These stations can be utilized immediately. The inundation would cause enormous damage to private and public property, create serious hazards to life and health, disrupt business and community life, and require immense expenditure of public and private funds for evacuation and subsequent rehabilitation of local residents. The potential for damage and disruption was well demonstrated in September 1965 when Hurricane Betsy passed west of New Orleans. Although this is not the most critical path for a project design hurricane, 18,260 homes and 837 commercial establishments were flooded in the project area, and some 80 persons lost their lives.

Urbanization of the project area would proceed at a reduced pace if the hurricane protection plan were not implemented. The no-action alternative would retard the environmental changes that would, under the proposed action, convert marsh-swamp ecosystems in St. Charles Parish and New Orleans East to urbanization. While the role of New Orleans East area as an important contributor to the associated ecosystem has been effectively negated by existing protective works and development the St. Charles Parish area remains an important part of the large estuarine ecosystem of the Lake Pontchartrain Basin. The marsh-swamp complex which would be irretrievably lost to urbanization through the project, would likely be lost at a lesser rate in any event from expansion of the metropolitan New Orleans area in the future. This will slowly occur in the less densely populated areas regardless of implementation of the hurricane protection project. Landfill through garbage disposal is presently occurring in the St. Charles Parish swamp north of the Airline Highway (US Highway 61). Construction of Interstate 10 through New Orleans East has greatly enhanced the potentials for land development in that area. The increasing population of the New Orleans area is restricted in expansion to the north by Lake Pontchartrain and to the south by the Mississippi River. The inevitable expansion will be to the east and west; namely, New Orleans East and St. Charles Parish.

SECTION 6--THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

6.01 GENERAL

a. The area to which the proposed action is directed is, in many ways, unique. Much of it is, or was, part of what is today the most productive estuarine ecosystem in the conterminous United States. Its terrain, for the most part, is without appreciable relief. In many of its most populous areas, the land lies below the level of the sea - in some locations as much as 7 feet below. Frequently, the level of the river to which this land owes its existence is above the roofs of most of the homes located on it. In many of the most populous areas every drop of rain which appears as runoff must be removed by pumps. It is moreover uniquely vulnerable to tidal surges. On the surface, the existence of a major metropolitan center of 1,075,369 people (1970) with its confines in an anomaly. The anomaly yields only to the knowledge and understanding of an existing complex of flood control and drainage works.

b. In 1712, a French engineer, Blond de la Tour, at the urging of his superiors, the Sieur de Bienville, laid out the first levees in the area to make possible the development of a new city, New Orleans. Since that time, the history of the area has been one of continuing expansion and development, through the provision of flood-control works, without which expansion would have been impossible.

c. The historical consequences, both beneficial and adverse, of the expansion have been documented, the latter more recently than the former. The probable consequences of future expansion, now susceptible of better definition than in the past, nevertheless can only be "dimly perceived, as through a glass."

d. It is within the context of these areas' exquisite vulnerability to flood, its role as host of a major metropolitan center, and its substance as a natural estuarine ecosystem of great value that the relationship between local, short-term uses of man's environment and the maintenance and enhancement of long-term productivity must be assessed.

6.02 THE LAKES

The operation of barriers at The Rigolets and Chef Menteur Passes will not modify the long-term productivity in Lakes Pontchartrain and Maurepas, nor in Lake Borgne and its associated estuarine ecosystem. The operation of the barrier at Seabrook will enhance long-term productivity in Lake Pontchartrain by increasing its viability as a nursery area in the form of improved nursery area. This enhancement will be accompanied by some reduction in harvest in the lake but, on balance, will substantially augment the productivity of the total estuarine complex in southeast Louisiana and Mississippi Sound.

6.03 THE UNLEVEED AREAS

The areas around the lakes which remain unleveed will remain subject to normal tidal flows. They will be partially protected from extreme hurricane tidal overflows which, in most instances, are detrimental to productivity.

6.04 ST. CHARLES PARISH

The leveeing of St. Charles Parish would enhance the area for long-term human occupation. This enhancement would be at the expense of long-term productivity by reason of the destruction of the nursery and production of aquatic resources in the swamps and marshes which would be drained. The total long-term productivity of Lake Pontchartrain and the associated estuarine ecosystem would be deprived of the input of detritus from the St. Charles Parish swamps and marshes with indeterminate impact on the productivity of that system.

6.05 JEFFERSON, ORLEANS, AND CITRUS AREAS

These areas would be enhanced for long-term human occupation with no additional costs to the natural long-term productivity.

6.06 NEW ORLEANS EAST

This area is partially protected and partially drained, no longer sustaining tidal interchange. While portions of the area remain seminatural marshes, the long-term productivity of the entire area has been substantially foreclosed by the existing level of protection. Conversion of the area to human occupation will likely continue either with implementation of the profound actions or construction of internal levees and the provision of improved drainage by others. The completion of the project will, however, tend to accelerate urban development and will likely result in an increase in the rate at which the remaining natural production of the area is lost. Conversely, the long-term urban use of the area will be enhanced.

6.07 CHALMETTE AREA

The completion of this unit of the project will improve the presently leveed and drained area for human occupation and safety. The undrained area within the hurricane protection levee will remain at its present level of productivity until such time as it is drained, or filled and developed. This development will be dependent upon a complex of interrelated factors including, but not limited to, demographic pressures, economic decisions by private owners, the policies of the local governing bodies, and the laws and rules, local, state, and Federal, governing development of wetlands at the time development is proposed. The Chalmette Area Plan will not, in itself, make development practicable, but will establish a milieu within which the practicability of development will be greatly increased. The project thus will favor long-term intensive use of the area, and the short-term gains inherent in such use, at the expense of a decline in long-term natural productivity.

SECTION 7--ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

7.01 GENERAL

The commitments of resources will involve several forms and degrees of irreversible and irretrievable implications.

a. The commitment of marsh and swampland to levee and closure structures is irreversible and irretrievable. Approximately 5,265 acres will be used for construction of the project features.

b. The esthetic appeal and hunting and trapping now provided by the area to be converted to hurricane protection structures will be permanently lost.

c. Four archeological sites within the rights-of-way will be covered and may be damaged. Three sites are located in St. Charles Parish. The middens along the St. Charles Parish lakeshore have not been studied. The midden site near the MR-GO and GIWW has been investigated, but currently is covered with spoil from the MR-GO channel. These losses are not permanent since future excavation and salvage remain a possibility.

d. Lake Pontchartrain is a part of the total interrelated estuarine complex in southeastern Louisiana. All of the lake affords nursery habitat for marine fishes and the upper portion is of exceptional importance. Several species utilizing the nursery habitat provide forage for desirable game and commercial fishes and contribute to the sport and commercial fisheries, not only within the lake, but also in a much larger area along the gulf coast. The maintenance of the nursery habitat and harvestable fish populations are dependent on the preservation on some reduction in the existing salinity gradient in Lake Pontchartrain.

e. The construction of levees along the St. Charles Parish shoreline of Lake Pontchartrain would decrease the flow of detritus into the lake. This loss will constitute a permanent decrease in the amount of secondary production in the lake.

f. The filling of marsh and swampland for construction of levees, control structures, navigable floodgates, and drainage structures will result in permanent loss of aquatic habitat for aquatic organisms.

g. In the Chalmette Area Plan, conditions favoring conversion of land to intensive type areas will be established as a result of the proposed action, resulting in probable progressive irreversible commitment of natural estuarine habitat to such use. While, many of the commitments would likely occur in the absence of the proposed action, that action will nevertheless increase the likelihood and the rate of occurrence of such development.

h. The natural resources such as fuel and building materials, and the human effort expended in implementing the proposed action will be irreversible.

SECTION 8--COORDINATION WITH OTHERS

8.01 PUBLIC MEETINGS

A formal public meeting was held by the Corps of Engineers in New Orleans, Louisiana, on 13 March 1956. Subsequently, and continuing through the present time, the Corps of Engineers has participated in numerous public affairs of various types at which project purposes, features and effects, and impacts have been exposed to widespread public scrutiny and analysis.

8.02 CITIZEN GROUPS

a. Letters from the St. Charles Parish Environmental Council express the opinion that the levee will result eventually in the loss of wildlife habitat and recreational hunting.

b. St. Tammany Parish interests maintain that structures at the natural passes of the Chef Menteur and The Rigolets will alter the ecology of Lake Pontchartrain. They feel that the structures will ultimately form a "dead" lake. Mandeville interests favor a new seawall instead of strengthening of the existing structure.

c. Two private environmental agencies oppose levee construction in St. Charles Parish and New Orleans East. Population densities in these areas are low and the agencies feel that publicly subsidized destruction of marshland ecosystems is not now in the public interest.

8.03 GOVERNMENT AGENCIES

The draft environmental statement was sent to the following governmental agencies requesting their views and comments. Their comments are summarized below and copies of the replies are attached to the environmental statement.

a. <u>US DEPARTMENT OF THE INTERIOR, ASSISTANT SECRETARY-PROGRAM POLICY</u>.

<u>Comment</u>: A paragraph should be added to explain the proposed operating schedules of the control structures.

<u>Response</u>: This information has been incorporated into the final statement in Section 1, Project Description.

<u>Comment</u>: The final statement should indicate evidence of consultation with the State Liaison Officer appointed by the Governor for possible properties on the National Register of Historic Places and for additional archeological values that may be involved.

Response: A draft statement was sent to this agency and no response has been received.

Comment: The statement should indicate that invasion of open marshes in St. Charles Parish by cypress will only be temporary since accelerated urban and industrial growth will be stimulated by the project.

Response: This information has been incorporated into the final statement in Section 3.

Comment: The statement erroneously indicates that the barrier system is beneficial to natural resources. The viability of marshes and lowlands is not destroyed by natural periodic extremes such as hurricanes and tidal surges. There is an inherent capacity for rejuvenation under natural conditions. However, the inevitable urban and industrial growth which will accrue with the levee system in place will eradicate fish and wildlife habitat.

Response: Except for the Seabrook lock feature, the barrier system will result in no significant change in the existing ecological regimen. The Seabrook lock will provide the means for establishing a salinity regimen in Lake Pontchartrain which will be more nearly optimum with respect to overall biological productivity. It is true that the overall project will result in the destruction of habitat for fish and wildlife, and the magnitude and consequences of such destruction are discussed in this statement.

Comment: The statement should include more conclusive evidence that the gated-control structure will not interfere with normal movements of aquatic organisms. The possible preclusion of migrating young and larval organisms is an extremely important consideration. The statement should discuss the currents which will be produced by the 76 percent cross sectional reduction of the Chef Menteur and Rigolets Passes and their significance to migrating organisms.

Response: Except for infrequent brief periods when approach and/or passage of a hurricane requires closure of the barrier structures, the only significant change in flow patterns in The Rigolets and Chef Menteur Passes which will be induced by the structures will be in the immediate vicinity of the structures and their associated transition channels, where flow velocities will be increased over those obtaining generally in the passes proper. Conditions elsewhere will remain the same and the cyclical reversals in flow induced by tidal action will continue to occur as they do now.

In the larval or very young stage, migrating species move with the flow, hence, the impact of the barrier structures on such organisms will be limited to increasing the rate at which they traverse a very small reach of the passes involved. Neither this effect, nor the interruption of flow occasioned by operation of the structures to prevent ingress of tidal surges will have any appreciable effect on the life patterns of larvae and very young migrating specimens.

More mature specimens will be subject to having their transits of the passes interrupted during periods of closure, and for the less mobile of these, during periods when velocities through the structures are too high for them to swim against, as well. Given the cyclical reversals of flow which will continue to occur, the delays involved have no significant implications insofar as these specimens are concerned.

Comment: The barrier plan which will reduce marshland erosion will also directly lead to the elimination of thousands of acres of marshland [in St. Charles Parish].

Response: The commitments of marshland to other uses as a result of the overall project, in St. Charles Parish and elsewhere, are discussed in Sections III, IV, VI, and VII of this final statement.

Comment: The exchange of nutrients is not adequately discussed. The levee system [in St. Charles Parish] will completely eliminate the broad interface between the marsh and the lake which is important to nutrient and organisms interchange in both directions. Further, the stated purpose of the drainage canal and structure in the St. Charles Parish levee does not coincide with the purpose indicated on page 13 of the draft statement.

Response: The interruption of nutrient exchange is noted in this final statement (Section III). The discrepancy between statements concerning the St. Charles Parish levee has been corrected.

Comment: The statement should specifically identify and quantify the additional acreages of the various types of natural habitat which will eventually be lost as a result of project implementation. The wetland wildlife habitat types should be classified in accordance with the US Fish and Wildlife's Circular 39, "Wetlands of the United States," dated 1956, reissued 1971.

Response: This information has been incorporated into this final statement in Section 4.

Comment: The importance of marshes and shallow water areas are not limited to coastal species. Estuaries are utilized by the entire spectrum of organisms from freshwater species to those considered entirely oceanic. This should be recognized in the statement.

Response: This information has been included in this final statement in Section IV.

Comment: A more thorough explanation is needed as to how the added cost of the St. Charles Parish lakefront levee can be justified if environmental factors are given equal consideration as provided by the National Environmental Policy Act.

Response: The St. Charles Parish levee portion of the project has been deferred. One of the reasons for deferral was the judgment that the existing informational base was insufficient to permit evaluation of the environmental factors to the level of confidence considered necessary.

Comment: The draft statement states, "Other than the total present effect of levee construction, the environmental effects of the proposed project will be identical with alternate plans except for the temporary effects due to method of construction." We believe this is incorrect. The natural environment will suffer much more if the St. Charles Parish lakefront levee is constructed than if it is not included in the plans.

Response: Section V has been extensively revised, and the referenced verbage deleted.

Comment: The statement recognized that the project will stimulate urbanization of the entire area. Therefore, problems which will accrue as a result of urbanization should be discussed; e.g., future domestic and industrialized pollution.

Response: A discussion of these effects has been included in the final statement in Section VI, The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

b. US DEPARTMENT OF COMMERCE, THE ASSISTANT SECRETARY OF COMMERCE.

Comment: Without the benefit-cost study, it is unknown what cost was attributed to the loss of marshland due to the project and additional loss of wetlands from accelerated urbanization.

Response: In the economic analysis made for the project, changed land use is reflected by changes in the economic value of land expected to accrue as a result of the project. This environmental statement identifies in physical terms, the land commitments which will be required as a result of the construction of project features, and those changes in land use likely to be induced by the project. Dollar values for such commitments are not included in the benefit-cost analyses. It is appropriate to observe that this did not preclude a judgment against proceeding with the St. Charles levee portion of the project.

Comment: Since the project will encourage urbanization, what will the cost be from a larger than designed hurricane?

Response: Flood damage data from experienced hurricanes are of little value in estimating future probable damages from major hurricanes approaching or exceeding the SPH for several reasons. Rapid development makes obsolete all but the most recent data. Partial protective works are effective against the moderate hurricanes of the past 20 years. Thus, hurricanes of magnitude somewhat larger than those of recent experience and exceeding the SPH occurring under present conditions of protection and development would cause damage of catastrophic proportions. The nature of damages within the area of overflow in the New Orleans District from Hurricane Camille in August 1969 ranged from devastative in lower Plaquemines Parish to nominal in some of the other protected areas. Nearly all of the region's economy suffered some damage and the total economic loss within the overflow area from Camille reached almost $200 million. Federal projects operated to prevent approximately $180 million in additional damage. Primary purpose of the project is to afford flood protection to existing improvements as well as to future developments that would occur in the absence of the project. There is no hesitancy on the part of local inhabitants about constructing improvements in any of the existing leveed areas. The project has been designed to afford complete protection from the occurrence of the largest probable storm (SPH) that can reasonably be expected in the region. In the unlikely event that a larger hurricane does occur, the system will not fail; flooding of only minor significance will occur in the lowest-lying areas. Losses attending such an event would be relatively minor. Probability of occurrence of hurricanes having a greater magnitude than the SPH are too remote to warrant practical consideration.

Comment: What is the design life of the project?

Response: The design life of this project is 100 years.

Comment: Have weather modifications been considered?

Response: While weather modification studies are being actively pursued on several fronts, there is no reason to anticipate that weather modification will comprise a workable solution to the prevention of hurricane flooding within a foreseeable timeframe. The technical and institutional problems incident to weather modification are of enormous scope and magnitude, and the deferral of structural measures to provide protection to this highly developed area on the assumption that weather modification will someday serve the problem would be irresponsible in the extreme.

Comment: Notes that the summary statement which indicates that "The barrier will not modify the salinity regimen or ecology of the Lake Pontchartrain area and fishery values will undergo little or no change" is both contradictory and inexplicable. Reasoning and basic data supporting this statement should be provided.

Response: Extensive model and office studies have established that the barrier structures in The Rigolets and Chef Menteur Passes will engender no material change in the flow and salinity regimen of Lake Pontchartrain. The Seabrook complex will make it possible to manage the salinity regimen in Lake Pontchartrain to enhance the productivity in the fish and wildlife resource. The summary has been revised to more accurately reflect this.

Comment: The ecological impacts of each alternative should also be determined for comparison with the selected plan.

Response: Such information has been incorporated into the statement in Section V, Alternatives to the Proposed Action.

c. US DEPARTMENT OF TRANSPORTATION, BUREAU OF PUBLIC ROADS.

No comments received.

d. US DEPARTMENT OF TRANSPORTATION, COAST GUARD.

No comments received.

e. US DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE.

Comment: We have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Response: Receipt and consideration of the comment are acknowledged.

f. ENVIRONMENTAL PROTECTION AGENCY.

Comment: The material presented in this section, Environmental Setting Without the Project, was excellent and provided an indepth biological analysis of the project area.

Response: Receipt and consideration of the comment are acknowledged.

Comment: An additional paragraph could be added in Section III on the overall environmental impacts of the project on sport and commercial fish species.

Response: A paragraph incorporating such information has been inserted on the overall environmental impacts of the project on sport and commercial fish species in Section III.

Comment: A qualifying sentence could be added explaining that results from the model study may not necessarily be accurate when applied to the large-scale natural environmental setting of the project area.

Response: The model was equipped with necessary appurtenances for the accurate reproduction and measurement of tides, tidal currents, salinity intrusion, freshwater inflow, and other significant prototype phenomena. The purpose of the model study was to determine the effects of gated structures--component parts of a proposed hurricane surge barrier system for the protection of New Orleans--in Chef Menteur, Rigolets, and the IHNC and of the MR-GO channel on the salinity and hydraulic regimens of Lake Pontchartrain, its connecting waterways, and connected lakes. Model verification tests indicated that the model hydraulic and salinity regimens were in satisfactory agreement with those of the prototype for comparable conditions.

g. ADVISORY COUNCIL ON HISTORIC PRESERVATION.

No comments received.

h. STATE OF LOUISIANA, DEPARTMENT OF PUBLIC WORKS.

Comment: It should be pointed out that Yscloskey, Oakdale, and Delacroix Island in St. Bernard Parish are not protected by the project levees.

Response: Concur. This information has been incorporated into the statement in Section III.

Comment: The statement is made that "The levees on the south and east of the New Orleans East Area and along side the lakeshore will protect people moving into the area from hurricane flooding." This does not present a true picture since hurricane water levels in Lake Pontchartrain will be on the order of +6.0 MSL along this area as a result of return winds after passage of a hurricane. These levels will be experienced in the lake even though hurricane tides are kept out by the Rigolets' and Chef's structures."

Response: The levees referred to will provide protection from hurricane overflow to that area bounded by Paris Road, Lake Pontchartrain, the South Point to GIWW levee, and the levee along the GIWW from Paris Road eastward. This area is, for project purposes, called New Orleans East. It is true that areas to the east lying landward of the barrier system, will remain subject to inundation from the waters of Lake Pontchartrain. The overflow hazard to these areas, will, however, be reduced. The state of the art, at this time, is such that a high level of confidence is achieved in model studies, and it is reasonable to assume that the model results are accurate within acceptable limits.

Comment: The statement is made that "East of Paris Road runoff is conveyed to the marshes by floodgates." This statement is incorrect inasmuch as the area east of Paris Road to Bayou Dupre or Violet Canal is drained by pumping stations. The area east of Violet Canal, however, is conveyed to the marshes by floodgates.

Response: The statement has been revised for this correction in Section III.

Comment: Hearsay statements are recorded as being voiced by hunting club members that certain adverse impacts will result from construction of the levee in St. Charles Parish. The DPW objects to this type hearsay statement being included in your environmental statement since such remarks are not based on factual data presented in the report.

Response: The information in the statement purported to reflect the views of hunting club members in St. Charles Parish is based on letters from such members on file in our office.

Comment: The statement is made that the pumping systems would be inoperable for extended periods of time following inundation of the area by a hurricane. While the area pumping stations are not designed to handle floodwaters resulting from inundation of the entire area, most stations are designed to operate independently without outside power sources. These stations can be utilized immediately.

Response: The statement has been revised to reflect the above information.

i. LOUISIANA STATE PARKS AND RECREATION COMMISSION.

Comment: No comment at this time.

j. STATE OF LOUISIANA, DEPARTMENT OF HEALTH.

No comments received.

k. LOUISIANA WILD LIFE AND FISHERIES COMMISSION.

Comment: In the opening summary statements, the paragraph states "The barrier will not modify the salinity regimen or ecology... little or no change." In the same paragraph the following sentence appears "Restriction of tidal overflow...will have an effect on the salinity of the open marshes." This seems to be contradictory.

Response: The barrier levees and the control structures at The Rigolets and Chef Menteur Passes will have immaterial effect on the salinity regimen. The Seabrook complex will provide a means for establishing a salinity regimen in Lake Pontchartrain more favorable to overall biological productivity than that which now exists. The enlargement and strengthening of existing protective works will have little impact on the fishery resources. Where land use conversions are expected to occur as new levees are built, as a result of the project, however, as in St. Charles Parish, the loss of estuarine marsh and swamp will impact unfavorably upon the fish and wildlife resource. The summary in this final statement has been revised to reflect the above.

Comment: It is asserted that a decrease in the amount of secondary production of organic material will occur. If detritus produced by marshes are prevented from reaching open waters then most certainly the effects will be reflected in fishing values since marshes are the primary producers.

Response: Concur.

Comment: The most desirable fishing spots are located near raised portions of the bottom.

Response: Different fish species seek different habitats. The conditions mentioned in your letter are natural, whereas the deep-fishing holes mentioned in the statement are manmade. During winter, many fishes seek the warmer areas which generally are deepwater holes. Fine winter sport fishing areas in cold weather are noted when fish seek deeper water which exceeds 30 feet in spots (George A. Rounsefell, 1963. Realism in the Management of Estuaries, Marine Resources Bulletin No. 1, Alabama Marine Resources Laboratory).

Comment: With the advent of lower salinities, from construction of a lock at Seabrook, it is doubtful that any of the species alluded to in the draft will inhabit that area.

Response: The availability of sufficient flow to meet the regimen agreed to by fish and wildlife interests and NOPSI will be insured by the gated outlet structure at the Seabrook Complex. The gates will be regulated to satisfy any flow requirements as would be necessary to satisfy these purposes. Extensive model investigations were conducted in connection with the preauthorization studies to determine the salinity regimen that would result with the overall project in place. Subsequent to project authorization, extensive additional coordination concerning operation of the Seabrook complex for salinity control and canal flow for riparian needs was accomplished. The controlling criterion for operating the Seabrook Complex will be optimization of the basic biological productivity of Lake Pontchartrain.

Comment: If the lock at Seabrook is functional, the higher saline waters will enter Lake Borgne thus affecting the oyster industry which already is suffering from saltwater intrusion.

Response: The gated structure is a separate feature of the Seabrook lock which is designed to control salinity flow into Lake Pontchartrain via the MR-GO. Model studies revealed that complete closure of all structures during a 2-week hurricane period, with the accompanying increase in freshwater flow into the system, resulted in a maximum reduction in salinity of 12 percent in Lake Pontchartrain and of 4 percent in Lake Borgne; the reductions were only temporary and the salinity of the lakes had returned to normal within 11 weeks in Lake Pontchartrain and within 1 week in Lake Borgne. The gates will be regulated to satisfy any flow requirements as would be necessary to satisfy riparian users located along the IHNC and the US Fish and Wildlife Service requested flow regimen. The Federal and state fish and wildlife agencies (letters dated 7 June 1967 and 2 May 1967, respectively) have approved the salinity regimen developed in the model studies for operation of the authorized Seabrook lock with all gates fully open on a continuous basis.

Comment: If the control locks are used to manage salinity in Lake Pontchartrain, the locks would have to be closed longer than stated in the draft. Keeping the locks closed would hurt passage of boats and we find that wildlife and fish have the lowest priority in regulation of control structures.

Response: The general plan for the Seabrook lock unit of the project is composed of three basic components: the navigation lock, the rock and shell dam, and the outlet structure through the dam. This unit will contribute the desired lake salinity control and hurricane barrier capability, consistent with related riparian concerns, and will eliminate excessive current velocity for safe passage between Lake Pontchartrain and the IHNC. The outlet structure will be capable of controlling salinities at the request of US and state fish and wildlife agencies.

Comment: We maintain that the public would be better served by dredging spoil for construction of levees on the inside of the proposed levees. Prompt pumping operations would rid the communities of excess water if collection of excess water were accomplished near the levees. These back levee canals would provide recreational opportunities to the public not afforded otherwise. In heavily populated areas, the back levee canal approach would be difficult since it would involve relocation of a number of homes but in the underdeveloped areas (which are in the majority) this alternative seems worthy of exploration. If the purpose of this project is to provide for protection of life and property against flooding caused by hurricanes, then levee construction would be reduced because vast amounts of area enclosed for protection are uninhabited. But, if this project was designed to protect areas of very low population densities and to hasten urbanization and industrialization of valuable marsh and swampland, then the back levee canals and levees would provide a buffer zone to preserve the remaining portion of our aquatic, marsh, and swamp from these same forces.

Response: The project levees have been planned to accord as closely as possible with existing and probable future drainage patterns in the areas involved. Borrow for levees is generally to be taken from adjacent waterbodies where suitable material is available and lesser environmental impact is likely. As alluded to in the comment, the social and economic costs of using landside borrow would, in some areas, be prohibitive. In almost all cases, use of landside borrow would involve serious technical difficulties and/or exorbitant costs.

Comment: It is probable that a hurricane comparable to the fury of Camille would top even the most elevated levees. In which case, destruction of life and property would be eminent despite man's most elaborately constructed devices.

Response: The project is designed to protect against the "standard project hurricane" moving on the most critical track. Only a combination of hydrologic and meteorologic circumstances anomalous to the region could produce higher stages. The probability of such a combination occurring is, for all practical purposes, nil.

Comment: The construction of new levees along the south shore of Lake Pontchartrain from Bonnet Carre' Spillway to its junction with the levee bordering the Intracoastal in the Chef Menteur Pass region is not necessary, if the levee from that junction to Apple Pie Ridge is purposeful. This amounts to double jeopardy--destruction of large areas of primary producing organic material for the protection of an area that is already protected.

Response: Of the levee systems described, only that portion fronting St. Charles Parish would result in the loss of detrital production. A decision or a future course of action with respect to that levee has been deferred. It should be observed that the implication, in the comment, that construction of the barrier levee to Apple Pie Ridge would obviate the need for the lakefront levees is erroneous.

Comment: In our opinion, locks and levees at Seabrook, Chef Menteur Pass, and Rigolets could be constructed so as to prevent large scale destruction by hurricane floodwaters without the use of the levee along the south shore of Lake Pontchartrain and that portion bordering New Orleans East.

Response: Your opinion is noted, but based on the exhaustive studies made for the project, we cannot agree. The barrier above cannot reduce stages sufficiently to obviate the need for lakefront protection levees.

Comment: We agree that the project will (1) decrease the amount of secondary (we inject, primary) production of organic material into associated bodies of water by destruction of salt and fresh water marsh and swamp, (2) have an effect (we add, adverse) on the salinity of the open marshes, and (3) decrease the acreage of total marsh by 5,265 acres and thereby eliminating fishery production in the area.

Response: Only that portion of marsh in St. Charles Parish would result in the loss of primary production. Insofar as other marshes are concerned, as pointed out in section VI, the operation of the Seabrook Structure will reduce salinities in Lake Pontchartrain. This will result in reduction of salinities in marshland connected to the lake. There will be no change in waters in the MR-GO or Lake Borgne or therefore in the marshes surrounding these waterbodies. The loss of 5,265 acres of marsh for project structures is not unusual for a project of this scope.

Comment: We agree that the project will hasten urbanization and industrialization of valuable marsh and swampland and that urbanization of the project-affected area would proceed at a much reduced pace if the hurricane protection plan were not implemented, but assert that if a supplemental plan whereby that portion of levee from the Chef area to Apple Pie Ridge were enlarged to prevent hurricane tides or surges from entering Lake Pontchartrain, the same purpose would be served--at much less environmental destruction.

Response: The purpose of the structures at Chef Menteur and Rigolets will be to prevent hurricane surge tides from entering Lake Pontchartrain. From an economic viewpoint the high-level levee plan would be much more costly than the selected plan. Levees in the New Orleans area would have to be raised to the high-level plan if the Chef Menteur and Rigolets plans were eliminated. The high-level plan would require moving people from permanent residences.

Comment: We do not agree that the project will affect fishery values with little or no change.

Response: The barrier levees and the control structures at The Rigolets and Chef Menteur Passes will have immaterial effect on the salinity regimen. The Seabrook Complex will provide a means for establishing a salinity regimen in Lake Pontchartrain more favorable to overall biological productivity than that which now exists. The enlargement and strengthening of existing protective works will have little impact on the fishery resources. Where land use conversions are espected to occur as new levees are built, as a result of the project however, as in St. Charles Parish, the loss of estuarine marsh and swamp will impact unfavorably upon the fish and wildlife resource. The summary in this final statement has been revised to reflect the above.

Comment: We do not agree that the project will render a beneficial service by filling of underdeveloped marshland with spoil.

Response: Whether filling a marsh is beneficial depends upon its intended use. We agree that the verbage in the draft statement was far too inprecise and have revised it in this final statement.

Comment: We do not agree that the project will create desirable fishing spots.

Response: As stated before, the deep holes will be favorable places for various fish species especially during winter. It is well known locally that the deep holes along the shore in Lake Pontchartrain were very productive. These areas were dug to build the existing Jefferson Parish hurricane protection levee. Also, the deep holes near the Seabrook bridge and the Lakefront Airport attract many local fishermen.

Comment: We do not agree that the project will control salinities--it will change them.

Response: Salinities have increased in Lake Pontchartrain since construction of the MR-GO. The gated structure at Seabrook will regulate salinity and the structures at Chef Menteur and Rigolets will not alter the salinity regimen of surrounding waters. The model studies in Vicksburg, Mississippi, have indicated that the control structures will not materially affect the existing salinity gradient in Lake Pontchartrain.

Comment: We do not agree that the project will provide necessary conditions so that flooding will no longer occur in the marshes and lowlands protected by this project.

Response: The proposed project will prevent massive tidal inundation of the project area. In many areas, additional drainage facilities will be required to prevent overflow by ponded runoff.

Comment: The development of these marshes, wetlands and estuaries for urban development cannot be included as a beneficial aspect of the plan as far as environment is concerned.

Response: Concur, insofar as the comment refers to the "natural environment." However, the amenities of urban development, under certain conditions, represent a beneficial aspect of man's environment.

Comment: A benefit-cost ratio of 11.5 to 1 is given for the project, but this is not documented. We would like to see values assigned to the loss of marshes, wetlands, and estuaries.

Response: A summary of economic data for the project is attached to this final statement.

Comment: It is suggested that the several alternatives be fully explored and examined before implementation of the hurricane protection project.

Response: The alternatives considered are described and evaluated in Section V of the final statement.

Comment: Definitions of marsh and swamp appear to be incomplete.

Response: Appropriate revisions have been made in Section II of this final statement.

Comment: The statement about an oyster industry in Lake Pontchartrain is correct, but not because the oyster is not present in commercial numbers. The oysters are not being harvested at present because it is a sanctuary where commercial operations are prohibited and secondly, the high bacteria count at times prevents marketing those oysters. Both of these prohibitions are in the process of being corrected.

Response: Concur.

Comment: The duck survey conducted by the Louisiana Wild Life and Fisheries Commission shows that this is a very important waterfowl winter habitat with over 600,000 lesser scaup annually in the area, plus many thousands of other species.

Response: Receipt and consideration of the comment are acknowledged.

l. STREAM CONTROL COMMISSION OF LOUISIANA.

No comments received.

m. LOUISIANA DEPARTMENT OF HIGHWAYS.

No comments received.

n. STATE OF LOUISIANA, COMMISSION ON INTERGOVERNMENTAL RELATIONS.

No comments received.

o. STATE OF LOUISIANA, OFFICE OF STATE PLANNING.

No comments received.

p. FLORIDA DISTRICT CLEARINGHOUSE.

No comments received.

q. TECHE DISTRICT CLEARINGHOUSE.

No comments received.

r. REGIONAL PLANNING COMMISSION FOR JEFFERSON, ORLEANS, AND ST. BERNARD PARISHES.

No comments received.

s. CURATOR OF ARCHEOLOGY, LOUISIANA STATE UNIVERSITY.

No comments received.

t. STATE OF LOUISIANA, DEPARTMENT OF CONSERVATION.

No comments received.

u. STATE OF LOUISIANA, REGISTER OF LAND OFFICE.

No comments received.

v. NATIONAL WILDLIFE FEDERATION.

No comments received.

w. LOUISIANA WILDLIFE FEDERATION.

Comment: Comments incorporated with Orleans Audubon Society.

x. LOUISIANA HISTORICAL PRESERVATION AND CULTURAL COMMISSION.

No comments received.

y. MAYOR, CITY OF NEW ORLEANS.

Comment: Finds the statement quite complete setting forth the pros and cons of the environmental effects.

Comment: It is urged that this project be pursued with all deliberate speed, because the benefits to the more than million people in the New Orleans area far outweigh any deleterious effects.

z. MAYOR, CITY OF KENNER.

No comments received.

aa. MAYOR OF MANDEVILLE.

No comments received.

bb. MAYOR OF SLIDELL.

No comments received.

cc. PRESIDENT, JEFFERSON PARISH.

No comments received.

dd. POLICE JURY, ST. BERNARD PARISH.

No comments received.

ee. POLICE JURY, ST. CHARLES PARISH.

Comment: This agency supports the project.

ff. POLICE JURY, ST. JOHN THE BAPTIST PARISH.

No comments received.

gg. POLICE JURY, ST. TAMMANY PARISH.

No comments received.

hh. POLICE JURY, TANGIPAHOA PARISH.

No comments received.

ii. LAKE BORGNE BASIN LEVEE DISTRICT.

Comment: The Board of Commissioners of the Lake Borgne Basin Levee District voted to defer to the Louisiana Department of Public Works to review this statement.

jj. THE BOARD OF LEVEE COMMISSIONERS OF THE ORLEANS LEVEE DISTRICT.

Comment: The levee terminating east of The Rigolets really ends at Prevost Island and not at Apple Pie Ridge.

Response: Highway 90 from Prevost Island to Apple Pie Ridge will be part of the barrier.

kk. PONTCHARTRAIN LEVEE DISTRICT.

No comments received.

ll. BOARD OF COMMISSIONERS OF THE PORT OF NEW ORLEANS.

No comments received.

8.04 GROUPS AND INDIVIDUALS

The draft environmental statement was furnished to the following citizen, environmental or conservation-type groups and/or individuals representing such groups. Their comments are summarized below and copies of the replies are attached.

a. THE DAILY SENTRY-NEWS, SLIDELL, LOUISIANA.

Comment: How much parish funds will be required of St. Tammany?

Response: The costs to be borne by St. Tammany Parish are divided into two separate categories. One of these categories includes only the local share for strengthening and repairing the Mandeville seawall. This cost amounts to 30 percent of the total cost for this work. The secondary category involves the St. Tammany pro rata portion of the barrier complexes; namely, the Chef Menteur Pass, The Rigolets, and Seabrook Complexes. The cost for constructing these works will be borne jointly by the local assuring agencies for Orleans, Jefferson, St. Charles, and St. Tammany Parishes. The local assuring agency for St. Tammany Parish is the St. Tammany Parish Police Jury. The agency designed to coordinate all aspects of local cooperation is the State of Louisiana, Department of Public Works (DPW). The DPW has divided the non-Federal costs of the barrier complexes among the four parishes and each parish is responsible for their pro rata contribution. The St. Tammany pro rata cost would have to be provided by the State of Louisiana.

Comment: Has the Governor of Louisiana executed the contract?

Response: On 8 May 1972, Governor John McKeithen executed the Act of Assurances on behalf of the St. Tammany Parish Police Jury. All matters relating to the St. Tammany Parish cost requirements are coordinated on behalf of the Federal Government by the DPW.

Comment: Have the Corps and the St. Tammany Parish Police Jury been able to agree on this matter?

Response: As of July 1974 no agreement has been reached.

Comment: Will there be hurricane protection for the proposed "Florida-type" private development in St. Tammany? Is there any protection for this area now?

Response: The Florida-type development will derive hurricane protection due to the effect of the barrier. There is no protection from hurricanes afforded this area at present.

Comment: Is protection of the Florida-type development planned for a Corps project in a future FY? Will this proposed low-barrier system help protect this area?

Response: No hurricane protection other than that described above is currently planned for St. Tammany Parish; this, of course, is not to stipulate that some form of protection would not be justified by other studies in the future. The degree of protection afforded these Florida-type developments would depend to a large extent on the elevations of the landfills after settlement, piling support, and thickness of the base slabs on buildings.

Comment: What did your model show in Vicksburg after a SPH would hit the St. Tammany area? Are the "Florida-type sites still above flood tides and will the Slidell area be protected?

Response: The model study which was performed at the Waterways Experiment Station in Vicksburg, Mississippi, was used to design and then verify the hydraulic characteristics and performance of the barrier complexes, and to assure that the ecological character of the lake would not be disrupted by the barrier system. The model was not used to evaluate hurricane conditions.

Comment: What St. Tammany Parish interests feel that the barrier system will eventually form a dead lake. Why are they the only dissention save for some St. Charles Parish hunting club members?

Response: Several private and public interests in St. Tammany Parish have opposed the project. Among the public interests are the Mayor of Slidell, the Slidell City Council, and the St. Tammany Parish Municipal Association. Other letters of opposition have been received from private local citizens.

b. NEW ORLEANS EAST, INC., WHICH INCLUDES INCLOSURE FROM WALLACE-MC HARG-ROBERTS-TODD, LAND PLANNERS FOR THE NEW ORLEANS EAST NEW TOWN-IN-TOWN PROJECT.

Comment: The impounded marsh behind the Southern Railway embankment in New Orleans East is likely to be receiving large amounts of seepage from Lake Pontchartrain.

Response: This suggestion is not compatible with our data.

Comment: Construction of the new levee could impede this seepage and thereby cause the marsh to deteriorate.

Response: It is apparent that there is an exchange of water between the marsh and lake at South Point. A positive exchange of saltwater between the brackish marsh and Lake Pontchartrain in the South Point area would tend to permit this estuarine nursery area to remain intact. The action would also avoid an adverse impact by providing for release of detrital materials and exchange of juvenile and larval forms of marine species.

c. ARTHUR CROWE, DEPARTMENT OF MARINE SCIENCE, LSU.

Comment: We should increase the height of the existing levees and implement levee systems that affect the actual population of New Orleans now, not the projected population area 20 years from now.

Response: This project was formulated basically to protect existing development and future improvements likely to occur even in the absence of the project. The St. Bernard levee was more economical in the project location when compared to other alternative locations. St. Charles Parish is a prime area for a growing population due to its very favorable location. Valid questions have, however, arisen with respect to whether this increment of the project should be constructed, and the St. Charles Parish levee has been deferred in view of the inclusion of Bayous LaBranche and Trepagnier in the Louisiana Natural and Scenic Rivers System.

Comment: An alternative that we have would be not to open these areas to urbanization and industrialization, but to force people to higher ground, for their own good.

Response: Flood plain regulation and authority of local government is an appropriate means of controlling and preventing certain types of development in flood plain areas under certain conditions. In the instant case, such measures are appropriate only in conjunction with the provision of effective means for protecting the lives and property already existing in the area.

d. ECOLOGY CENTER OF LOUISIANA, INC.

No comments received.

e. NEW ORLEANS SIERRA CLUB.

Comment: The Sierra Club opposes those portions of the project which subsidize urban development in presently unoccupied and undeveloped areas. The permanent loss of wetlands and the continuing cost of protecting and maintaining urban development induced by these projects is opposed.

Response: This project was formulated basically to protect existing development and future improvements likely to occur even in the absence of the project. The St. Bernard levee was more economical in the project location when compared to other alternative locations. St. Charles Parish is a prime area for a growing population due to its very favorable location. Valid questions have, however, arisen with respect to whether this increment of the project should be constructed, and the St. Charles Parish levee has been deferred in view of the inclusion of Bayous LaBranche and Trepagnier in the Louisiana Natural and Scenic Rivers System.

Comment: There is no justification for subsidizing these outcomes at public expense. The primary beneficiaries of such development will be landowners and developers, not the general public.

Response: The scope of this project and the diffusion of benefits are so great as to render private development of the project impracticable. The nature of the payout is such that private capital on the scale required would not be available. In the development of projects, the Corps of Engineers does not support private gain at public and environmental expense. As a matter of policy, where project benefits are expected to arise from changes or intensification of land use, ownership of the land involved is analyzed in detail to determine the possibility of "windfall" benefits accruing as a result of project construction. Where this possibility exists, Corps policy requires that special cost sharing be invoked to preclude unwarranted localized individual, or corporate gains. In the project under discussion, the analyses disclosed no basis for anticipating such gains. It should be borne in mind also that not less than 30 percent of all project first costs will ultimately be borne by some local entities. Further, local interests will maintain all project works after completion. Additionally, Corps policy is not to encourage deterioration of the environment but rather to select an optimum plan for meeting needs, and to disclose the nature, extent, and consequences of the "trade-offs" necessary to achieve such a result. Also, enhancements are a relatively small proportion of total benefits on a project-wide basis. These benefits accrue to the general public as well as to landowners.

Comment: The total impact of wetland loss especially to urban development induced by the project is nowhere clearly delineated. Much of it appears not to have been considered in the cost benefit ratio.

Response: In the economic analyses made for the project, changed land use is reflected by changes in the economic value of land expected to accrue as a result of the project. This environmental statement identified in physical terms, the land commitments which will be required as a result of the construction of project features, and those changes in land use likely to be induced by the project. Environmental losses were not evaluated in dollar terms. It is appropriate to observe that the fact that environmental impacts were not evaluated in dollar terms did not preclude a judgment against proceeding with the St. Charles levee portion of the project.

Comment: The increased costs both in urban construction and continuing maintenance are not alluded to.

Response: All costs for constructing, operating, and maintaining the project features were included in the economic analyses performed. The project will not induce any increase in the costs of urban construction and maintenance.

Comment: Alternatives to the project or portions of it are inadequately discussed. The no action alternative needs more attention.

Response: Section V - Alternatives to the Proposed Action, has been extensively revised in this final statement.

Comment: A full analysis will reveal that certain portions of the project should not be constructed.

Response: With the exception of the St. Charles Parish levee, the studies made for this project all support the conclusion that the project is urgently needed, economically sound, and environmentally viable. The St. Charles Parish levee has been deferred in view of the inclusion of Bayous LaBranche and Trepagnier in the Louisiana Natural and Scenic River System.

Comment: Protection of persons and property from hurricane damage is essential to the welfare of the New Orleans area. We support wisely considered measures for this purpose.

Response: Receipt and consideration of the comment is acknowledged.

Comment: The primary benefits claimed for the levees in St. Charles Parish and the New Orleans East area are "land enhancement," which is inconsistent with the public mission of the Corps of Engineers. Promotion of urbanization is not an objective of the flood control program, however popular it may be with local landowners and economic interests.

Response: As indicated previously, construction of the St. Charles Parish levee has been deferred in view of the inclusion of Bayous LaBranche and Trepagnier in the Louisiana Natural and Scenic Rivers System. The justification for the New Orleans East protective works is wholly in providing protection to existing development and future development expected to occur in the absence of the protective works. Further, the New Orleans East area has been effectively divorced from the estuarine system by levee and drainage construction undertaken by local interests more than a decade ago.

Comment: The areas of swamp and marsh in St. Charles Parish and New Orleans East are integral parts of the vast estuarine ecosystem of the coastal region. Public subsidy of the destruction of these ecosystems is not justified.

Response: The St. Charles feature has been deferred and the New Orleans East area is no longer estuarine.

Comment: The statement projects urbanization as a major project benefit. Although the Corps is not responsible for the land developments that follow its projects, it is responsible for evaluating their effects in relation to environmental values. Ignoring these social costs of the project invalidates the benefit-cost analysis.

Response: In the economic analysis for this project, only that development anticipated to occur in the absence of the project was projected, and flood damage prevented benefits on future growth were computed only on such development. The decision to recommend construction of the project was not taken in the absence of consideration of environmental values. Like all proposals for construction, the project involves both favorable and unfavorable consequences. The recommendation to construct reflects a judgment that the net of all consequences--economic, environmental, and social--is sufficiently favorable to warrant proceeding.

Comment: Local tax jurisdictions have not elected to build the project in spite of an alleged benefit cost ratio of 11.5 to 1. It seems curious that a 70-percent Federal subsidy would be required to induce local residents to contribute to such a highly beneficial project.

Response: Flood control, in general, has been a Federal responsibility since 1936, and hurricane flood control has been a Federal responsibility specifically since 1950. The Federal assumption of this responsibility reflects recognition of the national stake in reducing flood damages, and the increasing inability, for various reasons, of lesser jurisdictions to deal with the problem. Furthermore, the scope of this project and the diffusion of benefits are so great as to render local development of the project impracticable. The nature of the payout is such that local capital on the scale required would not be available.

Comment: We recommend that the St. Charles Parish and New Orleans East portions of this project be substantially curtailed. The project should be used to protect existing settlement, and not for any other purpose.

Response: As previously indicated, the St. Charles Parish levee has been deferred. The New Orleans East portion of this project will protect existing development and future improvements that would occur even in the absence of the project and the justification for its construction is based solely on preventing these damages.

Comment: The stated goal of "protection of lives and property" conflicts with the justifications offered for large portions of the project. If this is really a project to "hasten urbanization and industrialization of valuable marsh and swampland" then this should be clearly stated. St. Charles Parish is only 5 percent developed and the benefits from this portion of the project are "almost exclusively land enhancement." No contradiction is observed between these facts and the project purposes.

Response: As previously indicated, the St. Charles Parish lakefront levee has been deferred.

Comment: The statement recognizes the solicitude for wildlife and their habitat but is betrayed by the use of urbanization and land enhancement as justification for the project. We are asked to believe that urbanization will not cause any "destruction of wildlife and wildlife habitat."

Response: This final statement is explicit in its recognition that certain aspects of the project will result in the destruction of wildlife and wildlife habitat in the project area.

Comment: An unusual ecological argument is used with the view that man should protect nature's creatures from nature. What is unnatural, abnormal, about hurricanes? On what ecological grounds should man attempt to alter these processes?

Response: Man is a part of the ecological system and it is advantageous to protect him from floodwaters of hurricanes which strike the gulf coast. The recognition of the fact that the project works would result in reduced mortality to wildlife during hurricanes is not presented as an argument but as an item of information.

Comment: Creation of upland habitat as a result of spoil disposal is cited as a benefit. This is using ecological illogic. The astounding assertion that "filling of undeveloped marshlands with spoil" is a "beneficial aspect" of construction at the Rigolets and Chef Menteur, followed by the next paragraph which describes this as a detrimental aspect of the project.

Response: Whether conversion of marshland to other types is environmentally beneficial or detrimental depends on factors which may differ widely from case to case. We concur that the generalization is unwarranted, and the phrase in question has been removed from the final statement.

Comment: Improved fishing at holes where borrow pits are located, needs to be documented.

Response: Fine winter sport fishing areas in cold weather are noted when fish seek deeper water which exceeds 30 feet in spots (George A. Rounsefell, 1963, Realism in the Management of Estuaries, Marine Resources Bulletin No. 1, Alabama Marine Resources Laboratory).

Comment: The model studies used to determine that the project will not alter the salinity regimen in the lake should be described and a citation provided. This issue demands more complete discussion.

Response: Appropriate additions have been made to this final statement in Section I.

Comment: A more thorough description of the SPH is needed. What is the expected return period for the SPH? How does it compare in magnitude with hurricanes of past experience?

Response: Appropriate additions have been made to this final statement in Section I.

Comment: More description of past hurricane damages, damages of the SPH, and damages the project would prevent is needed.

Response: Appropriate additions have been made to this final statement in Section II.

Comment: A full discussion of the benefit cost analysis should be included. Various categories of cost and benefit should be summarized.

Response: The environmental impact statement, as defined by the National Environmental Policy Act (NEPA), and in the growing mass of jurisprudence interpreting that act, is a vehicle for fully disclosing, in physical terms, all relevant environmental information concerning proposed actions and their consequences. The intricacies of the benefit/cost analyses would, if included in the statement, contribute nothing to achieving the purpose for which the statement is prepared; i.e., to establish the background of relevant environmental information upon which the agency decided to act and to further establish that the background was sufficiently comprehensive to support the decision made. The details of the analyses upon which the economic stance of any proposal is based are included in other planning documents which are matters of public record. We have included, as a convenience to the reader, summary information on the economic analyses which have been established from these documents.

Comment: Assumed project lives, amortization, and interest rate assumptions are needed.

Response: As in all projects involving urban flood protection, an economic life of 100 years has been used. The interest rate, in accordance with current policy of the Executive Branch, is 3.25 percent.

Comment: Analyses of the project by its separate components are needed, especially to show what part of the claimed benefits are "land enhancement."

Response: The summary referred to previously presents project benefits by category. The only portions of the project in which land enhancement benefits represent significant increments of the total benefits are the St. Charles Parish levee and the Chalmette Area Plan.

Comment: An analysis of land ownership in the undeveloped areas is needed.

Response: Ownership of the land involved was analyzed in detail to determine the possibility of "windfall" benefits accruing as a result of project construction. Corps policy requires that special cost sharing be invoked to preclude unwarranted localized individual, or corporate gains. In the project under discussion, the analysis disclosed no basis for anticipating such gains.

Comment: Description of the project area needs to be supplemented by data on existing habitation and property uses. Such data, we suspect, would show clearly the lack of justification for the St. Charles Parish and New Orleans East segments of the project, as well as portions in St. Bernard Parish.

Response: As indicated previously, the St. Charles Parish levee has been deferred. Large areas of New Orleans East are now populated. The benefits for protection of existing development and future improvements that would occur even in the absence of the project are the sole basis for its justification--no enhancement benefits are involved. In the Chalmette area, enhancement benefits comprise only 7 percent of the total.

Comment: What is the obligation of the public to protect persons who desire to build homes at 8 feet below sea level in the path of hurricanes? Who should pay for this protection?

Response: The overriding consideration is the overall public interest, rather than the individual beneficiaries. Public policy, articulated by both the Congress and the Executive Branch, reflects the conviction that reducing flood damages is in the public interest. The measures available for accomplishing such reductions include the provision of structural works to prevent flooding, and institutional and regulatory constraints on development which is flood prone. The project in question is concerned with the former but not inconsistent with the latter. The people through their representation in the Congress determined who shall pay and in what manner. Present policy requires that local interests pay not less than 30 percent of the first cost and all future maintenance.

Comment: Could flood insurance provide a partial substitute for engineering work?

Response: Costs for flood insurance would greatly exceed the cost of the project as indicated by the large excess of project benefits over project costs. Furthermore, the threat to life would remain.

f. ORLEANS AUDUBON SOCIETY INCORPORATING LOUISIANA WILDLIFE FEDERATION.

Comment: Our organizations are in favor of hurricane protection for the populated areas of New Orleans but feel that the project should be restricted to hurricane protection, not "land enhancement" as mentioned on page i.

Response: The purpose of the project is hurricane protection. Several areas would be rendered more suitable for urban use as a result of the project works. This effect will be reflected in increases in value of these lands, which increases are called "enhancement benefits," since they do represent additions to the Gross National Product. The fact that the project will produce such benefits in no way alters its overriding objective which is to protect that which is in being and likely to come into being in the absence of the project.

Comment: Fifty-six thousand acres in the St. Charles Parish and New Orleans East areas are undeveloped marsh and swamp. These areas should not be included in the work plan. Not only is the taxpayer subsidizing the land developers in these two sections, he is also doing so at the expense of the environment.

Response: As previously indicated, the St. Charles levee has been deferred. The New Orleans East area has been leveed, is being developed, and would likely continue to be developed, even if the project were not built.

Comment: With the benefit-cost ratio at 11.5 to 1, land developers ought to be able to find capital to build their own levee system.

Response: The scope of this project and the diffusion of benefits are so great as to render private development of the project impracticable. The nature of the payout is such that private capital on the scale required would not be available.

Comment: Include the benefit-cost analysis of the project in the final statement.

Response: The environmental impact statement, as defined by the National Environmental Policy Act (NEPA), and in the growing mass of jurisprudence interpreting that act, is a vehicle for fully disclosing, in physical terms, all relevant environmental information concerning proposed actions and their consequences. The intricacies of the benefit/cost analyses would, if included in the statement, contribute nothing to achieving the purpose for which the statement is prepared; i.e., to establish the background of relevant environmental information upon which the agency decided to act and to further establish that the background was sufficiently comprehensive to support the decision made. The details of the analyses upon which the economic stance of any proposal is based are included in other planning documents which are matters of public record. We have included, as a convenience to the reader, summary information on the economic analyses which have been established from these documents.

Comment: Expand the section on alternative proposals to include the plan of exclusion of the St. Charles Parish levee and the New Orleans East levee systems.

Response: Section V, Alternatives to the Proposed Action, has been extensively revised.

Comment: The members of the Orleans Audubon Society and the Louisiana Wildlife Federation oppose the policy of private land enhancement at public and environmental expense.

Response: In the development of projects, the Corps of Engineers does not support private gain at public and environmental expense. As a matter of policy, where project benefits are expected to arise from changes or intensification of land use, ownership of the land involved is analyzed in detail to determine the possibility of "windfall" benefits accruing as a result of project construction. Where this possibility exists, Corps policy requires that special cost sharing be invoked to preclude unwarranted localized individual, or corporate gains. In the project under discussion, the analyses disclosed no basis for anticipating such gains. It should be borne in mind also that not less than 30 percent of all project first costs will ultimately be borne by some local entities. Further, local interests will maintain all project works after completion. Additionally, Corps policy is not to encourage deterioration of the environment but rather to select an optimum plan for meeting needs, and to disclose the nature, extent, and consequences of the "trade-offs" necessary for meeting needs.

g. Persons, organizations, and agencies which requested copies of the draft statement but did not comment:

P. Burgress Grisenbeck
Citizens Environmental Coalition
Educational Fund, Inc.

Mrs. David Brant
Gretna, Louisiana

Lamar Nunell, Jr.
Covington, Louisiana

Joseph E. Vidal, Jr.
Arabi, Louisiana

Mrs. Vera G. Hardmann
Covington, Louisiana

Dr. Dee S. Dundee
Louisiana State University, New Orleans

David Czamanske
Huran River Watershed Council
Ann Harbor, Michigan

Robert L. Shortle
Water Resources Congress
New Orleans, Louisiana

Murry F. Johnson
Arabi, Louisiana

Ernest Wittig
Galveston, Texas

E. Clarendon Jordan
Slidell, Louisiana

Ms. Peg Bubar
New York, New York

D. Bakker
Slidell, Louisiana

Mrs. Gus Baldwin, Jr.
Slidell, Louisiana

Homer G. Bartee
Metairie, Louisiana

H. B. Barton
Humble Oil and Refining Company
New Orleans, Louisiana

Mrs. Ann W. Rudolph
Columbus, Ohio

A. Denis Bechac
Mandeville, Louisiana

R. L. Ashley
Bechtel Corporation
Gaithersburg, Maryland

Bio-Oceanic Research, Inc.
New Orleans, Louisiana

F. Blankenstein
New Orleans, Louisiana

Edgar S. Bordes, Jr.
Mosquito Control
New Orleans, Louisiana

Mrs. Fred S. Bruce
New Orleans, Louisiana

Robert E. Chaplin
Lafayette, Louisiana

Arthur M. Chauusier, Jr.
Slidell, Louisiana

Nat Chesnut
New Orleans, Louisiana

Mrs. Melva Benton
Community Planners, Inc.
Baton Rouge, Louisiana

Bill Rushton
Vieux Carre Courier
New Orleans, Louisiana

Clifford M. Danby
New Orleans, Louisiana

William E. Daughdrill
Metairie, Louisiana

Mrs. E. Earl DiAurroy
New Orleans, Louisiana

Albert S. Dittmann, Jr.
New Orleans, Louisiana

E. L. Donaldson
New Orleans, Louisiana

B. M. Dornblatt
New Orleans, Louisiana

Beauregard A. Fournet, Jr.
East Jefferson General Hospital
Metairie, Louisiana

Henri F. Ferrer
St. Tammany Sportsman's League
Covington, Louisiana

George S. Frierson, Jr.
Lafayette, Louisiana

N. G. Geraci
New Orleans, Louisiana

Roy F. Guste
New Orleans, Louisiana

Terry J. Hartman
Engineers Architects Planners
Irvine, California

John R. Hammond
Louisiana State University, New Orleans

Bill Hass
WDSU-TV
New Orleans, Louisiana

Gerald Garner
Hawkeye Hunting Club
Center, Texas

John U. Hidalgo
Tulane University

Fred L. Hotstream
Department of Safety and Permits
New Orleans, Louisiana

Lloyd Irland
US Forest Service
New Orleans, Louisiana

A. H. Honeycutt
Jahncke Service
Metairie, Louisiana

Mrs. W. C. Jones
Slidell, Louisiana

Frank L. Keller
Tulane University

Ralph T. Lally
Slidell, Louisiana

Mrs. Allen W. Lee
Metairie, Louisiana

David P. Levy
David P. Levy Enterprises
Slidell, Louisiana

Lloyd O. Martiny
New Orleans, Louisiana

George A. McEwen
Slidell, Louisiana

Ms. Marie L. Meyer
New Orleans, Louisiana

Ralph A. Meynard
Metairie, Louisiana

Walter G. Moore
Loyola University
New Orleans, Louisiana

Robert W. Nelson
New Orleans, Louisiana

L. J. Bremenstul
Waldemar S. Nelson and Company
New Orleans, Louisiana

New Orleans Public Library
New Orleans, Louisiana

H. M. Rhodes
Oil Mop, Incorporated
New Orleans, Louisiana

Mrs. Adams
New Orleans, Louisiana

Mrs. Dorothy Parker
New Orleans, Louisiana

T. Edwin Patton
Slidell, Louisiana

C. P. Perilloux
Laplace, Louisiana

Stephen M. Redmann
New Orleans, Louisiana

H. Eustis Reily
New Orleans, Louisiana

Ms. Sheila Robichaux
Gretna, Louisiana

Ms. Nancy Sarrat
Louisiana State University, New Orleans

Edward C. Scogin
Representative
House District No. 76
Slidell, Louisiana

J. W. Selle
Metairie, Louisiana

Herbert O'Donnell
Southern Yacht Club
New Orleans, Louisiana

Ferrell Guillory
The States-item
New Orleans, Louisiana

Charles Torres
Norco, Louisiana

Russ Kintzley
Times-Picayune
New Orleans, Louisiana

J. M. Urner
Court of Appeal, Fourth Circuit
New Orleans, Louisiana

Thomas A Velazquez
New Orleans, Louisiana

Gordon S. Veith
New Orleans, Louisiana

Dianne Silva
Walker Land Company, Inc.
Metairie, Louisiana

Olene Wallace
Mandeville, Louisiana

Ed Planer
WDSU-TV
New Orleans, Louisiana

Rudy Weber
New Orleans, Louisiana

Mrs. Maurice Weilbaecher
New Orleans, Louisiana

George W. White
Bureau of Governmental Research
New Orleans, Louisiana

Donald F. Harang, Jr.
Joint Legislative Committee on
Environmental Quality
Baton Rouge, Louisiana

Ms. Peggy Rosenblatt
New York, New York

Francis Breaud
Norco, Louisiana

Mike Connor
New Orleans, Louisiana

J. Holtsclaw
New Orleans, Louisiana

Bill Hess
WDSU-TV News
New Orleans, Louisiana

The Daily Sentry-News

3648 PONTCHARTRAIN DR.
HWY. 11 SOUTH

P. O. BOX 910
SLIDELL, LOUISIANA 70458

May 25, 1972

Mr. Jerome C. Baehr, Chief, Engineering Division
Department of the Army
New Orleans District Corps of Engineers
P.O. Box 60267
New Orleans, La. 70160

Re: LMNED-PC

Dear Mr. Baehr:

Thank you for a copy of the "Draft environmental statement on the Lake Pontchartrain...hurricane protection project." It is most interesting reading. Several questions have come up regarding this draft, and we feel you can answer them. We are planning a series on the project and its value to St. Tammany Parish.

1. On page 4 of the draft, the St. Tammany Parish Police Jury had not assured the Corps of local cooperation and funding. How much Parish funds would be required of St. Tammany? Has the governor executed the contract? Have the Corps and the St. Tammany Parish Police Jury been able to agree on this matter?

2. On page 53, the Corps makes no comment about the proposed "Florida-type" private development in St. Tammany. Will there be hurricane protection for this area? Is there any protection for this area now? Is protection planned for a Corps project in a future FY? Will this porposed low-barrier system help protect this area? What did your model show in Vicksburg after a SPH would hit the St. Tammany area? Are these "florida-type" sites still about flood tides? Will the Slidell area be protected?

3. On page 77, what St. Tammany Parish interests feel that these structures will eventually form a "dead" lake? Why are they the only dissention save for some St. Charles Parish hunting club members?

I would appreciate your answers to these questions and a chance for a meeting at a date convenient to you. Thanks for the report. We shall closely follow the efforts of the Corps to provide flood protection on the North shore of Lake Pontchartrain.

Sincerely yours,

Bill Klink

Bill Klinkenstein

BK/mtf

New Orleans East, Inc.
Chef Menteur Highway at Michoud Boulevard
P. O. Box 29188 New Orleans, Louisiana 70129
(504) 254-1400

June 9, 1972

Colonel Richard L. Hunt, CE
District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

Dear Col. Hunt:

Enclosed is a copy of a letter from Wallace-McHarg-Roberts-Todd, land planners for the New Orleans East New Town-In Town Project. This letter was written as a result of our request that they examine the environmental impact statement in connection with the proposed lakefront levee fronting New Orleans East on Lake Pontchartrain.

We would like very much to meet with you as soon as possible to discuss this letter. I would like to suggest Tuesday morning, June 13, 1972, at a time convenient with you.

Sincerely,

NEW ORLEANS EAST, INC.

Harold E. Cook

Harold E. Cook
Executive Vice President

HEC:bb
encls.

ARCHITECTS / LANDSCAPE ARCHITECTS / URBAN AND ECOLOGICAL PLANNERS
1740 CHERRY STREET, PHILADELPHIA, PENNSYLVANIA 19103 / (215) 563-0800

June 5, 1972

RECEIVED JUN 9 1972 NEW ORLEANS EAST, INC.

CELOTEX CORPORATION
JUN 7 1972
RECEIVED

Mr. Marty Roberts
Executive Vice President
Pontchartrain Land Corporation
4600 Republic National Bank Tower
Dallas, Texas 75201

Dear Marty:

As you requested at our May 17th meeting, I am furnishing our comments on the Draft Environmental Impact Statement for a Hurricane Protection Project for Lake Pontchartrain, Louisiana and vicinity. The statement, dated April 1972, was prepared by the Corps of Engineers, U.S. Army Engineer District, New Orleans.

We have reviewed the Draft Statement in terms of the project's impact on the 32,000 acre tract owned by New Orleans East, Inc. Our initial comment is that the adverse impact of the proposed levee along the Southern Railway embankment, along the northern edge of the tract, has probably been underestimated. The Corps describes the impact as follows:

> The Southern Railway embankment currently prevents detritus flow into Lake Pontchartrain. The proposed levee should have no effect on this environ. The project will provide drainage equal to that which presently exists. Willow thickets will continue to become abundant on the margins of the marsh and will result in conversion of wetland habitats and associated organisms to terrestrial environment. (p.51)

Studies undertaken by the Center for Wetland Resources of Louisiana State University for our firm suggest that the 3,255 acre impounded marsh located between the Southern Railway embankment and Interstate 10 are in excellent condition. In fact, the Center has suggested that the marsh could be restored to a productive estuarine nursery area by providing three openings to Lake Pontchartrain under the railroad embankment. Locations for such openings have been identified as: (1) at the northern end of the Southern Natural Gas Company pipeline canal; (2) Black Lagoon Bayou; and, (3) at the end of Little River.

Further investigation of this marsh unit by my own staff provided the following additional information about its health, productivity and possible relationship with Lake Pontchartrain.

David A. Wallace, FAIA, AIP/Ian L. McHarg, ASLA, AMTPI/William H. Roberts, RIBA, ASLA/Thomas A. Todd, AIA
Associates: David C. Hamme/Narendra Juneja, AIIA, ASLA/
Donald H. Brackenbush, AIA, /Michael G. Clarke/Charles B. Tomlinson, Jr./Daniel Philip Busch

June 5, 1972

The marsh in the Lake Front Unit is primarily Spartina patens (Couch grass). Surface water exchange with Lake Pontchartrain has been closed since the construction of the Southern Railway embankment 50 years ago. A tide gate for drainage is located at the eastern end of the unit. Despite this, the marsh is in excellent condition and persists as a brackish Spartina patens marsh. The clumping growth-form of this grass was indicative probably of lowered salinity conditions and absence of tidal exchange. The abundance of marine species, such as the blue crab, was evidence of leakage of juvenile and larval forms of marine species through the tide gate. The uniformity of the condition of this marsh as well as the maintenance of the brackish marsh vegetation suggests that saltwater is entering the unit beneath the embankment of the Southern Railway.

Scirpus robustus (Leafy three-cornered grass) and Juncus roemerianus (Black rush) were scattered throughout the marsh, though not enough to suggest any expected change in vegetation type. In the open water bodies Ruppia maritima (Widgeon grass) and Alternanthera philoceroides (Alligator weed) were abundant. This unit is presently providing excellent waterfowl habitat and estuarine nursery area.

To summarize, the impounded marsh behind the Southern Railway embankment is likely to be receiving large amounts of seepage from Lake Pontchartrain. This would help to explain its excellent condition. Construction of the new levee could impede this seepage and thereby cause the marsh to deteriorate.

New Orleans East, Inc. is currently planning to develop 8-10,000 acres of its property as a New-Town-in-Town under Title VII of the Federal Urban Growth and New Communities Act of 1970. Much of the marsh area between I-10 and the new levee is scheduled for indefinite continuation as open space, with the objective of keeping it as a productive ecological asset. Alternatively, if it is allowed to deteriorate, it could have a seriously blighting influence on the new community whose center will be immediately adjacent on the other side of I-10.

It is our recommendation that steps be taken to ensure that this adverse impact be avoided.

Such an adverse impact could possibly be avoided by designing the new levee to provide for some water exchange between the marsh and Lake Pontchartrain. It may also be possible to design the new levee to enhance the marsh, should that be in the best interest of New Orleans East, Inc.

Sincerely,

Lewis

DAVID A. WALLACE

DAW:bbm

Arthur Crowe
Dept. of Marine Sc
LSU

June 5,1972

U.S. Army Engineer District
New Orleans, La.

Gentlemen:

It appears to me after reading the environmental statement for the proposed hurricane protection project that we have reached a crossroads in the growth of the New Orleans area. On the one hand, we could implement all of the proposed projects and see a great deal of land lost to productive marsh-swamp ecology--to be replaced by an increase in productive urban-industrial ecology. This present low lying marsh-swamp community affords recreational benefits to the people of New Orleans and more important supplies detritus which is responsible for the productivity of the surrounding waters. The sensible option left open to us is increasing the height of the existing levees and implementing levee systems that effect the actual population of New Orleans now, not the projected population area twenty years from now. This might seem short sighted, but actually it is not. By putting into effect all of the proposed projects you would be forcing urbanization and industrialization into certain highly productive marsh-swamp areas. These areas would no doubt undergo subsidence due to compaction of the soil from loss of water and this would result in thousands of more acres with a below sea level status. No one can assure that the new levees will hold at all points during a hurricane of the strength of Camille. A break in a levee at one or more points would introduce storm waters into a below sea level basin and be trapped there with the expected loss of life and damage to property. The alternative that we have would be not to open these areas to urbanization and industrialization, but to force them to higher ground as it were, for there own good. This higher ground that I am speaking of is north of Lake Pontchartrain in St. Tammany and Tangipahoa parishes. This is well drained, relatively high, Pleistocene area that could literally "support" increased urbanization and industrialization. I repeat that we are at the crossroads and the farsighted approach must be looked at with all sincerety.

Sincerely,

Arthur Crowe
Arthur Crowe
Dept. of Marine Science, LSU

United States Department of the Interior

OFFICE OF THE SECRETARY
SOUTHWEST REGION
Room 4030, 517 Gold Avenue SW.
Albuquerque, New Mexico 87101

ER 72/537

November 8, 1972

District Engineer
U.S. Army, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

This is in response to your request for our comments concerning the Draft Environmental Statement for Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project.

Generally, we find the environmental statement to be reasonably comprehensive in discussing many of the project-occasioned environmental problems. We believe, however, that the statement could be strengthened in certain areas. The following specific comments are provided for your consideration.

1. Project description. A paragraph should be added to explain the proposed operating schedules of the control structures.

2. Environmental setting without the project. The final statement should indicate evidence of consultation with the State Liaison Officer appointed by the Governor for possible properties on the National Register of Historic Places and for additional archeological values that may be involved.

3. The environmental impact of the proposed action. The statement should describe the possible effects the project will have on boating activities and facilities at the New Orleans Municipal Yacht Club and the Southern Yacht Club Harbor. The statement should also indicate any effects the project will have on West End Park, Pontchartrain Amusement Park, Pontchartrain Park, and any other park or recreation facility within the project areas. Our review indicates that the project levees and other features will directly affect several of the previously mentioned recreation areas. There is also a distinct possibility that the proposed St. Bernard Parish State Park might be adversely affected. The effect on the public boat ramps located on the south shore of Lake Pontchartrain should also be explained. The impact on the visual esthetics from the proposed Interstate 10 scenic drive system should be recognized.

The first paragraph on page 39 should be revised. The value of a marshland is closely related to the absence of human encroachment and development. It is misleading, when overall values are considered, to indicate that the draining and/or filling of marshland with spoil is beneficial. Artificial alteration of natural habitat is almost always detrimental; the original biota is destroyed and the replacement biota is of poor quality. Therefore, replacement of a natural marsh with an artificial upland habitat should not be indicated as beneficial. In addition, future urbanization of the area will eliminate any chances for long-term establishment of upland wildlife habitat.

The statement should indicate that invasion of open marshes in St. Charles Parish by cypress will only be temporary since accelerated urban and industrial growth will be stimulated by the project.

On page 36, the statement erroneously indicates that the barrier system is beneficial to natural resources. The viability of marshes and lowlands is not destroyed by natural periodic extremes such as hurricanes and tidal surges. There is an inherent capacity for rejuvenation under natural conditions. However, the inevitable urban and industrial growth which will accrue with the levee system in place will eradicate fish and wildlife habitat.

The statement should include more conclusive evidence that the gated control structure will not interfere with normal movements of aquatic organisms. The possible preclusion of migrating young and larval organisms is an extremely important consideration. The statement should discuss the currents which will be produced by the 76 percent cross-sectional reduction of the Chef Menteur and Rigoletes Passes and their significance to migrating organisms.

Paragraph 3 on page 46 is contradictory. The barrier plan which will reduce marshland erosion will also directly lead to the elimination of thousands of acres of marshland.

The exchange of nutrients is not adequately discussed on page 46. The levee system will completely eliminate the broad interface between the marsh and the lake which is important to nutrient and organism interchange in both directions. Further, the stated purpose of the drainage canal and structure in the St. Charles Parish levee does not coincide with the purpose indicated on page 13 of the statement.

4. Any adverse environmental effects which cannot be avoided should the proposal be implemented. The statement should specifically identify and quantify the additional acreages of the various types of natural habitat which will eventually be lost as a result of project implementation. The wetland wildlife habitat types should be classified in accordance with the U.S. Fish and Wildlife's Circular 39, "Wetlands of the United States," dated 1956, reissued 1971.

The importance of marshes and shallow water areas are not limited to coastal species. Estuaries are utilized by the entire spectrum of organisms from freshwater species to those considered entirely oceanic. This should be recognized in the statement.

5. Alternatives to the proposed action. A more thorough explanation is needed as to how the added cost of the St. Charles Parish lakefront levee can be justified if environmental factors are given equal consideration as provided by the National Environmental Policy Act.

On page 67 it is stated, "Other than the total present effects of levee construction, the environmental effects of the proposed project will be identical with alternate plans except for the temporary effects due to method of construction." We believe this is incorrect. The natural environment will suffer much more if the St. Charles Parish lakefront levee is constructed than if it is not included in the plans.

6. The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. The statement recognized that the project will stimulate urbanization of the entire area. Therefore, problems which will accrue as a result of urbanization should be discussed; e.g., future domestic and industrialized pollution.

We appreciate the opportunity to comment on this draft statement.

Sincerely,

Copp Collins

Copp Collins
Field Representative

Eng Div

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

June 26, 1972

Colonel Richard L. Hunt
District Engineer
U. S. Department of the Army
Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hunt:

The draft environmental statement for the "Lake Pontchartrain, Louisiana and Vicinity, Hurricane Protection Project," reference LMNED-PC, which accompanied your letter of May 8, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

The subject statement mentions the loss of marsh land due to the project and implies additional loss of wetlands from accelerated urbanization; however, without the benefit-cost study, it is unknown what cost was attributed to this loss. Furthermore, since the project will encourage urbanization, what will the cost be from a larger than designed hurricane? It is also impossible to determine what the design life of the project is or whether weather modification has been considered.

Throughout the statement, frequent references are made to the dependency of aquatic resources on high productivity of surrounding marshes and wetlands--a fact that has long been recognized and accepted by scientists throughout the Nation. Approximately 5,265 acres of these marshes and wetlands will be used for construction purposes, and many additional acres of this important and irreplaceable habitat will be changed into terrestrial environment, which may lead to urbanization and industrialization. Thus, the summary statement under Environmental Impacts (page i), which indicates that "The barrier will not modify the salinity regimen or ecology of the Lake Pontchartrain area and fishery values will undergo little or no change" (our italics), is both contradictory and inexplicable. The reasoning and basic data supporting this statement should be provided.

The alternatives to the proposed plan are discussed principally with regard to their economic feasibilities. The ecological impacts of each alternative should also be determined for comparison with the selected plan.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 COMMERCE STREET
DALLAS, TEXAS 75202

OFFICE OF
THE REGIONAL DIRECTOR

Our Reference: EI# 0572-134

U. S. Army Engineer District
New Orleans
New Orleans, Louisiana

Re: Lake Pontchartrain, Louisiana
vicinity Hurrican Protection
Project

Gentlemen:

Pursuant to your request, we have reviewed the Environmental Impact Statement for the above project proposal in accordance with Section 102(2)(C) of P. L. 91-190, and the Council on Environmental Quality Guidelines of April 23, 1971.

Environmental health program responsibilities and standards of the Department of Health, Education, and Welfare include those vested with the United States Public Health Service and the Facilities Engineering and Construction Agency. The U. S. Public Health Service has those programs of the Federal Food and Drug Administration, which include the National Institute of Occupational Safety and Health and the Bureau of Community Environmental Management (housing, injury control, recreational health and insect and rodent control).

Accordingly, our review of the Draft Environmental Statement for the project discerns no adverse health effects that might be of significance where our program responsibilities and standards pertain, provided that appropriate guides are followed in concert with state, county, and local environmental health laws and regulations.

We therefore have no objection to the authorization of this project insofar as our interests and responsibilities are concerned.

Very truly yours,

Jerry D. Stephens

Jerry D. Stephens
Environmental Impact
Coordinator

ORD-EI-1

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

June 7, 1972

OFFICE OF THE
REGIONAL ADMINISTRATOR

Colonel Richard L. Hunt
District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hunt:

We have reviewed the Draft Environmental Impact Statement, prepared by your office, on the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project. The project includes the construction of a barrier along the east side of Lake Pontchartrain, a levee along the St. Charles Parish lakefront, an additional levee along the Citrus and New Orleans East lakeshores, the improvement and enlargement of existing protection works on the south and north shores of the lake, along the Gulf Intracoastal Waterway and the Inner Harbor Navigation Canal including a dual purpose lock at Seabrook. The Chalmette Area Plan will include the construction of a new levee along the south shore of the Mississippi River-Gulf Outlet from the Inner Harbor Navigation Canal to the Vicinity of Verret and thence to the Mississippi River at Caernarvon.

The Environmental Protection Agency would like to commend your office on the preparation of this statement. The material presented in the section, Environmental Setting Without the Project, was excellent and provided an in-depth biological analysis of the project area. However, we suggest that the following comments should be considered in preparing the Final Statement:

Although the Statement objectively discussed several of the possible adverse environmental effects which may occur as a result of the project, an additional paragraph could be added in Section 3, on the overall environmental impacts of the project on commercial fish species. Because ✓ Lake Pontchartrain receives fresh water inflow from nutrient-poor acid soils in the north, untreated sewage is discharged into the lake from the south, and it is expected that the exchange of nutrients from the surrounding marshlands will be restricted after levee construction, the project could have detrimental effects on sport and commercial fisheries. Also, the present discharge of domestic sewage into the lake has caused considerable eutrophication with periodic fish kills resulting from low dissolved oxygen levels and high concentrations of ammonia. We realize that simulated biological model studies in the laboratory to analyze these factors would be impossible; however, we do believe that more discussion on the expected impacts from these combined factors after project completion would aid in projecting the impact on commercial fishing in future years.

We acknowledge the importance and the significance of the findings from the hydraulic model testing described on page 34. However, we believe that under small scale laboratory conditions, it would be impossible to simulate environmental conditions as they would normally occur in the project area. Although we do not disagree with these findings, we believe that a qualifying sentence could be added to the paragraph, explaining that results from the model study may not necessarily be accurate when applied to the large scale natural environmental setting of the project area. Therefore, a brief discussion of the above comments would provide the reader with a better understanding of the hydraulic model studies, while at the same time the significance of the test results would not be weakened.

We thank you for the opportunity to review and comment on the Draft Environmental Impact Statement, and would like to receive two copies of the Final Statement when it is available.

Sincerely yours,

Arthur W. Busch

Arthur W. Busch
Regional Administrator

STATE OF LOUISIANA
DEPARTMENT OF PUBLIC WORKS
P. O. BOX 44155. CAPITOL STATION
BATON ROUGE, LA. 70804

ROY AGUILLARD
DIRECTOR

July 7, 1972

Colonel Richard L. Hunt, District Engineer
U. S. Army, Corps of Engineers
New Orleans District
P. O. Box 60267
New Orleans, Louisiana 70160

Re: LMNED-PC
May 4, 1972

Dear Colonel Hunt:

Your letter of May 4, 1972, forwarded for our review and comment a draft environmental statement for the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project as required by the National Environmental Policy Act of 1969, Public Law 91-190.

We have completed our review of your draft environmental statement and are in agreement with the overall context of your statement. There are, however, several minor points we believe should be clarified in order to correct some possible misunderstandings. Several misleading statements should be modified to reflect current conditions. The following comments are offered for your consideration.

1. Page 20 - The study area in St. Bernard Parish includes such areas as Yscloskey, Oakdale and Delacroix Island, etc., however, it should be pointed out that these areas are not protected by the project levees.

2. Page 52 - The statement is made that "The levees on the south and east of the New Orleans East Area and along side the lakeshore will protect people moving into the area from hurricane flooding." This does not present a true picture since hurricane water levels in Lake Pontchartrain will be on the order of +6.0 MSL along this area as a result of return winds after passage of a hurricane. These levels will be experienced in the lake even though hurricane tides are kept out by the Rigolets' and Chef's structures.

3. Page 54 - The first paragraph states that "East of Paris Road runoff is conveyed to the marshes by floodgates." This statement is incorrect inasmuch as the area east of Paris Road to Bayou Dupre or Violet Canal is drained by pumping stations. The area east of Violet Canal, however, is conveyed to the marshes by floodgates.

4. Page 56 - Hearsay statements are recorded as being voiced by hunting club members that certain adverse impacts will result from construction of the levee in St. Charles Parish. Further statements are made that the members feel this will result in a change of vegetation which will not be attractive to wildlife. The Department of Public Works objects to this type hearsay statement being included in your environmental statement since such remarks are not based on factual data presented in the report.

5. Page 61 - The statement is made that the pumping systems would be inoperable for extended periods of time following inundation of the area by a hurricane. While the area pumping stations are not designed to handle flood waters resulting from inundation of the entire area, most stations are designed to operate independently without outside power sources. These stations can be utilized immediately.

We appreciate the opportunity to comment on your draft environmental statement and wish to compliment you on a most comprehensive approach.

Sincerely yours,

Roy Aguillard

ROY AGUILLARD
DIRECTOR

ART:mal
Cc: Lake Borgne Basin Levee District

Eng Div

STATE OF LOUISIANA
STATE PARKS AND RECREATION COMMISSION
BUREAU OF OUTDOOR RECREATION

P. O. DRAWER 1111 BATON ROUGE, LOUISIANA 70821

11 MAY 1972

COL. RICHARD L. HUNT, DIST. ENGR.
U. S. CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LA. 70160

RE: DRAFT ENVIRONMENTAL STATEMENT - LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

DEAR SIR:

AT THIS TIME WE DO NOT HAVE SUFFICIENT PERSONNEL OR EXPERTISE TO COMMENT COMPREHENSIVELY ON THE SUBJECT PROJECT.

WE WISH TO RESERVE THE RIGHT TO COMMENT AT A LATER DATE.

SINCERELY,

Lamar Gibson
LAMAR GIBSON
DIRECTOR

Gus Stacy III
GUS STACY III
RESEARCH STATISTICIAN

GS/MSB

LAMAR GIBSON
DIRECTOR—LIAISON OFFICER

CLYDE FUNDERBURK
EXECUTIVE ASSISTANT

N.
8th/Copthing
2, Eng Div

LOUISIANA WILD LIFE AND FISHERIES COMMISSION

WILD LIFE AND FISHERIES BUILDING
400 ROYAL STREET
NEW ORLEANS, LOUISIANA 70130

July 24, 1972

Colonel Richard L. Hunt
District Engineer, CE
New Orleans District, Corps of Engineers
U. S. Department of the Army
P. O. Box 60267
New Orleans, Louisiana 70160

RE: LMNED-PC

Dear Col. Hunt:

Reference is made to your correspondence, dated May 4, 1972, and draft statement for the authorized project "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection" in which you request our views, comments and/or recommendations.

In the opening summary statements, the paragraph states "The barrier will not modify the salinity regimen or ecology...little or no change." However, in the same paragraph the following sentence appears "Restriction of tidal overflow...will have an effect on the salinity of the open marshes." This seems to be contradictory. Further, it is asserted that a decrease in the amount of secondary production of organic material will occur. If detritus produced by marshes are prevented from reaching open waters then most certainly, the effects will be reflected in fishing values since marshes are the primary producers.

Spoil for construction of levees is to be derived from the bottom of Lake Pontchartrain and other waterways and these "deep holes creates desirable fishing spots." It has been our experience that most desirable fishing spots are located near raised portions of the bottom, as with oyster reefs, small islands, and other exposed or partially so land areas. Construction of a functional lock at Seabrook will prevent more highly saline waters from the Industrial Canal and MR-GO from entering Lake Pontchartrain, ultimately lowering salinities. With the advent of lower salinities, it is doubtful that any of the species alluded to in the draft will inhabit that area. If the lock at Seabrook is functional, i.e. prevents higher saline waters from entering Lake Pontchartrain, where will these waters go? The obvious answer to that question is Lake Borgne. The oyster industry of Louisiana is already suffering from salt water intrusion, rendering vast expanses of previously productive waterbottoms barren of oysters. As salt water encroaches upon southeastern Louisiana, the oyster fishermen have turned northward--toward the less saline waters of Lake Borgne. Increased salinities in Lake Borgne will undermine the oyster fishermen and industry resulting in a serious economical setback for the state and local communities. If the control locks are used to manage salinity in Lake Pontchartrain, the locks would have to be closed longer than stated in the draft. Keeping the locks closed would hurt passage of boats, both pleasure and commercial, and we find that wildlife and fish has the lowest priority in regulation of control structures.

Following examination of the chart supplied to us with the draft, we maintain that the public would be better served by dredging spoil for construction of levees on the inside of the proposed levees. This project completely surrounds areas of human habitation in three regions (1-St. Charles, Jefferson and Orleans; 2-Orleans and St. Tammany; 3-Orleans and St. Bernard). If flood waters from any source were to enter either of these, it would become trapped (the elevation in all three is below or slightly above sea level, with a few ridges of higher elevation). The public would be better served if collection of excess water were accomplished near the levees where prompt pumping operations would rid the communities of potential health hazards as well as loss to property and to life. It is probable that a hurricane comparable to the fury of Camille would top even the most elevated levees. In which case, destruction of life and property would be eminent despite man's most elaborately constructed devices.

In addition, these back levee canals would provide recreational opportunities to the public not afforded otherwise (e. g., fishing, boating, water skiing, etc.). We realize that this approach would be difficult and awkward to accomplish in heavily inhabited areas since it would involve relocation of a number of homes but, in the under developed areas (which are in the majority) this alternative seems worthy of exploration.

If indeed the purpose of this project is to provide for protection of life and property against flooding caused by hurricane waves and surges, then levee construction would be abbreviated because vast amounts of area enclosed for protection are uninhabited. But, if this project was designed to protect areas of very low population densities and to hasten urbanization and industrialization of valuable marsh and swampland, then these back levee canals and levees would provide a buffer zone to preserve the remaining portion of our aquatic, marsh and swamp from these same forces.

Furthermore, the construction of new levees along the south shore of Lake Pontchartrain from Bonnet Carre' Spillway to it's junction with the levee bordering the Intracoastal in the Chef Menteur Pass region is not necessary, if the levee from that junction to Apple Pie Ridge is purposeful. This amounts to double jeopardy--destruction of large areas of primary producing organic material for the protection of an area that is already protected. In our opinion, locks and levees at Seabrook, Chef Menteur Pass and Rigolets could be constructed so as to prevent large scale destruction by hurricane flood waters without the use of the levee along the south shore of Lake Pontchartrain and that portion bordering New Orleans East.

In essence, we agree that the project will (1) decrease the amount of secondary (we inject, primary) production of organic material into associated bodies of water by destruction of salt and fresh water marsh and swamp, (2) have an effect (we add, adverse) on the salinity of the open marshes, (3) decrease the acreage of total marsh by 5,265 acres and thereby eliminating fishery production in this area, (4) hasten urbanization and industrialization of valuable marsh and swampland and that urbanization of the project affected area would proceed at a much reduced pace if the hurricane protection plan were not implemented, but assert that if a supplemental plan whereby, that portion of levee from the Chef area to Apple Pie Ridge were enlarged to prevent hurricane tides or surges from entering Lake Pontchartrain, the same purpose would be served--at much less environmental destruction.

However, we do not agree that the project will (1) affect fishery values with little or no change, (2) render a beneficial service by filling of underdeveloped marshland with spoil, (3) create desirable fishing spots, (4) control salinities--it will change them, (5) provide necessary conditions so that flooding will no longer occur in the marshes and lowlands protected by this project.

Louisiana's marshes, wetlands and estuaries are far too valuable (documented) to be squandered by any poorly implemented plan which does not consider the full value of these ecosystems. Again the development of these marshes, wetlands and estuaries for urban development cannot be included as a beneficial aspect of the plan as far as environment is concerned. A benefit cost ratio of 11.5 to 1 is given for the project, but this is not documented. We would like to see the values assigned to the loss marshes, wetlands and estuaries. Several alternatives have been offered for consideration and it is suggested that these be fully explored and examined before implementation of the Hurricane Protection Project.

On page 24 the definitions of swamp and marsh appear to be incomplete. It is suggested that swamp is "wet timbered area" and marsh is "vegetated (grasses, sedges, rushes) wetland devoid of trees.

On page 28, the statement about an oyster fishery in Lake Pontchartrain is correct, but not because the oyster is not present in commercial numbers. The oysters are present, but are not being harvested at the present time because it is a sancturary where commercial operations are prohibited and secondly, the high bacteria count at times prevents marketing these oysters. Both of these prohibitions are in the process of being corrected, and it is predicted that there will be a season for the commercial harvest of these oysters.

On page 30, the report hurridly passes over the fact that ducks are present in the area. The duck survey conducted by the Louisiana Wild Life and Fisheries Commission shows that this is a very important waterfowl winter habitat with over 600,000 lesser scaup annually in the area, plus many thousands of other species.

We appreciate the opportunity to review and offer comment on this project and request to be kept informed regarding it's progress.

Sincerely yours,

Clark M. Hoffpauer
Director

cgl

cc: Oyster Division

CITY OF NEW ORLEANS
OFFICE OF THE MAYOR

MOON LANDRIEU
MAYOR

May 12, 1972

Richard L. Hunt, Colonel, CE
District Engineer
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, La. 70160

Dear Colonel Hunt:

I have reviewed the draft of the Environmental Statement in connection with the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project as requested in your letter of May 4.

I find the statement quite complete and properly setting forth the pros and cons of the Environmental Effects.

As you are aware, this matter has been under study by the Board of Levee Commissioners of Orleans Parish and various City Departments for quite some time.

Because of the urgency of precluding widespread devastation to the New Orleans area experienced in Hurricane Betsy, or as would have been experienced in Hurricane Camille, it is urged that this project be pursued with all deliberate speed, because the benefits to the more than million people in the New Orleans area far outweigh any deleterious effects.

Sincerely,

Moon Landrieu

Moon Landrieu

ML:acs

ST. CHARLES PARISH POLICE JURY

P. O. BOX 302
HAHNVILLE, LOUISIANA 70057

783-2233
783-2030
523-0615

July 21, 1972

Col. Richard L. Hunt, C. E.
District Engineer
U. S. Corps of Engineers
Box 60267
New Orleans, Louisiana 70160

Dear Mr. Hunt:

We have reference to your letter dated May 4, 1972 together with draft environmental statement for the project "Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection."

We have reviewed this statement and wish to advise that we have no reason to believe that this installation will result in any appreciable change in the Lake. We do believe that it will help alleviate some detritus produced in the marshes, that produce unwanted growth in the Lake. We can foreseee that this protection levee will be beneficial to the wildlife habitat of the area, until such time as urbanization takes over.

We trust the above statement will expedite this project.

Yours truly,

Inez R. Schillaci

INEZ R. SCHILLACI
SECRETARY

irs/jal

Board of Commissioners

Lake Borgne Basin Levee District

POST OFFICE BOX 216
VIOLET, LA. 70092
Phone: 682-5941

OFFICERS:
IRVIN J. G. JANSSEN, President
DANIEL CALUDA, Vice-President
LOUIS P. MUNSTER, Secretary

COMMISSIONERS:
DANIEL CALUDA
IRVIN J. G. JANSSEN
MAURICE VINSANAU

May 15, 1972

Mr. Hu B. Myers, Acting Director
Louisiana Department of Public Works
P. O. Box 44155
Baton Rouge, Louisiana 70804

Dear Sir:

The Board of Commissioners for the Lake Borgne Basin Levee District voted unanimously at its meeting held Tuesday, May 9, 1972 to refer to your agency the attached draft of Enviornmental Statement on Lake Pontchartrain & Vicinity Hurricane Protection Project by the U. S. Army Corps of Engineers, to review and make written recommendations prior to the forty-five days stipulated in their letter of transmittal.

Yours truly,

BOARD OF COMMISSIONERS
LAKE BORGNE BASIN LEVEE DISTRICT

Louis P. Munster

Louis P. Munster, Secretary

LPM/mvc

cc: U. S. Corps of Engineers
Mr. Earl Magner, District Engineer, Dept. Pub. Works.

523-5042

The Board of Levee Commissioners

OF THE

Orleans Levee District

200 WILDLIFE AND FISHERIES BUILDING
418 ROYAL STREET

New Orleans, La.
70130

Eng Div

June 23, 1972

Richard L. Hunt
Colonel, C.E.
U. S. Army District
N. O. Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Hunt:

I have reviewed the draft of the enviromental statement on the Lake Pontchartrain, Louisiana and Vicinity Hurricane Protection Project.

You and your staff are to be congratulated on the contents of the report and the manner in which it is presented.

Although the primary purpose of the statement is to present the impact of the project on our enviroment, as an Engineer, I was particularly impressed with the manner in which the pertinent aspects of the entire project were brought out, making it a condensed version of the 21 November 1962 Interim Survey Report.

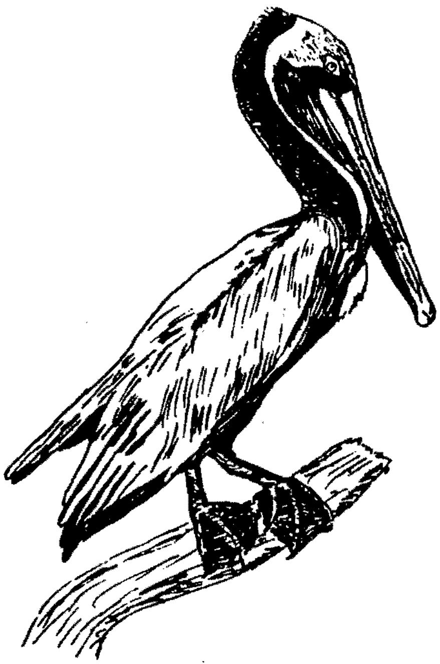
I would like to call your attention to one statement which, although I feel is insignificant, warrants review. The last line of the first paragraph on page 7 mentions the levee terminating east of the Rigolets at Apple Pie Ridge. At a public meeting I attended, a speaker made a big issue of the fact that although we have been stating that the terminus is Apple Pie Ridge, it really terminates at Prevost Island. You can consider this for what its worth.

Yours truly,

JOHN P. MCNAMARA
CHIEF ENGINEER & ASST. SEC.

JPMCN:sm

cc: Hon. Guy F. LeMieux, Pres.
Mr. W. E. Shell, Jr., Dept. of the Army, Corps of Engrs.



SIERRA CLUB, DELTA CHAPTER

June 16, 1972

Colonel Richard L. Hunt
District Engineer
US Army Engineer District, New Orleans
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

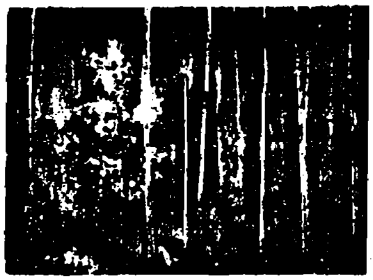
Enclosed are comments on the Environmental Impact Statement for the Lake Ponchartrain Hurricane Protection Project submitted for the record.

Sincerely,

DONALD M. BRADBURN, M.D.
Chairman
465 Audubon Street
New Orleans, La. 70118

cc: Environmental Protection Agency
Council on Environmental Quality

DMB/ms



by Ansel Adams in *This Is the American Earth*

SIERRA CLUB Mills Tower, San Francisco 94104

COMMENTS OF THE DELTA CHAPTER, SIERRA CLUB ON THE DRAFT IMPACT STATEMENT:

"LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY HURRICANE PROTECTION PROJECT"

The Delta Chapter of the Sierra Club opposes those portions of the Hurricane Protection Project (HPP) which effectively subsidize urban development in presently unoccupied and undeveloped areas. Such development would create two ongoing social costs. One is the permanent loss of wetlands, the other is the continuing cost of protecting and maintaining urban development induced by these projects. There is no justification for subsidizing these outcomes at public expense. The primary beneficiaries of such development will be landowners and developers, not the general public.

The total impact of wetland loss especially to urban development induced by the project is nowhere clearly delineated despite the great importance of Louisiana's coastal marshes. Much of it appears not to have been considered in the cost benefit ratio.

The increased costs both in urban construction and continuing maintenance in such areas are not alluded to.

Alternatives to the project or portions of it are inadequately discussed.

A full analysis, we believe, will reveal that certain portions of the project should not be constructed.

Protection of persons and property from hurricane damage is essential to the welfare of the New Orleans area. We support wisely considered measures for this purpose. Some aspects of the present project, however, raise fundamental objections. These include levees from the Orleans Parish line to the Bonnet Carre Spillway in St. Charles Parish, and the levees for the Orleans East area. Objections to these


by Ansel Adams in This Is the American Earth

SIERRA CLUB Mills Tower, San Francisco 94104

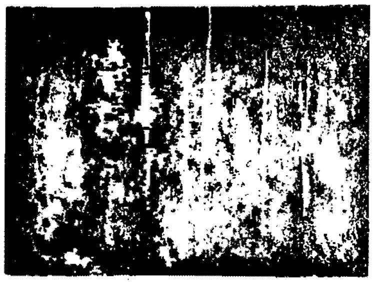
portions of the HPP are of three kinds:

1. The primary benefits claimed for these works is "land enhancement", which is inconsistent with the public mission of the Corps of Engineers. The goal of the HPP is stated on pp. i and 1 to be "protection of life and property against flooding caused by hurricane wages and surges." But the constant theme of the sections justifying the project is an appeal to "land enhancement" benefits. Promotion of urbanization is not an objective of the flood control program, however popular it may be with local landowners and economic interests.

2. The areas of swamp and marsh in question are integral parts of the vast estuarine ecosystem of the coastal region. Their importance as wildlife habitat and food sources for marine food chains and ultimately therefore for mankind is acknowledged in the Impact statement. Public subsidy of the destruction of these ecosystems is not justified.

3. The statement continually expresses concern for protection of wildlife and plant communities from hurricanes. But it projects urbanization as a major project benefit. Urbanization will destroy the ecosystem more surely than will hurricanes. Although the Corps is not responsible for the land developments that follow its projects, it is responsible for evaluating their effects in relation to environmental values. Ignoring these social costs of the project invalidates the benefit-cost analysis.

It is interesting that in the face of an alleged benefit cost ratio of 11.5 to 1 that local tax jurisdictions have not elected to build it.



by Ansel Adams in This Is the American Earth

SIERRA CLUB Mills Tower, San Francisco 94104

It seems curious that a 70% federal subsidy would be required to induce local residents to contribute to such a highly beneficial project.

In summary, we believe that it is poor public policy to distribute capricious capital gains by means of federally financed construction which meets no flood protection goal. We also believe that publicly subsidized destruction of marshland ecosystems is not now in the public interest. For these reasons, we recommend that the St. Charles Parish and New Orleans East portions of this project be substantially curtailed. The HPP should be used to protect existing settlement, and not for any other purpose.

We further recommend that the Corps of Engineers seek authorization to assure that its projects are built in accord with broad-gauge planning by local governments, so that market responses to flood protection can be directed into desirable channels, and maximum benefit preserved for the public. The Corps already requires performance by local authorities of a series of obligations related to financing and maintenance of projects. Requiring land use planning and control would be fully in the spirit of the Congressional intent that Corps projects promote resource development in the public interest.

The remainder of this statement contains our suggestions for the improvement of the Impact Statement. Suggestions fall in the general areas of removing contradictions of logic, adding documentation and additional discussion, and organization and presentation.

by Ansel Adams in *This Is the American Earth*

SIERRA CLUB Mills Tower, San Francisco 94104

SUGGESTIONS ON IMPACT STATEMENT:

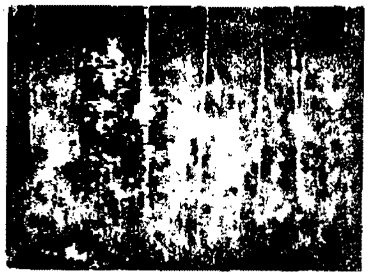
These pages offer our attempt at constructive criticism. We believe they will contribute to an improved final Impact Statement and a better project plan.

I. Contradictions in Reasoning -

A. The stated goal of "protection of lives and property" conflicts with the justifications offered for large portions of the project. If this is really a project to "hasten urbanization and industrialization of valuable marsh and swampland", (p. IV) as it appears to be, then this should be clearly stated at the outset. References to "land enhancement" and promotion of development appear on pages V, 62, 63, 67, 77 and elsewhere. The statement itself admits that only 5% (1,370 acres out of 29,600) of St. Charles Parish is developed, (p. 47, 48) and that the benefits of that portion of the project are "almost exclusively land enhancement" (p.67). But no contradiction is observed between these facts and the project purposes.

B. This leads to a further contradiction. The solicitude for wildlife and their habitat, evident in p. III: "the barrier system will vastly decrease the great destruction of wildlife and wildlife habitat caused by tidal surge", is betrayed by the use of urbanization and land enhancement as justification for the project. We are asked to believe that urbanization will not cause any "destruction of wildlife and wildlife habitat".

C. Despite an abundance of ecological data and frank recognition of many adverse impacts, some rather unusual ecological arguments are used. One is the view that man should protect nature's creatures from nature.



by Ansel Adams in *This Is the American Earth*

SIERRA CLUB Mills Tower, San Francisco 94104

Hurricane damage to wildlife is emphasized repeatedly. On p. 75, changes resulting from hurricane flooding in St. Charles Parish are described: "A wave of water disturbed the entire area". Several sentences later, these changes are described as resulting from "normal tidal overflow... and hurricane damage". What is unnatural, abnormal, about hurricanes?* On what ecological grounds should man attempt to alter these processes? Further, on p. 39, creation of upland habitat as a result of spoil disposal is cited as a benefit, using similar ecological illogic. These arguments are all specious: the effects should be eliminated from consideration as benefits and merely displayed as side effects, if desired.

D. Confusion is evident in the treatment of project benefits and costs. There needs to be clearer distinction drawn between economic and ecological costs and benefits. On page 39 appears the astounding assertion that "filling of undeveloped marshlands with spoil" is a "beneficial aspect" of construction at the Rigolets and Chef Menteur. The next paragraph describes this as a detrimental aspect of the project. These confusions could be avoided by adopting a sort of double-entry bookkeeping for both economic aspects and environmental aspects. Then, creation of filled building sites could be entered as an economic gain (though unrelated to the actual purpose of this project), while the same effect would appear in the environmental account on the liability side.

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*The 1970-1971 Biennial Report of the Louisiana Wildlife and Fisheries Commission summarizes impacts of hurricanes on several wildlife refuges (pages 65, 66, and 195 ff.). Studies indicated rapid recovery of vegetation from hurricane damage, and slight modifications of salinities.

by Ansel Adams in *This Is the American Earth*

SIERRA CLUB Mills Tower, San Francisco 94104

II. ADDITIONAL INFORMATION AND DOCUMENTATION:

A. Complete lack of documentation renders evaluation of the report difficult. Many assertions of ecological benefits, such as improved fishing at holes where borrow pits are located, need to be documented. The model studies used to determine that the project will not alter the salinity regimen in the Lake should be described and a citation provided. The importance of this issue demands more complete discussion.

B. A more thorough description of the SPH is needed. Apart from passing reference on pages 5 and 31, little description is provided. What is the expected return period for the SPH? How does it compare in magnitude with hurricanes of past experience? More description of past hurricane damages, damages of the SPH, and damages the project would prevent is needed.

C. A full discussion of the benefit-cost analysis should be included. Various categories of cost and benefit should be summarized. Assumed project lives, amortization, and interest rate assumptions are needed. Analyses of the project by its separate components are needed, especially to show what part of the claimed benefits are "land enhancement".

D. An analysis of land ownership in the undeveloped areas is needed. The public deserves to know who will receive the capital gains to be distributed by project promoting urbanization and development. Reluctance to include such data is understandable, since it could be embarrassing to local politicians and project boosters.

E. Description of the project area given on p. 20 ff. needs to be supplemented by data on existing habitation and property uses. The project objective is not


by Ansel Adams in *This Is the American Earth*

SIERRA CLUB Mills Tower, San Francisco 94104

to protect empty tracts, but people. Data on this would seem to be an integral part of a full justification for the project. Such data, we suspect, would show clearly the lack of justification for the St. Charles Parish and New Orleans East segments of the HPP, as well, as portions in St. Bernard Parish.

F. Fuller discussion of alternatives is required. As is typically the case, the alternative of foregoing the project receives scant attention. It is rejected in two sentences on p. V, hardly suggesting that a full and unbiased analysis has been made. We have adduced compelling arguments to the effect that two parts of this project should not be constructed. If the discussions of alternatives included an analysis of omitting these portions of the project, their lack of justification would be apparent.

Analysis of alternatives would highlight the issues more clearly. What is the obligation of the public to protect persons who desire to build homes at 8 feet below sea level in the path of hurricanes? Who should pay for this protection? Could flood insurance provide a partial substitute for engineering works?

III. <u>ORGANIZATION AND PRESENTATION</u> - Information in the Statement would be more useful if it were organized more with the reader in mind.

A. We suggest, an outline and roadmapping section be used at the beginning to apprise the reader of the sequence of the discussion.

B. We urge the use of more graphic material to describe the project, ecological conditions, and project effects. Graphics would be especially useful in indicating the areas of current settlement which need protection. The excellent drawings which appear in the Corps publication "Water Resources Development in


by Ansel Adams in *This Is the American Earth*

SIERRA CLUB Mills Tower, San Francisco 94104

Louisiana, 1971" would be helpful.

C. Organization and readability could be improved by placing all material relating to hurricane damages together, all ecological material together, and the descriptions of salinity models together. Elimination of redundancy would permit more detailed discussion. Requirements of the prescribed outline could be met by cross-referencing appropriate sections. For example, the discussion of salinity in Lake Ponchartrain on p. 41-42 could be moved to the ecological and environmental costs and benefits, with references to page numbers in the text, would provides a useful overall view of the project, and would help avoid certain confusions pointed out above.

Orleans Audubon Society

A CHAPTER OF THE NATIONAL AUDUBON SOCIETY

346 Audubon St.
New Orleans, La. 70118
June 18, 1972

Col. R.L. Hunt
District Engineer
Corps of Engineers
P.O. Box 60267
New Orleans, La. 70160

Re: Lake Pontchartrain, La. and Vicinity
Hurricane Protection Project

Dear Col.Hunt,

The Orleans Audubon Society and the Louisiana Wildlife Federation have reviewed the above draft 102 statement with the following comments:

Our organizations are in favor of hurricane protection for the populated areas of New Orleans. But we feel that the project should be restricted to hurricane protection, not "land enhancement" as mentioned in page 1.

Fifty-six thousand acres in the St. Charles Parish and New Orleans East areas are undeveloped marsh and swamp. These areas should not be included in the work plan. Not only is the taxpayer subsidizing the land developers in these two sections, he is also doing so at the expense of the environment.

With the benefit-cost ratio at 11.5 to 1, land developers ought to be able to find capital to build their own levee system.

We recommend that the St. Charles Parish levee from the Bennet Carre Spillway to the St.Charles-Jefferson Parish line be excluded from the project. We also recommend that the undeveloped New Orleans East area be deleted.

This will reduce the adverse effects of these projects on the environment and the adverse effects on the U.S. taxpayer.

We offer the following recommendations:

1) Include the benefit-cost analysis of the project in the final 102 statement. This will aid the public review of the project.

2) Expand the section on alternative proposals to include the plan of exclusion of the St. Charles Parish levee and the New Orleans East leveeesystems.

3) A reorganization of the data and inclusion of additional graphic materials would greatly facilitate the review of the impact statement.

The members of the Orleans Audubon Society and the Louisiana Wildlife Federation oppose the policy of private land enhancement at public and environmental expense.

Yours sincerely,

Barry Kohl

Barry Kohl
Conservation Chairman
Orleans Audubon Society

Rick Bryan /bk

Richard W. Bryan Jr.
La. Wildlife Federation

CC: Council on Environmental Quality

Environmental Protection Agency

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LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

APPENDIX A
UNIT 1

A LIST OF THE PLANTS
MENTIONED IN THIS STATEMENT

TREES, SHRUBS, AND VINES

American elm
Ulmus americana

Ash, pumpkin
Fraxinus tomentosa

Ash, water
Fraxinus caroliniana

Baldcypress
Taxodium distichum

Box elder
Acer negundo

Buttonbush
Cephalanthus occidentalis

Cottonwood, eastern
Populus deltoides

Cucumber tree
Magnolia acuminata

Drummond red maple
Acer drummondi

Eastern baccharis
Baccharis halimifolia

Elderberry
Sambucus canadensis

Flowering dogwood
Cornus florida

Hackberry
Celtis laevigata

Marsh elder
Iva frutescens

Oak, live
Quercus virginiana

Oak, nuttall
Quercus nuttallii

Oak, overcup
Quercus lyrata

Oak, southern red
Quercus falcata

Oak, water
Quercus nigra

Oak, willow
Quercus phellos

Palmetto
Sabal minor

Pine, loblolly
Pinus taeda

TREES, SHRUBS, AND VINES (Cont'd)

Pine, longleaf
Pinus palustris

Pine, shortleaf
Pinus echinata

Pine, slash
Pinus elliotii

Pine, spruce
Pinus glabra

Roughleaf dogwood
Cornus drummondii

Southern magnolia
Magnolia grandiflora

Southern sweet bay
Magnolia virginica

Sweetgum
Liquidambar styraciflua

Tulip tree
Liriodendron tulipifera

Sycamore
Platanus occidentalis

Tupelogum
Nyssa aquatica

Wax myrtle
Myrica cerifera

Willow, black
Salix nigra

Willow, sandbar
Salix interior

HERBACEOUS SPECIES

Alligatorweed
Alternanthera philoxeroides

Arrowhead
Sagittaria graminea

Arrowhead
Sagittaria sp.

Bahia grass
Paspalum notatum

Batis
Batis maritima

Bedstraw
Galium aparine

Belle-dame
Acnida alabamensis

Bermuda grass
Cynodon dactylon

Blackberry
Rubus spp.

Black rush
Juncus roemerianus

Bulltongue
Sagittaria falcata

Buttercup
Ranunculus muricatus

Buttercup
Ranunculus parviflorus

Butterweed
Senecio glabellus

Buttonweed
Diodia virginiana

Camphorweed
Pluchea camphorata

Carpet grass
Axonopus affinis

Cattail, broad-leaved
Typha latifolia

Chickweed
Stellaria media

Cocklebur
Xanthium strumarium

Coco
Scirpus robustus

Coontail
Ceratophyllum demersum

Crabgrass
Digitaria sanguinalis

Cyperus
Cyperus odoratus

Cyperus
Cyperus sp.

Daisy fleabane
Erigeron philadelphicus

Dallis grass
Paspalum dilatatum

Dandelion
Taraxacum officinale

Deerpea
Vigna luteola

Delta duck potato
Sagittaria platyphylla

Dewberry
Rubus trivialis

Dewberry
Rubus spp.

Duck-potato
Sagittaria latifolia

Duckweed
Lemna minor

Duckweed
Wolffiella floridana

Dwarf spikerush
Eleocharis parvula

Eelgrass (wild celery)
Vallisneria americana

Evening primrose
Oenothera laciniata

False dandelion
Pyrrhopappus carolinianus

Feather grass
Panicum virgatum

Frogbit
Limnobium spongia

Giant ragweed
Ambrosia trifida

Goldenrod
Solidago altissima

Goldenrod
Solidago spp.

HERBACEOUS SPECIES (Cont'd)

Goosegrass
Eleusine indica

Great bulrush
Scirpus validus

Great duckweed
Spirodela polyrhiza

Hardstem bulrush
Scirpus californicus

Hogcane
Spartina cynosuroides

Horned pondweed
Zannichella palustris

Ironweed
Sida rhombifolia

Johnson grass
Sorghum halapense

Ladies eardrops
Brunnichia cirrhosa

Little barley
Hordeum pusillum

Maidencane
Panicum hemitomon

Marsh mallow
Hibiscus lasiocarpus

Morning glory
Ipomoea sagittata

Morning glory
Ipomoea trichocarpa

Naiad
Najas quadalupensis

Oystergrass
Spartina alterniflora

Panic grass
Panicum sp.

Peppervine
Ampelopsis arborea

Pigweed
Amaranthus spp.

Pink hibiscus
Kosteletzkya virginica

Poison ivy
Rhus radicans

Pondweed
Potamogeton perfoliatus

Poor man's peppergrass
Lepidium virginicum

Rattan vine
Berchemia scandens

Roseau
Phragmites communis

Saltgrass
Distichlis spicata

Santa maria
Parthenium hysterophorus

Sawgrass
Cladium jamaicense

Sensitive plant
Mimosa strigillosa

Sesbania
Sesbania exaltata

HERBACEOUS SPECIES (Cont'd)

Smartweed
Polygonum hydropiperoides

Smartweed
Polygonum punctatum

Smartweed
Polygonum spp.

Smut grass
Sporobolus poiretti

Soft rush
Juncus effusus

Spikerush
Eleocharis sp.

Spiny-leaved sow thistle
Sonchus asper

Three-cornered grass
Scirpus olneyi

Vervain
Verbena littoralis

Walter's millet
Echinochloa walteri

Water hyacinth
Eichhornia crassipes

Water hyssop
Bacopa monnieri

Water lettuce
Pistia stratiotes

Watermeal
Wolffia sp.

Water pennywort
Hydrocotyle umbellata

Water pennywort
Hydrocotyle verticillata

White clover
Trifolium repens

Widgeongrass
Ruppia maritima

Wild geranium
Geranium carolinianum

Wiregrass
Spartina patens

Yellow foxtail
Setaria glauca

FERN AND FERN ALLIES

Horsetail
Equisetum hyemale var. *affine*

Royal fern
Osmunda regalis var. *spectabilis*

Shield fern
Dryopteris normalis

PHYTOPLANKTON

Actinastrum sp.
Anabaena spp.
Biddulphia mobiliensis
Campylodiscus echeneis
Ceratium sp.
Chactoceros spp.
Chlamydomonas sp.
Cladophora sp.
Closterium sp.
Coscinodiscus spp.
Dictyosphaerium sp.
Eudorina elegans
Euglena sp.
Fragilaria sp.
Gomphonema sp.
Gonium pectorale
Gyrosigma sp.
Hydrodictyon sp.

Melosira sp.
Merismopaedia sp.
Micrasterias laticeps
Oscillatoria sp.
Pandorina norum
Pediastrum boryanum
Pediastrum simplex
Peridinium sp.
Rhizosolenia sp.
Scenedesmus brasiliensis
Scenedesmus denticulatus
Schroederia sp.
Sphaerocystis sp.
Spirosyra sp.
Spirulina sp.
Synedra sp.
Tabellaria sp.

APPENDIX A
UNIT 2

TABLE 12
A PRELIMINARY LIST OF PLANT SPECIES, THEIR COMMON NAMES AND HABITAT AROUND LAKE PONTCHARTRAIN
COMPILED BY G. MONTZ, US ARMY CORPS OF ENGINEERS, NEW ORLEANS DISTRICT, 1973

Species	Common Name	Habitat
Acacia farnesiana	Sweet acacia	Ridges
Acalypha ostryaefolia	Three-seeded mercury	Ridges
Acalypha rhomboidea	Three-seeded mercury	Ridges
Acalypha virginica	Three-seeded mercury	Ridges
Acer drummondii	Drummond red maple	Swamp and ridges
Acer negudo	Box elder	Swamp and ridges
Acer rubrum	Red maple	Ridges (north shore)
Acnida cuspidata	Belle-dame	Fresh marsh
Adiantum capillus-veneris	Venus-hair fern	Ridges
Aesculus pavia	Buckeye	Ridges (north shore)
Agrostis hiemalis	Bent grass	Ridges
Allium canadense	Wild onion	Ridges
Alopecurus carolinianus	Carolina foxtail	Wet areas near ridges
Alternanthera philoxeroides	Alligatorweed	Swamp and fresh marsh
Amaranthus palmeri	Pigweed	Ridges
Amaranthus retroflexus	Pigweed	Ridges
Amaranthus spinosus	Thorny amaranth	Ridges
Amaranthus viridis	Pigweed	Ridges
Ambrosia artemisiifolia	Common ragweed	Ridges
Ambrosia trifida	Giant ragweed	Ridges
Ammannia coccinea	Ammannia	Fresh marsh and wet areas near ridges

Species	Common Name	Habitat
Amorpha fruticosa	Lead plant	Ridges
Ampelopsis arborea	Peppervine	Swamp and ridges
Ampelopsis cordata	Heart-leaved peppervine	Swamp and ridges
Amsonia tabernaemontana	Blue star	Ridges
Anagallis arvensis	Scarlet pimpernel	Ridges
Andropogon glomeratus	Bushy broomsedge	Ridges
Andropogon virginicus	Broomsedge	Ridges
Apios americana	Potato bean	Ridges
Apium leptophyllum	Marsh parsley	Ridges
Argemone albiflora	White prickley poppy	Ridges (north shore)
Arthraxon hispidus	Spear point anthroxon	Ridges
Arundinaria tecta	Switchcane	Ridges
Arundo donax	Giant reed	Ridges
Asclepias lanceolata	Coast milkweed	Intermediate marsh
Ascyrum hypericoides	St. Andrew's cross	Ridges (north shore)
Asplenium platyneuron	Ebony spleenwort	Swamp
Aster exilis	Aster	Intermediate marsh
Aster subulatus	Saltmarsh aster	Brackish marsh
Aster tenuifolius	Aster	Brackish marsh
Athyrium filix-femina var. *asplenioides*	Lowland lady fern	Wet areas near ridges
Axonopus affinis	Carpet grass	Ridges
Azolla carolinianum	Water fern	Swamp and canals
Baccharis angustifolia	Narrowleaf baccharis	Brackish marsh ridges
Baccharis halimifolia	Eastern baccharis	Ridges and fresh to brackish marsh
Bacopa monnieri	Water-hyssop	Intermediate to fresh marsh and swamp
Berchemia scandens	Rattan vine	Swamp and ridges
Bidens cernua	Beggarticks	Ridges
Bidens frondosa	Beggarticks	Ridges
Bidens laevis	Beggarticks	Ridges

Species	Common Name	Habitat
Bidens mitis	Beggarticks	Ridges
Bidens pilosa	Beggarticks	Ridges
Bignonia radicans	Cross vine	Ridges
Boehmeria cylindrica	Bog-hemp	Swamp and ridges
Boerhaavia erecta	Spiderling	Ridges
Bowlesia septentrionalis		Ridges
Brachiaria platyphylla	Creeping brachiaria	Ridges
Briza minor	Quaking grass	Ridges
Bromus unioloides	Rescue grass	Ridges
Brunnichia cirrhosa	Ladies-eardrops	Swamp and ridges
Bumelia lanuginosa	Gum bumelia	Ridges
Cabomba caroliniana	Fanwort	Swamp
Callicarpa americana	French mulberry	Swamp and ridges
Calyptocarpus vialis	Calyptocarpus	Ridges
Campsis radicans	Trumpet flower	Ridges
Canna flaccida	Canna	Fresh marsh and swamp
Caperonia castaneaefolia		Ridges
Capsella bursa-pastoris	Shepherd's-purse	Ridges
Cardamine parviflora	Bittercress	Ridges
Carex cherokeensis	Sedge	Wet areas near ridges
Carex crus-corvi	Crow-spur	Wet areas near ridges
Carex frankii	Sedge	Wet areas near ridges
Carex hyalinolepis	Lake sedge	Marsh
Cardiospermum halicacabum	Balloon-vine	Ridges
Carpinus caroliniana	American hornbeam	Ridges (north shore)
Carya aquatica	Bitter pecan	Swamp and ridges
Carya illinoensis	Sweet pecan	Ridges
Cassia fasiculata	Patridge pea	Ridges
Cassia obtusifolia	Sicklepod	Ridges
Cayaponia boykinii	Wild cucumber	Ridges
Celtis laevigata	Hackberry	Ridges

Species	Common Name	Habitat
Cenchrus incertus	Sandbur	Sand beaches
Centaurea cyanus	Cornflower	Ridges
Centunculus minimus	Chaffweed	Wet areas near ridges
Cephalanthus occidentalis	Buttonbush	Swamp and ridges
Cerastium viscosum	Mouse-ear chickweed	Ridges
Ceratophyllum demersum	Coontail	Swamp, bayous, and canals
Chaerophyllum tainturieri	Wild chervil	Ridges
Chenopodium album	Lamb's quarters	Ridges
Chenopodium ambrosioides	Pigweed	Ridges
Chloris virgata	Finger grass	Ridges
Cicuta maculata	Water-hemlock	Wet areas near ridges
Cirsium horridulum	Thistle	Ridges
Cissus incisa	Marine-ivy	Ridges
Cladium jamaicense	Saw grass	Fresh marsh
Clematis crispa	Leather flower	Ridges
Clematis virginiana	Virgin's bower	Swamp and ridges
Cleome houtteana	Spider flower	Ridges (north shore)
Clethra alnifolia	Pepperbush	Swamp (north shore)
Cocculus carolinus	Moonseed	Ridges
Colocasia antiquorum	Elephant's ear	Wet areas near ridges
Commelina diffusa	Dayflower	Wet areas near ridges
Commelina virginica	Dayflower	Swamp
Corchorus siliquosus	Jew's mallow	Ridges
Coreopsis tinctoria	Tickseed	Ridges
Cornus drummondii	Roughleafed dogwood	Swamp and ridges
Coronopus didymus	Wart-cress	Ridges
Corydalis micrantha	Golden corydalis	Ridges
Crataegus viridis	Hawthorn	Swamp and ridges
Crepis japonica	Hawk's beard	Ridges
Crinum americanum	Swamp-lily	Swamp
Croton capitatus	Wolly croton	Ridges

Species	Common Name	Habitat
Croton glandulosus	Croton	Ridges
Cucumis melo var. *dudain*	Smell melon	Ridges
Cuscuta geonovii	Dodder	Ridges
Cynoctonum mitreola	Miterwort	Ridges
Cynodon dactylon	Bermuda grass	Ridges
Cyperus aristatus	Sedge	Wet areas near ridges
Cyperus erythrorhizos	Sedge	Wet areas near ridges
Cyperus esculentus	Nutgrass	Wet areas near ridges
Cyperus iria	Sedge	Ridges
Cyperus odoratus	Sedge	Fresh marsh
Cyperus pseudovegetus	Sedge	Wet areas near ridges
Cyperus rotundus	Coco grass	Ridges
Cyperus strigosus	Sandy sedge	Ridges
Cyperus virens	Sedge	Wet areas near ridges
Cyrilla racemiflora	Titi	Wet areas near ridges (north shore)
Dactylenium aegyptium	Crowfoot grass	Ridges
Datura strumondii	Jimson weed	Ridges
Daubentonia texana	Rattlebox	Marsh and ridges
Desmanthus illinoensis	Prairie-mimosa	Ridges
Desmodium paniculatum	Begger's tick	Ridges
Desmodium sp.	Begger's tick	Ridges
Dichondra repens		Ridges
Dichromena colorata	White top	Wet areas near ridges
Digitaria ischaemum		Ridges
Digitaria sanguinalis	Crabgrass	Ridges
Diodia teres	Buttonweed	Ridges
Diodia virginiana	Buttonweed	Wet areas near ridges
Dioscorea paniculata	Wild yam	Ridges
Diospyros virginiana	Persimmon	Swamp and ridges
Distichlis spicata	Saltgrass	Brackish marsh
Drosera filiformis	Sundew	Wet piney woods (north shore)

Species	Common Name	Habitat
Dryopteris ludoviciana	Shield fern	Swamp
Dryopteris normalis	Shield fern	Swamp and ridges
Duchesnea indica	Indian strawberry	Ridges
Echinochloa colonum	Jungle rice	Wet areas near ridges
Echinochloa crusgalli	Barnyard grass	Wet areas near ridges
Echinochloa walteri	Walter's millet	Fresh marsh and ridges
Echinochloa zelayensis		Fresh marsh
Echinodorus cordiflorus	Creeping water plantain	Fresh marsh and swamp
Eclipta alba	Eclipta	Wet areas near ridges
Eichhornia crassipes	Water-hyacinth	Swamp-canals, bayous
Eleocharis parvula	Dwarf spikerush	Brackish and intermediate marsh
Eleocharis spp.	Spikerush	Wet areas near ridges
Elephantopus carolinianus	Elephant's-foot	Ridges
Eleusine indica	Goosegrass	Ridges
Elymus virginicus	Wild rye	Ridges
Equisetum hyemale var. *affine*	Horsetail	Wet areas near ridges
Equisetum laevigatum	Smooth horsetail	Ridges
Eragrostis glomerata	Pond lovegrass	Wet areas near ridges
Eragrostis hypnoides	Creeping lovegrass	Ridges
Eragrostis oxylepis		Ridges
Eragrostis pectinacea	Lovegrass	Ridges
Eragrostis reptans	Creeping lovegrass	Ridges
Eragrostis spectabilis	Lovegrass	Ridges
Erechtites hieracifolia	Fireweed	Ridges
Erianthus giganteus	Sugarcane plumegrass	Wet areas near ridges
Erigeron bonariensis	Fleabane	Ridges
Erigeron canadensis	Horseweed	Ridges
Erigeron myrionactis		Sand beaches
Erigeron philadelphicus	Daisy fleabane	Ridges

Species	Common Name	Habitat
Eriocaulon decangulare	Pipewort	Wet areas near ridges
Eryngium prostatum		Ridges
Eryngium yuccifolium		Ridges
Erythrina herbacea	Coral bean	Ridges
Eupatorium capillifolium	Yankeeweed	Ridges
Eupatorium coelestinum	Mistflower	Ridges
Eupatorium perfoliatum	Thoroughwort	Ridges
Eupatorium serotinum	Thoroughwort	Ridges
Euphorbia humistrata	Spurge	Ridges
Euphorbia maculata	Eyebane	Ridges
Euphorbia prostata	Spurge	Ridges
Festuca elatior	Fescue grass	Ridges
Fimbristylis autumnalis		Ridges
Fimbristylis vahlii		Ridges
Foresteria acuminata	Swamp privet	Swamp
Fraxinus americana	White ash	Ridges
Fraxinus caroliniana	Water ash	Swamp and ridges
Fraxinus pennsylvanica	Green ash	Swamp and ridges
Fraxinus tomentosa	Pumpkin ash	Swamp and ridges
Gaillardia pulchella	Indian blanket	Ridges (north shore)
Galium aparine	Bedstraw	Ridges
Galium tinctorium	Bedstraw	Ridges
Gaura parviflora	Gaura	Ridges
Gelsemium sempervierns	Yellow jessamine	Ridges
Geranium carolinianum	Wild geranium	Ridges
Geum canadense	Avens	Ridges
Gleditsia aquatica	Water locust	Swamp and ridges
Gleditsia triacanthos	Honey locust	Ridges
Glinus lotoides		Ridges
Gnaphalium purpureum	Cudweed	Ridges
Helenium amarum	Bitterweed	Ridges

Species	Common Name	Habitat
Helenium autumnale	Sneezeweed	Ridges
Helianthus mollis	Sunflower	Ridges
Heliotropium curassavicum	Seaside heliotrope	Brackish marsh
Heliotropium europeum	Heliotrope	Ridges
Heliotropium indicum	Turnsole	Ridges
Heterotheca subaxillaris	Camphor weed	Ridges
Hibiscus lasiocarpus	Marsh mallow	Fresh marsh
Hibiscus militaris	Halbert-leaved hibiscus	Wet areas near ridges
Hordeum pusillum	Little barley	Ridges
Hydrocotyle bonariensis	Water pennywort	Brackish and intermediate marsh
Hydrocotyle ranunculoides	Water pennywort	Fresh marsh
Hydrocotyle umbellata	Water pennywort	Intermediate and fresh marsh
Hydrocotyle verticillata	Water pennywort	Wet areas near ridges
Hydrolea ovata	Blue water leaf	Wet areas near ridges
Hymenocallis occidentalis	Spider lily	Swamp
Hypochoeris radiata	Cat's-ear	Ridges
Ilex decuida	Deciduous holly	Ridges
Ilex opaca	American holly	Ridges (north shore)
Ilex vomitoria	Yaupon	Ridges
Impatiens capensis	Touch-me-not	Swamp and ridges
Ipomoea coccinea	Morning glory	Ridges
Ipomoea hederacea	Morning glory	Ridges
Ipomoea lacunosa	Morning glory	Ridges
Ipomoea purpurea	Morning glory	Ridges
Ipomoea sagittata	Salt marsh morning glory	Brackish to fresh marsh
Ipomoea trichocarpa	Morning glory	Ridges
Iris giganticaerulea	Wild iris	Swamp
Itea virginica	Virginia willow	Swamp

Species	Common Name	Habitat
Iva ciliata	Sumpweed	Ridges
Iva frutescens	Marsh elder	Brackish and intermediate marsh and ridges
Jacquemontia tamnifolia	Tie vine	Ridges
Juncus acuminatus	Rush	Ridges
Juncus biflorus	Rush	Ridges
Juncus diffusissimus	Rush	Ridges
Juncus effusus	Soft rush	Wet areas near ridges and fresh marsh
Juncus roemerianus	Black rush	Brackish marsh
Juncus tenuis	Rush	Ridges
Justicia lanceolata	Water-willow	Wet areas near ridges
Kosteletzkya virginica	Wild hibiscus	Brackish to fresh marsh and ridges
Lactuca floridana	Wild lettuce	Ridges
Lamium amplexicaule	Henbit	Ridges
Lantana camara	Ham and eggs	Ridges
Leersia virginica	White grass	Fresh marsh
Lemna minor	Duckweed	Swamp, fresh marsh, and bayous
Leonorus sibiricus	Motherwort	Ridges
Lepidium virginicum	Poor man's pepper grass	Ridges
Leptochloa fascicularis	Bearded sprangletop	Intermediate marsh
Leptochloa filiformis	Red sprangletop	Fresh marsh and ridges
Leptochloa nealleyi	Nealley sprangletop	Brackish marsh
Leptochloa uninervia	Sprangletop	Ridges
Leucospora multifida	Leucospora	Ridges
Limnobium spongia	Frogbit	Swamp
Linaria canadensis	Toadflax	Ridges
Lindernia anagallidea	False pimpernel	Ridges

Species	Common Name	Habitat
Lippia lanceolata	Fogfruit	Ridges
Lippia nodiflora	Fogfruit	Ridges
Liquidambar styraciflua	Sweetgum	Swamp and ridges
Lobelia cardinalis	Cardinal flower	Wet areas near ridges (north shore)
Lolium multiflorum	Rye grass	Ridges
Lonicera japonica	Japanese honeysuckle	Swamp and ridges
Lorinseria areolata	Dwarf chain fern	Swamp
Ludwigia alternifolia	Primrose-willow	Wet areas near ridges
Ludwigia angustifolia	Primrose-willow	Wet areas near ridges
Ludwigia decurrens	Primrose-willow	Wet areas near ridges
Ludwigia glandulosa	False loosestrife	Wet areas near ridges
Ludwigia leptocarpa	Primrose-willow	Wet areas near ridges
Ludwigia peploides	Primrose-willow	Wet areas near ridges
Lycopodium alopecuroides	Foxtail clubmoss	Wet areas near ridges (north shore)
Lygodium japonicum	Japanese climbing fern	Swamp and ridges
Lythrum alatum	Loosestrife	Ridges
Lythrum lineare	Loosestrife	Brackish to fresh marsh and ridges
Marsilea mucronata	Water clover	Wet areas near ridges
Matelea gonocarpa		Swamp and ridges
Mazus japonicus		Ridges
Mecardonia acuminata	Purple mecardonia	Ridges
Medicago arabica	Spotted medick	Ridges
Medicago hispida	Bur-clover	Ridges
Medicago lupulina	Black medic	Ridges
Melia azedach	Chinaberry	Ridges
Melilotus indica	Sweet clover	Ridges
Melochia corchorifolia	Chocolate-weed	Ridges
Melothria pendula	Creeping cucumber	Swamp and ridges

Species	Common Name	Habitat
Mikania scandens	Climbing hempweed	Ridges
Mimosa strigillosa	Sensitive plant	Ridges
Mimulus alatus	Monkey flower	Wet areas near ridges
Modiola caroliniana		Ridges
Mollugo verticillata	Carpetweed	Ridges
Monarda punctata	Horsemint	Ridges
Morus alba	White mulberry	Ridges
Morus rubra	Red mulberry	Ridges
Muhlenbergia schreberi		Ridges
Myosotis macrosperma	Forget-me-not	Ridges
Myrica cerifera	Wax myrtle	Swamp and ridges
Najas guadalupensis	Naiad	Canals and bayous
Nephrolepis exaltata	Sword fern	Ridges
Neptunia lutea	Yellow sensitive plant	Ridges
Nothoscordum bivalve	False garlic	Ridges
Nothoscordum fragrans	False garlic	Ridges
Nymphaea sp.	Waterlily	Intermediate marsh
Nyssa aquatica	Tupelogum	Swamp and ridges
Nyssa sylvatica	Blackgum	Ridges (north shore)
Nyssa sylvatica var. *biflora*	Swamp blackgum	Swamp and ridges
Oenothera biennis	Evening primrose	Ridges
Oenothera laciniata	Evening primrose	Ridges
Oenothera speciosa	Evening primrose	Ridges
Onoclea sensibilis	Sensitive fern	Swamp
Oplismenus setarius	Oak forest grass	Swamp and ridges
Orontium aquaticum	Golden-club	Wet areas near ridges (north shore)
Osmunda cinnamomea var. *cinnomomea*	Cinnamon fern	Swamp (north shore)
Osmunda regalis var spectabilis	Royal fern	Swamp and fresh marsh
Ostrya virginiana	Eastern hophorn bean	Ridges (north shore)
Oxalis stricta	Wood sorrel	Ridges
Panicum anceps	Spreading panicum	Ridges
Panicum capillare	Witch grass	Wet areas near ridges

Species	Common Name	Habitat
Panicum dichotomiflorum	Fall panicum	Wet areas near ridges
Panicum gymnocarpon	Water panicum	Swamp
Panicum hemitomon	Maidencane	Fresh marsh
Panicum hians	Gaping panic grass	Wet areas near ridges (north shore)
Panicum repens	Dogtooth grass	Intermediate and fresh marsh and sand beaches
Panicum virgatum	Switchgrass	Intermediate and fresh marsh
Parthenium hysterophorus	Santa maria	Ridges
Parthenocissus quinquefolia	Virginia creeper	Swamp and ridges
Paspalum conjugatum		Ridges
Paspalum dilatatum	Dallis grass	Ridges
Paspalum dissectum	Mudbank paspalum	Wet areas near ridges
Paspalum floridanum		Ridges
Paspalum fluitans	Water paspalum	Wet areas near ridges
Paspalum langei		Ridges
Paspalum notatum	Bahia grass	Ridges
Paspalum plicatum		Ridges
Paspalum urvillei	Vasey grass	Ridges
Paspalum vaginatum	Jointgrass	Intermediate and fresh marsh and ridges
Passiflora incarnata	Maypop	Ridges
Passiflora lutea	Passion flower	Swamp
Peltandra virginica	Arrow-arum	Wet areas near ridges
Phalaris angusta	Tall canary grass	Fresh marsh and ridges
Phalaris caroliniana	Little canary grass	Ridges
Phragmites communis	Roseau	Intermediate and fresh marsh and ridges
Physalis angulata	Ground cherry	Ridges
Phytolacca americana	Pokeberry	Swamp and ridges
Planera aquatica	Water elm	Ridges
Plantago major	Plantain	Ridges
Plantago virginica	Plantain	Ridges
Platanus occidentalis	Sycamore	Ridges

Species	Common Name	Habitat
Pluchea camphorata	Camphorweed	Brackish and intermediate marsh
Pluchea purpurascens	Marsh fleabane	Intermediate marsh
Poa annua	Six weeks grass	Ridges
Polygala nana	Milkwort	Ridges (north shore)
Polygonum aviculare	Knotweed	Ridges
Polygonum densiflorum	Smartweed	Wet areas near ridges
Polygonum hydropiper	Smartweed	Wet areas near ridges
Polygonum hydropiperoides	Smartweed	Wet areas near ridges
Polygonum punctatum	Water-Smartweed	Swamp and wet areas near ridges
Polypodium polypodioides	Ressurection fern	Swamp on trees
Polypogon monspeliensis	Beardgrass	Ridges
Polyprenum procumbens		Ridges
Pontederia cordata	Pickerelweed	Swamp
Populus deltoides	Eastern cottonwood	Ridges
Populus heterophylla	Swamp cottonwood	Swamp
Portulaca oleracea	Common purslane	Ridges
Prunus serotina	Black cherry	Ridges (north shore)
Psilotum nudum	Whisk fern	Swamp
Ptilimnium costatum	Bishopweed	Fresh marsh
Pyrrhopappus carolinianus	False dandelion	Ridges
Quercus falcata	Southern red oak	Ridges (north shore)
Quercus lyrata	Overcup oak	Swamp and ridges
Quercus marilandica	Chestnut oak	Wet areas near ridges
Quercus nigra	Water oak	Swamp and ridges
Quercus nuttallii	Nuttall oak	Swamp
Quercus virginiana	Live oak	Ridges
Ranunculus muricatus	Buttercup	Ridges
Ranunculus parviflorus	Buttercup	Ridges
Ranunculus pusillus	Buttercup	Ridges
Ranunculus sardous	Buttercup	Wet areas near ridges
Ranunculus scleratus	Buttercup	Wet areas near ridges
Rhexia mariana	Meadow-beauty	Wet areas near ridges (north shore)
Rhus copallinum	Dwarf sumac	Ridges
Rhus radicans	Poison ivy	Swamp and ridges
Rhynchosia minima	Snout bean	Ridges

Species	Common Name	Habitat
Rhynchospora corniculata	Horned rush	Wet areas near ridges
Rhynchospora grayii	Horned rush	Ridges
Rivina humilis	Rouge plant	Ridges
Rorippa islandica	Yellow cress	Ridges
Rorippa sessiflora	Yellow cress	Ridges
Rorippa sylvestris	Creeping yellow cress	Ridges
Rotala ramosior	Tooth-cup	Wet areas near ridges
Rosa bracteata	Macartney rose	Ridges
Rubus spp.	Blackberry	Swamp and ridges
Rubus trivialis	Southern dewberry	Swamp and ridges
Rudbeckia amplexicaulis	Coneflower	Ridges
Rumex crispus	Dock	Ridges
Rumex pulcher	Dock	Ridges
Rumex verticillatus	Swamp dock	Wet areas near ridges
Sabal minor	Palmetto	Swamp and ridges
Sabatia calycina	Gentian	Brackish marsh
Sacciolepis striata	Sacciolepis	Fresh marsh
Sagittaria falcata	Bulltongue	Intermediate and fresh marsh
Sagittaria graminea	Arrowhead	Wet areas near ridges
Sagittaria latifolia	Duck-potato	Fresh marsh
Sagittaria platyphylla	Delta duck potato	Fresh marsh
Salix interior	Sandbar willow	Ridges
Salix nigra	Black willow	Ridges and fresh marsh
Salvia lyrata	Lyre-leaved sage	Ridges
Sambucus canadensis	Elderberry	Ridges
Samolus parviflorus	Water-pimpernel	Swamp
Sanicula canadensis	Snakeroot	Swamp
Sapium sebiferum	Tallow tree	Ridges
Saururus cernuus	Lizard's tail	Swamp
Scirpus californicus	Hardstem bulrush	Intermediate and fresh
Scirpus cyperinus	Wool-grass	Wet areas near ridges (north shore)
Scirpus koilolepis		Wet areas near ridges

Species	Common Name	Habitat
Scirpus lineatus	Bulrush	Wet areas near ridges
Scirpus olneyi	Three cornered grass	Brackish and intermediate marsh
Scirpus robustus	Coco	Brackish marsh
Scirpus validus	Great bulrush	Brackish and intermediate marsh
Scutellaria integrifolia	Skullcap	Wet areas near ridges
Senecio glabellus	Butterweed	Ridges
Servinia oppositifolia		Ridges
Sesbania exaltata	Wild-coffee (sesbania)	Intermediate and fresh marsh and ridges
Setaria faberii	Foxtail	Ridges
Setaria geniculata	Foxtail	Ridges
Setaria glauca	Yellow foxtail	Ridges
Setaria magna	Giant foxtail	Fresh marsh
Sicyos angulatus	Bur-cucumber	Ridges
Sida rhombifolia	Ironweed	Ridges
Sida spinosa	Prickly mallow	Ridges
Sisyrinchium altlantium	Blue eyed grass	Ridges
Smilax bona-nox	Greenbriar	Ridges
Smilax glauca	Greenbriar	Ridges
Smilax laurifolia	Greenbriar	Ridges
Smilax walteri	Greenbriar	Ridges
Solanum americanum	Nightshade	Ridges
Solanum carolinense	Horse nettle	Ridges
Solanum nigrum	Nightshade	Ridges
Solidago altissima	Goldenrod	Ridges
Solidago sempervirens	Seaside goldenrod	Brackish marsh
Soliva sessilis		Ridges
Sonchus asper	Spiny-leaved sowthistle	Ridges
Sorghum halapense	Johnson grass	Ridges
Sparganium americanum	Bur-reed	Swamp
Spartina alterniflora	Oystergrass	Brackish marsh
Spartina cynosuroides	Hogcane	Intermediate marsh on elevated areas

Species	Common Name	Habitat
Spartina patens	Wiregrass	Brackish and intermediate marsh
Specularia biflora	Venus's looking-glass	Ridges
Specularia perfoliata	Venus's looking-glass	Ridges
Sphenoclea zeylandica	Gooseweed	Ridges
Sphenopholis obtusata	Prairie wedgegrass	Ridges
Spilanthes americana	Creeping spilanthes	Ridges
Spiranthes cernua	Ladies tresses	Ridges
Spirodela polyrhiza	Great duckweed	Swamp-bayous-canals
Sporobolus poiretii	Smut grass	Ridges
Sporobolus virginicus	Coast dropseed	Brackish marsh
Stachys arvensis	Hedge nettle	Ridges
Stachys floridana	Hedge nettle	Ridges
Stellaria media	Chickweed	Ridges
Stenotraphrum secundatum	St. Augustine grass	Ridges
Strophostyles helvola	Wild bean	Ridges
Taraxacum officinale	Dandelion	Ridges
Taxodium distichum	Baldcypress	Swamp and ridges
Teucrium canadense	Germander	Ridges
Thelypteris palustris var. *haleana*	Southern marsh fern	Wet areas near ridges
Tillandsia usneoides	Spanish moss	Swamp, on trees
Trachelospermum difforme	Climbing dogbane	Ridges
Tradescantia ohiensis	Spiderwort	Swamp
Trifolium dubium	Hop clover	Ridges
Trifolium pratense	Red clover	Ridges
Trifolium procumbens	Clover	Ridges
Trifolium repens	White clover	Ridges
Trifolium resupinatum	Reversed clover	Ridges
Tripsacum dactyloides	Gama grass	Brackish marsh
Typha domingensis	Narrow-leaved cat-tail	Fresh marsh
Typha latifolia	Broad-leaved cat-tail	Fresh marsh
Ulmus alata	Winged elm	Ridges
Ulmus americana	American elm	Swamp and ridges
Ulmus parviflora	Chinese elm	Ridges (cultivated)
Uniola sessiflora		Ridges (north shore)
Urtica chamaedryoides	Stinging nettle	Ridges

Species	Common Name	Habitat
Urticularia sp.	Bladderwort	Canals and bayous
Valerianella radiata	Corn salad	Ridges
Verbena bonariensis	Vervain	Ridges
Verbena brasiliensis	Vervain	Ridges
Verbena halei	Vervain	Ridges
Verbena littoralis	Vervain	Ridges
Verbena rigida	Vervain	Ridges
Verbena tenuisecta	Vervain	Ridges
Verbesina virginica	Virginia crownbeard	Ridges
Vernonia altissima	Ironweed	Ridges
Veronica peregrina	Neckweed	Ridges
Veronica persica	Speedwell	Ridges
Vicia angustifolia	Narrow-leaved vetch	Ridges
Vicia ludoviciana	Common vetch	Ridges
Vigna luteola	Deerpea	Intermediate marsh and ridges
Viola lanceolata	Lance-leaved violet	Wet areas near ridges (north shore)
Viola papilionacea	Violet	Wet areas near ridges
Vitis rotundifolia	Muscadine	Swamp
Wolffia sp.	Water meal	Swamp
Wolffiella sp.	Wolffiella	Swamp
Woodwardia virginica	Virginia chain fern	Swamp
Xanthium strumarium	Cocklebur	Ridges
Zizaniopsis miliacea	Giant cutgrass	Fresh marsh

APPENDIX A
UNIT 3

SPECIES BY HABITAT LISTED BY FAMILY IN ST. BERNARD PARISH (FROM LEMAIRE, 1961)

Numbers 1 through 5 indicate relative abundance as follows:
(1) rare (2) infrequent (3) frequent (4) common (5) abundant

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Selaginellaceae					
Selaginella sp.	2				
Osmundaceae					
Osmunda regalis var. *spectabilis*					2
Polypodiaceae					
Dryopteris normalis		2			
Asplenium platyneuron	2	3			
Pteris vittata		on brick fort (Martello Castle)			
Polypodium polypodioides	2	2			
Salviniaceae					
Azolla caroliniana			2		4
Pinaceae					
Taxodium distichum			2		5
Typhaceae					
Typha domingensis			3		

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Zosteraceae					
Potamogeton pusillus			2		
Ruppia maritima			2	3	
Zannichellia palustris			3		
Najadaceae					
Najas guadalupensis			5		
Alismataceae					
Sagittaria falcata			4		
Hydrocharitaceae					
Limnobium spongia			2		
Vallisneria americana			1		
Gramineae					
Arundinaria gigantea		2			
Tripsacum dactyloides		2			
Poa anua		2			
Bromus catharticus		1			
Distichlis spicata	2	3	3	5	
Phragmites communis	2	4	3		
Elymus virginicus	3	2			
Sphenopholis obtusata	1	2			
Sphenopholis intermedia		2			
Sporobolus poiretti	2				
Axonopus affinis		1			
Polypogon monspeliensis		2			
Polypogon interruptus					
Muhlenbergia screberi		2			

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Gramineae (cont'd)					
Spartina cynosuroides		4	3	2	2
Spartina alterniflora			3	5	
Spartina patens	2	2	5	3	
Stenotaphrum secundatum		4			
Cynodon dactylon		3			
Eleusine indica		1			
Leptochloa nealleyi			2		
Phalaris angusta		2			
Phalaris caroliniana		2	1		
Zizaniopsis miliacea			2		2
Digitaria sanguinalis		1			
Paspalum distichum		1			
Paspalum vaginatum		2			
Paspalum urvillei		2			
Paspalum dilatatum		1			
Panicum dichotomiflorum		1			
Panicum repens			1		
Panicum virgatum		3	2		
Panicum anceps		1			
Panicum ciliatum		2	2		
Sacciolepis striata		2			
Oplismenus setarius	2				2
Echinochloa colonum		1			
Echinochloa crusgalli			2		
Setaria geniculata	2	2	3	1	
Setaria magna		2	3		
Erianthus giganteus		1			
Andropogon glomeratus	2	2			
Sorghum halapense		2			

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Cyperaceae					
Cyperus filicinus			4		1
Cyperus haspan	1		1		
Cyperus rotundus				1	
Cyperus virens				1	
Cyperus strigosus			4		
Cyperus brevifolis				1	
Cyperus ferruginescens			2	2	
Eleocharis parvula					
Eleocharis tennis	2			2	
Eleocharis ambigens			1		
Eleocharis albida		1	2		
Fimbristylis castanea		3	2		
Scirpus olneyi			5		
Scirpus validus			4		
Scirpus californicus			3		
Scirpus robustus		2	4		
Cladium jamaicense	2		2	2	
Carex tribuloides				2	
Carex sp.					1
Palmaceae					
Sabal minor	5			3	3
Lemnaceae					
Lemna minor	4		4		
Wolffia columbiana	3		4		
Wolffiella floridana	3		4		
Wolfiella lingulata	3		4		

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Bromeliaceae					
Tillandsia usneoides	5			3	5
Commelinaceae					
Commelina erecta var. *angustifolia*					2
Commelina diffusa					3
Tradescantia ohiensis				2	3
Pontederiaceae					
Eichornia crassipes			2		4
Pontederia cordata					2
Juncaceae					
Juncus effusus			1		1
Juncus roemerianus			2	5	
Juncus tenuis		2			
Liliaceae					
Allium canadense	2				
Nothoscordum bivalve	2				
Yucca aloifolia	3	1			3
Smilax bona-nox	3				2
Smilax rotundifolia					
Amaryllidaceae					
Hymenocallis occidentalis			1		
Crinum americanum			2		
Iridaceae					
Iris giganticaerulea			3		

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Cannaceae					
Canna sp.		1			
Saururaceae					
Saururus cernuus					2
Salicaceae					
Salix nigra		2		4	
Myricaceae					
Myrica cerifera		2			4
Juglandaceae					
Carya illinoensis		1			
Fagaceae					
Quercus virginiana	5	4			2
Quercus nigra		2			3
Ulmaceae					
Ulmus americana		3			4
Ulmus alata		2			
Celtis laevigata	2	3			4
Moraceae					
Morus rubra	2	1			
Urticaceae					
Parietaria floridana	2	2			
Urtica chamaedryoides	2				

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Polygonaceae					
Rumex pulcher		2			
Polygonum punctatum		3	5		
Polygonum densiflorum			1		
Brunnichia cirrhosa	3	3		3	
Chenopodiaceae					
Chenopodium berlandieri	1	2			
Chenopodium ambrosioides		1			
Chenopodium album		2			
Salicornia virginica		3	4		
Suaeda linearis		2	2		
Amaranthaceae					
Acnida alabamensis			3	1	
Iresine rhizomatosa		2			
Alternanthera philoxeroides		3	4		3
Phytolaccaceae					
Phytolacca americana	3	3			
Batidaceae					
Batis maritima			4		
Aizoaceae					
Sesuvium maritimum		1			

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Caryophyllaceae					
Spergularia marina			2		
Stellaria media		2			
Cerastium viscosum		2			
Ceratophyllaceae					
Ceratophyllum demersum			4		
Ranunculaceae					
Ranunculus sceleratus		2			
Ranunculus lindheimeri		1			
Lauraceae					
Persea borbonia	2				3
Cruciferae					
Lepidium virginicum	3	3			
Coronopus didymus		1			
Cardamine pennsylvanica		2		2	
Cardamine parviflora		1			
Hamamelidaceae					
Liquidambar styraciflua					3
Rosaceae					
Rubus trivialis	3	3			
Rubus sp.		3			
Rosa laevigata		2			
Prunus caroliniana	4				

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Leguminosae					
Desmanthus illinoensis		2			
Gleditsia triacanthos	3	3			3
Trifolium repens		2			
Trifolium dubium		2			
Medicago lupulina		2			
Melilotus indica		2			
Sesbania exaltata			3		
Desmodium paniculatum		2			
Vicia ludoviciana	2	2			
Vigna repens	2	3	2		
Galactia volubilis		1			
Daubentonia drummondii		2			
Rutaceae					
Zanthoxylum clava-herculis	3	2			
Oxalidaceae					
Oxalis stricta	3	3			
Oxalis corniculata		2			
Geraniaceae					
Geranium carolinianum		2			
Meliaceae					
Melia azedarach	3	3			
Euphorbiaccae					
Chamaesyce tracyi		1			

List of Plants	Indian shell mounds	Canal spoil banks, bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Anacardiaceae					
Rhus copallina	3	2			
Rhus glabra	1				
Rhus radicans	4	2			4
Aquifoliaceae					
Ilex vomitoria	4	3			2
Ilex decidua	2				2
Illex cassine	2	1			2
Aceraceae					
Acer rubrum		2			4
Rhamnaceae					
Berchemia scandens					3
Vitaceae					
Ampelopsis arborea					3
Vitis cinerea		2			
Vitis vulpina					
Cissus incisa	3	2			
Parthenocissus quinquefolia	2	2			
Malvaceae					
Modiola caroliniana		2			
Sida rhombifolia		1			
Sida rubromarginata	2	2			
Kosteletskya virginica var. *alteaefolia*		3	3		2
Hibiscus lasiocarpus		2	3		2

List of Plants	Indian shell mounds	Canal spoil banks bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Guttiferae					
Ascyrum linifolium		2			
Tamaricaceae					
Tamarix pentandra		1			
Passifloraceae					
Passiflora incarnata		2	2		
Cactaceae					
Opuntia sp.	3	1			
Lythraceae					
Ammania teres		2	2		
Lythrum lineare			5	3	
Nyssaceae					
Nyssa aquatica					2
Nyssa sylvatica					3
Onagraceae					
Isnardia intermedia					1
Ludwigia palustris					2
Umbelliferae					
Hydrocotyle verticillata		2	3		3
Chaerophyllum dasycarpum					3
Circuta maculata var. *curtissii*		2			2
Apium leptophyllum		3			
Apium graveolens		1			

List of Plants	Indian shell mounds	Canal spoil banks bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Umbelliferae (cont'd)					
Ptilimium nuttallii			2		3
Lilaeopsis chinensis			3	3	
Lilaeopsis carolinensis			1		
Cornaceae					
Cornus drummondii		1			3
Primulaceae					
Centunculus minimus			2		2
Samolus parviflorus			3	2	
Ebenaceae					
Diospyros virginiana	2	2			
Sapotaceae					
Bumelia lanuginosa	2				
Oleaceae					
Fraxinus pennsylvanica					3
Fraxinus profunda					2
Gentianaceae					
Sabatia stellaris			4	2	
Asclepiadaceae					
Gonolobus gonocarpos	2	2			2
Lyonia pulustris	2		3	3	

List of Plants	Indian shell Mounds	Canal spoil banks bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Convolvulaceae					
Dichondra repens	3	3			
Ipomoea sagittata		3	3	3	
Ipomoea trichocarpa		1			
Convolvulus sepium		3	3		
Cuscutaceae					
Cuscuta indecora	3	3	3		
Boraginaceae					
Heliotropium curassvicum		2	2	2	
Onosmodium hispidissimum	1				
Berbenaceae					
Verbena bonariensis		2			
Verbena brasiliensis	2	2			
Verbena scabra		1			
Verbena xutha		2			
Lantana camara		2			
Callicarpa americana		3			
Avicenniaceae					
Avicennia nitida				5	
Labiatae					
Teucrium nashii	2	2			
Scutellaria ovata	2				
Lamium amplexicaule		2			

List of Plants	Indian shell mounds	Canal spoil banks bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Solanaceae					
Solanum nigrum	3				
Lycium carolinianum	2	2	2	2	
Physalis pubescens		1			
Scrophulariaceae					
Bacopa monnieri		3	3	3	3
Veronica agrestis		2			
Veronica peregrina		2			
Gratiola virginiana					2
Gerardia purpurca			2		
Gerarlia maritima var. *grandiflora*			2	2	
Rubiaceae					
Galium aparine	2	2			
Galium tinctorium		1			
Cephalanthus occidentalis		1			2
Caprifoliaceae					
Sambucus simpsonii	3	3			
Lonicera japonica		2			2
Cucur bitaceae					
Melothria pendula	2	2			
Melothria crassifolia	1				
Cucurbita pepo (escape)		1			
Campanulaceae					
Specularia biflora		2			

List of Plants	Indian shell mounds	Canal spoil banks bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Compositae					
Eupatorium pinnatifidum		1			
Eupatorium serotinum		2			
Eupatorium capillifolium	2	2			
Mikania scandens	2	2			
Solidago graminifolia var. *mexicana*	3	3	2		
Solidago sempervirens		2			
Boltonia diffusa		1	1		
Aster prealtus var. *subasper*	2	3			
Aster subulatus var. *euroauster*			2		2
Aster exilis		3			
Aster tenuifolius	2	2	3	3	
Aster ericoides		1			
Erigeron canadensis		2			
Erigeron philadelphicus		2			
Baccharis halimifolia	3	5	3		3
Baccharis angustifolia		1			
Pluchea purpurascens		3			
Pluchea camphorata		3	2		
Gnaphalium purpureum		2			
Facelis apiculata		1			
Iva frutescens	3	5	3	3	3
Iva ciliata		2			
Ambrosia trifida		3			
Ambrosia artemisiifolia var. *paniculata*		2			
Parthenium hysterophorus		2			
Eclipta alba					2

List of Plants	Indian shell mounds	Canal spoil banks bayou natural levees and oak ridges	Brackish marsh	Salt marsh	Swamp
Compositae (cont'd)					
Verbesina virginica		2			
Coreopsis longifolia		1			
Borrichia frutescens	2	2		4	
Soliva sessilis		1			
Gymnostyles anthemifolia		1			
Anthemis cotula		1			
Erechtites hieracifilia		2			
Senecia glabellus		3			
Cirsium horridulum forma		2			
elliottii		2			
Taraxacum officinale	2	2			
Sonchus oleraceus		2			
Sonchur asper		1			
Lactuca floridana					

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HURRICANE PROTECTION PROJECT

APPENDIX B
UNIT 1

A LIST OF THE ANIMALS
IN THE STUDY AREA

MAMMALS

Big-brown bat
Eptesicus fuscus

Black rat
Rattus rattus

Cotton mouse
Peromyscus gossypinus

Cotton rat
Sigmodon hispidus

Cottontail rabbit
Sylvilagus floridanus

Eastern harvest mouse
Reithrodontomys humulis

Eastern mole
Scalopus aquaticus

Eastern spotted skunk
Spilogale putorius indianola

Eastern wood rat
Neotoma floridana

Evening bat
Nycticeius humeralis

Florida yellow bat
Lasiurus intermedius

Fox squirrel
Sciurus niger

Free-tailed bat
Tadarida brasiliensis

Fulvous harvest mouse
Reithrodontomys fulvescens

Golden mouse
Ochrotomys nuttalli

Gray fox
Urocyon cineroargenteus

Gray squirrel
Sciurus carolinensis

Hispid cotton mouse
Perognathus hispidus

Hispid cotton rat
Neotoma floridana

House mouse
Mus musculus

Least shrew
Cryptotis parva

Long-tailed shrew
Sorex longirostris

MAMMALS (Cont'd)

Long-tailed weasel
Mustela frenata

Louisiana vole
Microtus ludovicianus

Marsh rice rat
Oryzomys palustris

Mink
Mustela vison

Muskrat
Ondatra zibethicus

Nine-banded armadillo
Dasypus novemcinctus

Nutria
Myocastor coypus

Opossum
Didelphis virginiana

Otter
Lutra canadensis

Pine mouse
Pitymys pinetorum

Raccoon
Procyon lotor varius

Rafinesque big-eared bat
Plecotus rafinesquii

Red bat
Lasiurus seminolus

Red fox
Vulpes fulva

Ring-tailed cat
Bassariscus astutus

Seminole bat
Lasiurus seminolus

Short-tailed shrew
Blarina brevicauda

Southeastern myotis
Myotis australoriparius

Southern flying squirrel
Glaucomys volans

Striped skunk
Memphitis memphitis

Swamp rabbit
Sylvilagus aquaticus

White-tailed deer
Odocoileus virginianus

BIRDS (from Lowery, 1960)
UNIT 2

Acadian flycatcher
Empidonax virescens

American bittern
Botaurus lentigenosus

American coot (poule d'eau)
Fulica americana

American goldfinch
Spinus tristis

American oystercatcher
Haematopus palliatus

American pintail
Anas acuta

American redstart
Setophaga ruticilla

American widgeon (baldpate)
Mareca americana

Bachman's sparrow
Aimophila aestivalis

Bank swallow
Riparia riparia

Barn owl
Alba pratincola

Barn swallow
Hirundo rustico

Bay breasted warbler
Dendroica castanea

Belted kingfisher
Megaceryle alcyon

Black and white warbler
Mniotilta varia

Blackburnian warbler
Dendroica fusca

Black-bellied plover
Squatarola squatarola

Black-crowned night heron (gros-bec)
Nycticorax nycticorax

Black duck
Anas rubripes

Black skimmer
Rynchops nigra

Black tern
Chlidonias nigra

Black vulture
Coragyps atratus

Black-throated green warbler
Dendroica nigrescens

Blue goose
Chen coerulescens

Blue-gray gnatcatcher
Polioptila caerulea

Blue grosbeak
Guiraca caerulea

Blue jay
Cyanocitta cristata

BIRDS (Cont'd)

Blue-winged teal
Anas discors

Boat-tailed grackle
Cassidix mexicanus

Bobolink
Dolichonyx oryzivorus

Bobwhite
Colinus virginianus

Bonaparte's gull
Larus philadelphia

Brewer's blackbird
Euphagus cyanocephalus

Broad-winged hawk
Buteo platypterus

Brown booby
Sula leucagaster

Brown-headed cowbird
Molothrus ater

Brown-headed nuthatch
Sitta pusilla

Brown thrasher
Toxostoma rufum

Buff-breasted sandpiper
Tryngites subruficollis

Bufflehead
Blaucionetta clangula

Bullock's oriole
Icterus bullockii

Burrowing owl
Speotyto cunicularia

Canada goose
Branta canadensis

Canvasback
Aythya valisineria

Cardinal
Richmondena cardinalis

Carolina chickadee
Parus carolinensis

Carolina wren
Thryothorus ludovicianus

Caspian tern
Hydroprogne caspia

Catbird
Dumetella carolinensis

Cattle egret
Bubulicus ibis

Cedar waxwing
Bombycilla cedrorum

Cerulean warbler
Dendroica cerulea

Chimney swift
Chaetuta pelagica

Chipping sparrow
Spizella passerina

Chuck-wills-widow
Caprimulgus carolinensis

Clapper rail
Rallus longirostris

Common crow
Corvus brachyrhynchos

Common egret
Casmerodius albus

Common gallinule
Gallinula chloropus

Common goldeneye
Bucephala clangula

Common grackle
Quiscalus quiscula

Common loon
Gavia immer

Common nighthawk
Chordeiles minor

Common snipe
Capella gallinago

Common tern
Sterna hirundo

Cooper's hawk
Accipiter cooperii

Double-crested cormorant
Phalacrocorax auritus

Downy woodpecker
Dendrocopos pubescens

Eastern bluebird
Sialia sialis

Eastern kingbird
Tyrannus tyrannus

Eastern meadowlark
Sturnella magna

Eastern phoebe
Sayornis phoebe

Eastern wood pewee
Contopus virens

Field sparrow
Spizella pusilla

Fish crow
Corvus ossifragus

Forster tern
Sterna foresteri

Gadwall (gray duck)
Anas strepera

Golden-crowned kinglet
Regulus satrapa

Golden plover
Pluvialis dominica

Golden-winged warbler
Vermivora chrysoptera

Gray-cheeked thrush
Hylocichla minima

Great blue heron
Ardea herodias

Great horned owl
Bubo virginianus

Greater yellowlegs
Totanus melanoleucus

Green heron
Butorides virescens

Green-winged teal
Anas discors

Groove-billed ani
Crotophaga sulcirostris

BIRDS (Cont'd)

Ground dove
Columbigallina passerina

Gull-billed tern
Gelochelidon nilotica

Harlan's hawk
Buteo harlani

Henslow's sparrow
Passerherbulus henslowii

Hermit thrush
Hylocichla guttata

Herring gull
Larus argentatus

Hooded merganser
Lophodytes cucullatus

Hooded warbler
Wilsonia citrina

Horned grebe
Podiceps auritus

House sparrow
Passer domesticus

House wren
Troglodytes aedon

Indigo bunting
Passerina cyanea

Kentucky warbler
Oporornis formosus

Killdeer
Charadrius vociferus

King rail
Rallus elegans

Knot
Calidris canutus

Laughing gull
Larus atricilla

Least bittern
Ixobrychus exilis

Least sandpiper
Erolia minutilla

Least tern
Sterna albifrons

Le Conte's sparrow
Passerherbulus caudacutus

Lesser scaup (dos-gris)
Aythya affinis

Lesser yellowlegs
Totanus flavipes

Lincoln's sparrow
Melospiza lincolnii

Little blue heron
Florida caerulea caerulea

Loggerhead skrike (catbird)
Lanius ludovicianus

Long-billed marsh wren
Telmatodytes palustris

Long-billed curlew
Numenius americanus

Long-billed dowitcher
Limnodromus scolopaceus

Louisiana heron
Hydranassa tricolor

BIRDS (Cont'd)

Magnolia warbler
Dendroica magnolia

Mallard (French duck)
Anas platyrhynchos

Marsh hawk
Circus cyaneus

Mockingbird
Mimus polyglottos

Mottled duck (Summer duck)
Anas fulvigula

Myrtle warbler
Dendroica coronata

Northern waterthrush
Seiurus noveboracensis

Oldsquaw
Clangula hyemalis

Orange-crowned warbler
Vermivora celata

Orchard oriole
Icterus spurius

Painted bunting
Passerina ciris

Parula warbler
Parula americana

Pectoral sandpiper
Erolia melanotos

Philadelphia vireo
Vireo philadelphicus

Pied-billed grebe
Podilymbus podiceps

Pine warbler
Dendroica pinus

Piping plover
Charadrius melodus

Pileated woodpecker
Dryocopus pileatus

Purple martin
Progne subis subis

Prothonotary warbler
Protonotaris citrea

Red-bellied woodpecker
Centurus carolinus

Red-breasted merganser
Mergus serrator

*Red-cockaded woodpecker
Dendrocopus borealis

Red-eyed vireo
Vireo olivaceus

Redhead
Aythya americana

Red-headed woodpecker
Melanerpes erythrocephalus

Red-shouldered hawk
Buteo lineatus

Red-tailed hawk
Buteo jamaicensis

Red-winged blackbird
Agelaius phoeniceus

Ring-billed gull
Larus delawarensis

BIRDS (Cont'd)

Ring-neck duck
Aythya collaris

Robin
Turdus migratorius

Rock dove
Columba livia

Rose-breasted grosbeak
Pheucticus ludovicianus

Royal tern
Thalasseus maximum

Ruby-crowned kinglet
Regulus calendula

Ruddy duck
Oxyura jamaicensis

Ruddy turnstone
Arenaria interpres

Rufous-sided towhee
Pipilo erythrophthalmus

Rusty blackbird
Euphagus carolinus

Sanderling
Crocethia alba

Savannah sparrow
Passerculus sandwichensis

Scarlet tanager
Piranga olivacea

Screech owl
Otus asio

Seaside sparrow
Ammospiza maritima

Semipalmated plover
Charadrius hiaticula

Sharp-shinned hawk
Accipter striatus

Sharp-tailed sparrow
Ammospiza caudaduta

Short-billed dowitcher
Limnodromus griseus

Short-billed marsh wren
Cistothorus platensis

Short-eared owl
Asio flammeus

Shoveler
Spatula clypeata

Snow goose
Chen hyperborea

Snowy egret
Leuophoyx thula

Solitary sandpiper
Tringa solitaria

Solitary vireo
Vireo solitarias

Song sparrow
Melospiza melodis

Sora
Porzana carolina

*Southern bald eagle
Haliaeetus leucocephalus

Sparrow hawk
Falco sparverius

Spotted sandpiper
Actitis macularis

Starling
Sturnus vulgaris

Stilt sandpiper
Mictopalama himantopus

Summer tanager
Piranga rubra

Swainson's thrush
Hylocichla ustulata

Swainson's warbler
Limnothlypsis swainsonii

Swallow-tailed kite
Elanoides forficatus

Swamp sparrow
Melospiza georgiana

Tennessee warbler
Vermivora peregrina

Traill's flycatcher
Empidonax traillii

Tree swallow
Iridoprocne bicolor

Tufted titmouse
Parus bicolor

Turkey
Meleagris gallopavo

Turkey vulture
Cathartes aura

Upland plover
Bartramia longicauda

Veery
Hylocichla fuscesscens

Vermilion flycatcher
Pyrocephalus rubinus

Vesper sparrow
Pooecetes gramineus

Virginia rail
Rallus limicola

Water pipit
Anthus spinoletta

Warbling vireo
Vireo gilvus

Western sandpiper
Ereunetes mauri

White-eyed vireo
Vireo griseus

White-fronted goose
Anser albifrons

White ibis
Eudocimus albus

White pelican
Pelecanus erythrorhynchos

White-rumped sandpiper
Erolia fuscicollis

White-throated sparrow
Zonotrichia albicollis

Whimbrel
Numemius phaeopus

Wilson's phalarope
Steganopus tricolor

Wilson's plover
Charadrius wilsonia

Wilson's warbler
Wilsonia pusilla

Winter wren
Troglodytes troglodytes

Woodcock
Philohela minor

Wood duck
Aix sponsa

Wood ibis
Mycteria americana

Wood thrush
Hylocichla mustelina

Worm-eating warbler
Helmitheros vermivorus

Yellow-billed cuckoo
Coccyzus americanus

Yellow-bellied flycatcher
Empidonax flaviventris

Yellow-bellied sapsucker
Sphyrapicus varius

Yellow-breasted chat
Icteria virens

Yellow-crowned night heron
Nycticorax violacea

Yellow rail
Coturnicops noveboracensis

Yellow-shafted flicker
Colaptes auratus

Yellow throat
Geothlypis trichas

Yellow-throated vireo
Vireo flavifrons

Yellow-throated warbler
Dendroica dominica

Yellow warbler
Dendroica petechia

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*Endangered species.

APPENDIX B
UNIT 3

A LIST OF SOME SPECIES OF FISHES FROM THE STUDY AREA

I--FRESHWATER SPECIES

Alligator gar
Lepisosteus spatula

Blacktail shiner
Notropis venustus

Bowfin
Amia calva

Carp
Cyprinus carpio

Creek chub
Semotilus atromaculatus

Gizzard shad
Dorosoma cepedianum

Longnose gar
Lepisosteus osseus

Paddle fish
Polyodon spathula

Redfin shiner
Notropis umbratilis

Red shiner
Notropis lutrensis

Shortnose gar
Lepisosteus platostomus

Shovelnose sturgeon
Scaphirhynchus platorychos

Silver chub
Hybopsis storeriana

Silverbank shiner
Notropis shumardi

Silvery minnow
Hybognathus nuchalis

Southern brook lamprey
Iehthyomyzon gagei

Southern striped shiner
Notropis chrysocephalus isolepis

Speckled chub
Hybopsis aestivalis

Spotted gar
Lepisosteus oculatus

Threadfin shad
Dorosoma petenense

II--SALTWATER-ESTUARINE SPECIES

American eel
Anguilla rostrata

Atlantic bumper
Chloroscrombrus chrysurus

II--SALTWATER-ESTUARINE SPECIES (Cont'd)

Atlantic croaker
Micropogon undulatus

Atlantic cutlassfish
Trichiurus lepturus

Atlantic midshipman
Porichthys porosissimus

Atlantic needlefish
Strongylura marina

Atlantic spadefish
Chaetodipterus faber

Atlantic stingray
Dasyatis sabina

Atlantic threadfin
Polydactylus octonemus

Banded drum
Larimus fasciatus

Bay anchovy
Anchoa mitchelli

Bay whiff
Citharichthys spilopterus

Bayou killifish
Fundulus pulverus

Bighead searobin
Prionotus tribulus

Bigmouth buffalo
Ictiobus cyprinellus

Black buffalo
Ictiobus niger

Black bullhead
Ictalurus melas

Blackcheek tonguefish
Symphurus plagiusa

Black crappie
Pomoxis nigromaculatus

Black drum
Pogonias cromis

Blue catfish
Ictalurus furcatus

Blue fish
Pomatomus saltatrix

Blue gill
Lepomis macrochirus

Blue runner
Caranx crysos

Bull shark
Carcharhinus leucas

Channel catfish
Ictalurus punctatus

Clown goby
Microgobius gulosus

Cobia
Rachycentron canadum

Crevalle jack
Caranx hippos

Diamond killifish
Adinia xenica

Fat sleeper
Dormitator maculatus

Flathead catfish
Pylodictis olivaris

II--SALTWATER-ESTUARINE SPECIES (Cont'd)

Florida blenny
Chasmodes saburrae

Florida pompano
Trachinotus carolinos

Flounder
Syacium sp.

Freckled blenny
Hypsoblennius ionthas

Freckled madtom
Noturus nocturnus

Freshwater drum
Aplodinotus grunniens

Freshwater goby
Gobionellus shufeldti

Gafftopsail catfish
Bagie marinus

Gizzard shad
Dorosoma cepedianum

Gray snapper
Lutjanus griseus

Greater amberjack
Seriola dumerili

Green sunfish
Lepomis cyanellus

Gulf menhaden
Brevoortia patronus

Gulf pipefish
Syngnathus scovelli

Gulf toadfish
Opsanus beta

Hogchoker
Trinectes maculatus

Inshore lizardfish
Synodus foetens

Jew fish
Epinephelus itajara

Lady fish
Elops saurus

Largemouth bass
Micropterus punctulatus

Least killifish
Heterandria formosa

Least puffer
Sphorroides parvus

Leatherjacket
Oligoplites saurus

Lesser amberjack
Seriola fasciata

Lined sole
Archirus lineatus

Longear sunfish
Lepomis magalotis

Longnose killifish
Fundulus similis

Lookdown
Selene vomer

Louisiana pipefish
Syngnathus louisianae

Marked goby
Gobionellus stigmaticus

II--SALTWATER-ESTUARINE SPECIES (Cont'd)

Marsh killifish
Fundulus confluentus

Mississippi silverside
Menidia audens

Mosquito fish
Gambusia affinis

Naked goby
Gobiogoma bosci

Orangespotted sunfish
Lepomis humilis

Pinfish
Lagodon rhomboides

Rainwater killifish
Lucania parva

Red drum
Sciaenops ocellata

Red snapper
Lutjanus campechanus

Redear sunfish
Lepomis microlophus

Rough silverside
Membras martinica

Sailfin molly
Poecilia latipinna

Sand seatrout
Cynoscion arenarius

Scaled sardine
Harengula pensacolae

Scup
Stenotomus chrysops

Sea catfish
Arius felis

Sharptail goby
Gobionellus hastatus

Sheepshead
Archosargus probatocephalus

Sheepshead minnow
Cyprinodon variegatus

Silver jenny
Eucinostomus gula

Silver perch
Bairdiella chrysura

Silver seatrout
Cynoscion nothus

Skilletfish
Gobiesox strumosus

Skipjack herring
Alosa chrysochloris

Smallmouth buffalo
Ictiobus bubalus

Smalltooth sawfish
Pristis pectinatus

Southern flounder
Paralichthys lethostigma

Southern hake
Urophycis floridanus

Southern kingfish
Menticirrus americanus

Spanish mackerel
Scomberomorus maculatus

II--SALTWATER-ESTUARINE SPECIES (Cont'd)

Speckled worm eel
Myrophis punctatus

Spiny cheek sleeper
Eleortris pisonis

Spot
Leiostomus xanthurus

Spot fin mojarra
Eucinostomus argenteus

Spotted bass
Micropterus punctulatus

Spotted seatrout
Cynoscion nebulosus

Spotted sunfish
Lepomis punctatus

Striped anchovy
Anchoa hepsetus

Striped mullet
Mugil cephalus

Tarpon
Megalops atlantica

Threadfin shad
Dorosoma petenense

Tidewater silverside
Menidia beryllina

Triple tail
Lobotes surninamensis

Violet goby
Godioides broussonneti

Warmouth
Lepomis gulosus

Warsaw grouper
Epinephelus nigritur

White bass
Morone chrysops

White crappie
Pomoxis annularis

White mullet
Mugil curema

Yellow bass
Morone mississipiensis

Yellow bullhead
Ictalurus natalis

Yellowtail snapper
Ocyurus chrysurus

APPENDIX B
UNIT 4

A LIST OF SOME SPECIES OF
AMPHIBIANS FROM THE STUDY AREA

Barking treefrog
Hyla gratiosa

Bronze frog
Rana clamitans

Bullfrog
Rana catesbiana

Central newt
Notophthalmus viridescens

Dusky gopher frog
Rana areolata areolata

Dwarf salamander
Manculus quadridigitatus

Eastern lesser siren
Siren intermedia intermedia

Eastern narrow-mouthed toad
Gastrophryne caroliniensis carolinensis

Eastern tiger salamander
Ambystoma tigrinum tigrinum

Eastern spadefoot
Scaphiopus holbrooki holbrooki

Fowler's toad
Bufo woodhousei fowleri

Gray treefrog
Hyla versicolor

Gulf coast mud salamander
Pseudotriton montanus

Gulf coast toad
Bufo valiceps

Gulf coast waterdog
Necturus beyeri

Marbled salamander
Ambystoma opacum

Mole salamander
Ambystoma talpoideum

Northern cricket frog
Acris crepitans crepitans

Northern spring peeper
Hyla crucifer crucifer

Oak toad
Bufo quericus

Ornate chorus frog
Pseudacris ornata

Pig frog
Rana grylio

Pine woods treefrog
Hyla fermoralis

Slimy salamander
Plethodon glutinosus

Small-mouthed salamander
Ambystoma texanum

Southern chorus frog
Pseudacris nigrita

AMPHIBIANS (Cont'd)

Northern cricket frog
Acris crepitans crepitans

Southern dusky salamander
Desmognathus auriculatus

Southern leopard frog
Rana pipiens sphenocephala

Southern red salamander
Pseudotriton ruber vioscai

Southern toad
Bufo terrestris

Southern two-lined salamander
Eurycea bislineata cirrigera

Squirrel treefrog
Hyla squirella

Two-toed amphiuma
Amphiuma means means

Upland chorus frog
Pseudacris triseriata feriarum

Western bird-voiced treefrog
Hyla avivoca avivoca

APPENDIX B
UNIT 5

A LIST OF SOME SPECIES OF
TURTLES FROM THE STUDY AREA

TURTLES

Alligator snapping turtle
Macroclemys temmincki

Common snapping turtle
Chelydra serpentina

Eastern chicken turtle
Deirochelys reticularia reticularia

Gopher tortoise
Gopherus polyphemus

Gulf coast box turtle
Terrapene carolina major

Gulf coast softshell
Trionyx spinifer asper

Mississippi diamondback terrapin
Malaclemys terrapin pileata

Mississippi map turtle
Graptemys kohni

Mississippi mud turtle
Kinosternon subrubrum hippocrapis

Missouri slider
Pseudemys floridana hayi

Mobile cooter
Pseudemys concinna mobilensis

Razor-backed musk turtle
Sternothaerus subrubrum hippocrapis

Red-eared turtle
Chrysemys scripta elegans

Ringed sawback turtle
Graptemys oculifera

Smooth softshell
Trionyx muticus

Southern painted turtle
Chrysemys picta dorsalis

Stinkpot turtle
Sternothaerus odoratus

Stripe-necked musk turtle
Sternothaerus minor peltifer

Texas softshell
Trionyx spinifer emoryi

Yellow-bellied turtle
Pseudemys scripta scripta

APPENDIX B
UNIT 6

A LIST OF SOME SPECIES OF LIZARDS AND SKINKS FROM THE STUDY AREA

LIZARDS

Broad-headed skink
Eumeces laticeps

Coal skink
Eumeces anthracinus

Eastern glass lizard
Ophisaurus ventralis

Eastern slender glass lizard
Ophisaurus attenuatus longicaudus

Five-lined skink
Eumeces fasciatus

Green anole
Anolis carolinensis

Ground skink
Lygosoma laterale

Six-lined racerunner
Cnemidophorus sexlineatus

Southeastern five-lined skink
Eumeces inexpectatus

Southern fence lizard
Sceloporus undulatus undulatus

Western slender glass lizard
Ophisaurus attenuatus attenuatus

APPENDIX B
UNIT 7

A LIST OF SOME SPECIES OF
SNAKES FROM THE STUDY AREA

SNAKES

Black pine-snake
Pituophis melanoleucus lodingi

Broad banded water snake
Natrix fusciata confluens

Canebrake rattlesnake
Crotalus horripus

Corn snake
Elaphe guttata guttata

Diamond-backed water snake
Natrix rhombifera

Eastern coachwhip
Masticophis flagellum

Eastern coral snake
Micrurus fulvius fulvius

Eastern diamondback rattlesnake
Crotalus adamanteus

Eastern garter snake
Thamnophis sirtalis sirtalis

Eastern hognose snake
Heterodon platyrhinos

Glossy water snake
Regina rigida

Gray rat snake
Elaphe obsoleta spiloides

Green water snake
Natrix cyclopion

Gulf salt marsh snake
Natrix fasciata clarki

Midland brown snake
Storeria dekayi wrightorum

Midland water snake
Natrix sipedon plueralis

Midwest worm snake
Carphophis amoenus vermis

Mississippi ringneck snake
Diadophis punctatus stictogenys

Northern red-bellied snake
Storeria occipitomaculata

Rainbow snake
Abastor erythrogrammus

Rough earth snake
Virginia striatula

Rough green snake
Opheodrys aestivus

Scarlet kingsnake
Lampropeltis doliata doliata

SNAKES (Cont'd)

Scarlet snake
Cemophora coccinea

Southeastern crowned snake
Tantilla coronata coronata

Southern black racer
Coluber constrictor priapus

Southern copperhead
Agkistrodon contortrix contortrix

Speckled kingsnake
Lampropeltis getulus holbrooki

Western cottonmouth
Agkistrodon piscivorus leucostoma

Western earth snake
Virginica valeriae elegans

Western mud snake
Farancia abacura reinwardti

Western pigmy rattlesnake
Sistrurus miliarius streckeri

Western ribbon snake
Thamnophis sauritus prorimus

Yellow-bellied water snake
Natrix erythrogaster flavigaster

Yellow-lipped snake
Rhadinea flavilata

APPENDIX B
UNIT 8

INVERTEBRATES

Acartia tonsa
Asplanchna sp.
Balanus sp.

Blue crab
Callinectes sapidus

Bosmina longirostris
Brachionus calyciflorus
Brachionus havanaeusis
Brachionus plicatilis

Brown shrimp
Penaeus aztecus

Bursaria truncatella
Centropyxis sp.

Clam
Rangia cuneata

Copepod nauplius
Coscinodicus sp.

Crayfish
Cambarellus puer
Cambarellus shufeldii
Cambarus diogenes
Procambarus blandingii
Procambarus clarkii

Cymbella sp.
Didinium nasutum
Difflugia sp.
Euchalinis parva
Euplotes patella
Filinia longiseta

Gastropod
Littorridina sp.

Gastropod
Probithinella sp.

Harpactacoid copepod
Hexarthra sp.
Keratella sp.
Keratella valga
Melosira sp.
Mollusca (shellfish)

Mosquitoes
Culicoides arboricola
Culicoides furens
Culicoides hellensis
Culicoides spinosus

Mud crab
Rithnopanopeus harris

Mussel
Congenia leucopheata

Nematoda (round worms)

Paramecium sp.
Pentaneura sp.
Polychaet larva (annelida)
Stento polymorphus
Synchaeta sp.
Tardigrada
Terspinoe sp.
Trichocerca sp.
Volvox sp.

White shrimp
Penaeus setiferus

LAKE PONTCHARTRAIN, LOUISIANA, AND VICINITY
HURRICANE PROTECTION PROJECT

APPENDIX C

PHOTOGRAPHS OF THE PROJECT AREA

St. Charles Parish

St. Charles Parish along lakeshore.

LAKE PONTCHARTRAIN AND VICINITY

Causeway Bridge
in Lake

New Orleans
Lakeshore

LAKE PONTCHARTRAIN AND VICINITY

Seabrook

MR-GO and GIWW

New Orleans
East

New Orleans
East

The Rigolets

The Rigolets

Chef Menteur

Chef Menteur

Citrus Back Levee along Michoud Canal

South Point to GIWW

Bayou Dupre

Bayou Bienvenue

LAKE PONTCHARTRAIN AND VICINITY

GIWW near MR-GO

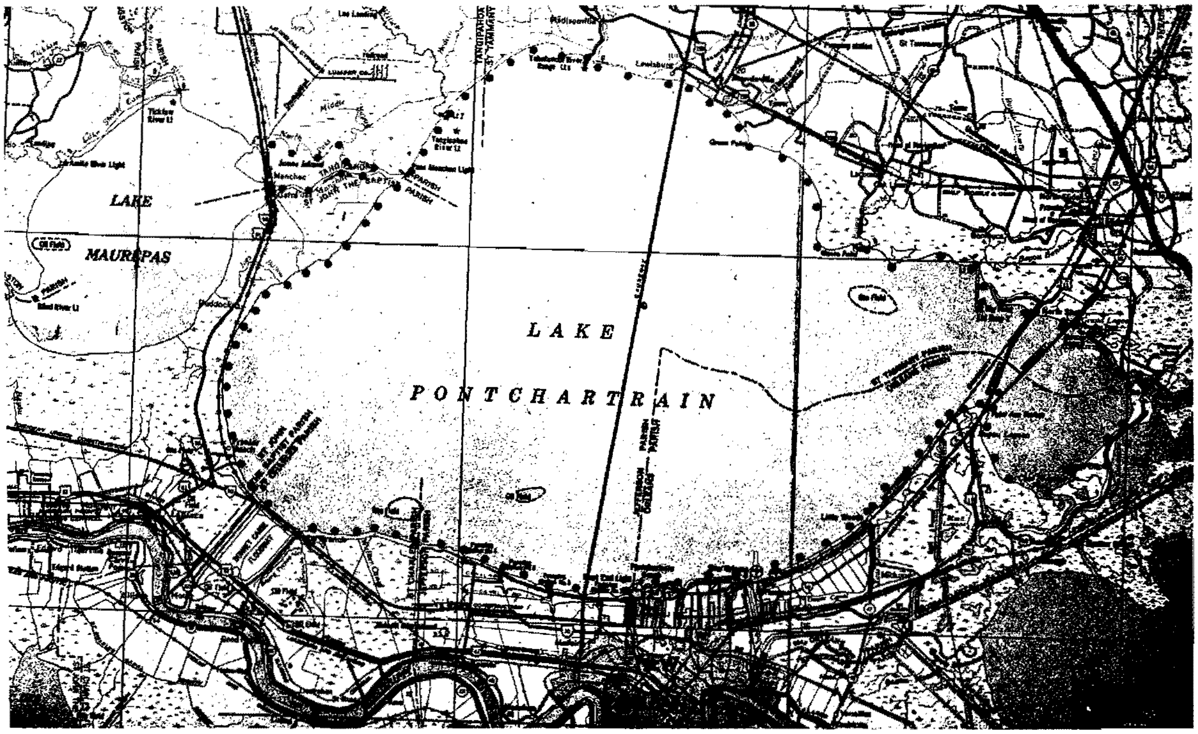
Bayou Dupre

North Shore
near Slidell

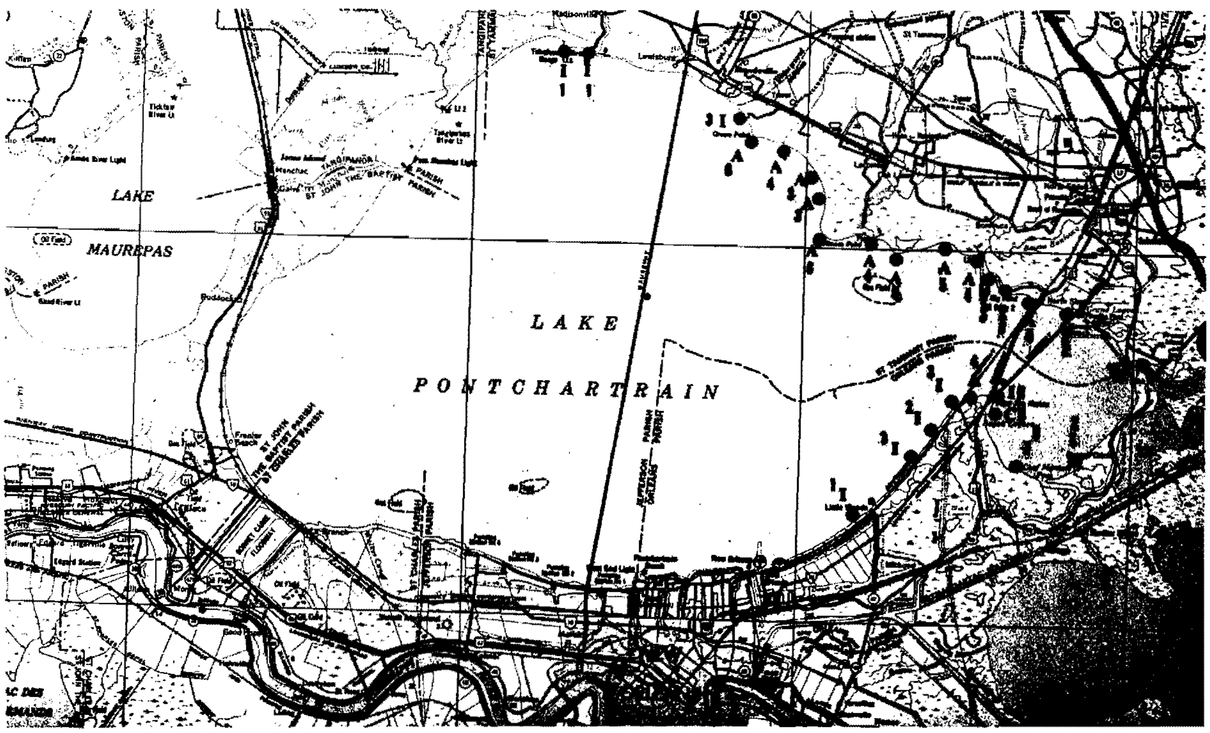
Mandeville
seawall after
Betsy- 1965

APPENDIX D
SUBMERGED VEGETATION OF LAKE PONTCHARTRAIN

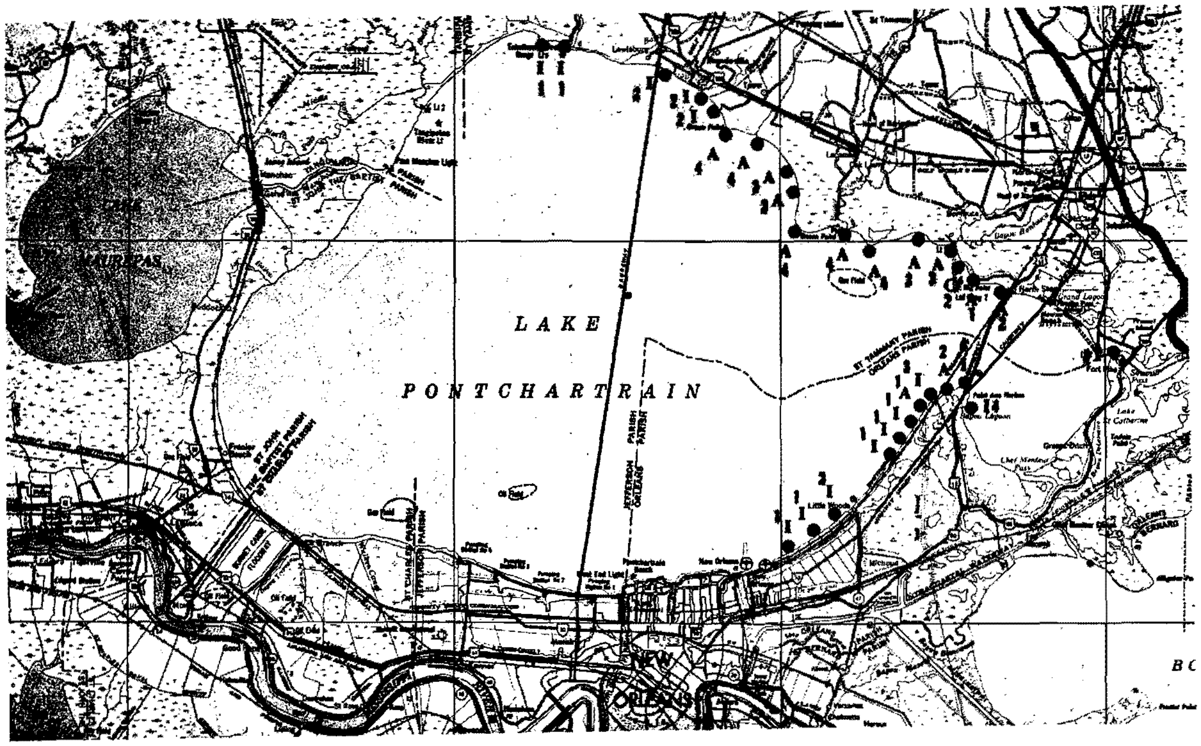
Abundance values noted on the following maps for each species reflect subjective estimates given to vegetation at that station. Values assigned to each species have used the following schematic system: abundant (A) - many plants noted in the area; common (C) - more scattered occurrence; and infrequent (I) - here and there or infrequently noted. The number next to each abundance value reveals the greatest depth that the species was recorded in this area.



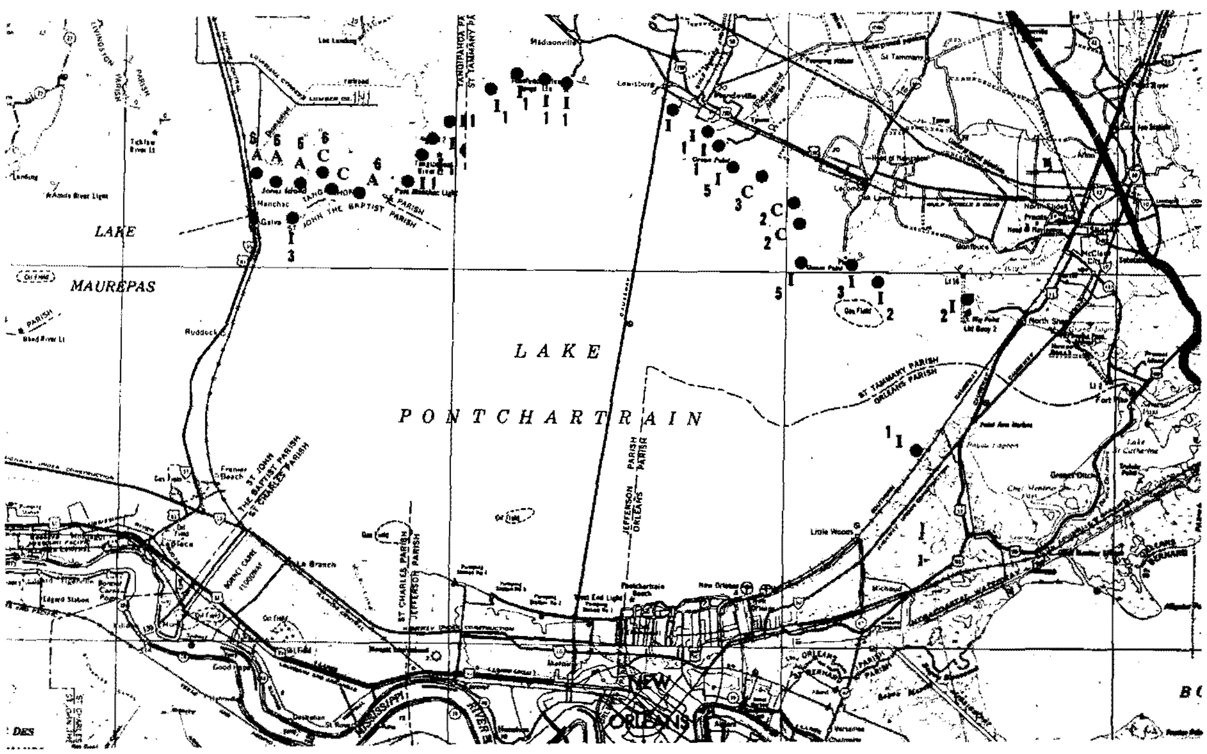
STATIONS SURVEYED



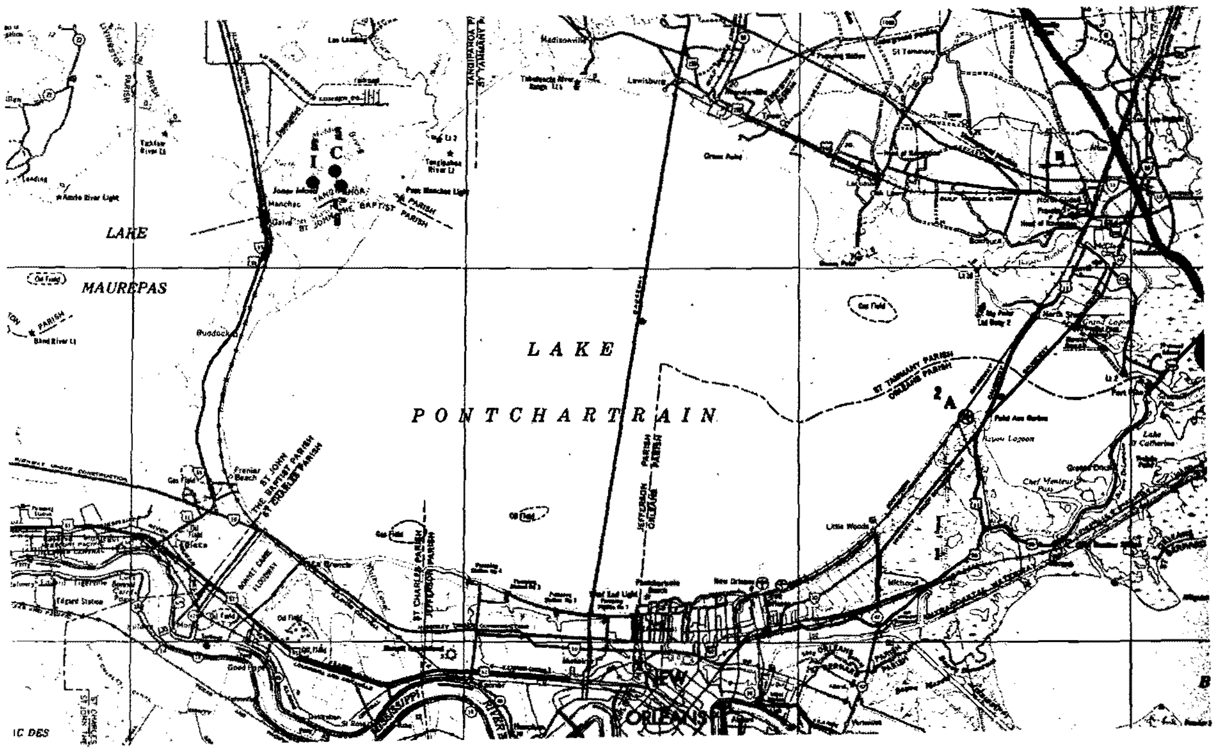
DISTRIBUTION OF VALLISNERIA AMERICANA



DISTRIBUTION OF RUPPIA MARITIMA



DISTRIBUTION OF NAJAS GUADALUPENSIS



DISTRIBUTION OF <u>ZANNICHELLIA PALUSTRIS</u>
(SOLID CIRCLE) AND <u>POTAMOGETON</u>
<u>PERFOLIATUS</u> (STAR)

APPENDIX E
ARCHEOLOGICAL ELEMENTS

Name(s)	Location
JEFFERSON PARISH	
National Register of Historic Places	
None listed	
Louisiana State Plan (not listed in National Register)	
Harvey Locks of The Harvey Canal or The Destrehan Canal	Linking the Mississippi River and the Intracoastal Waterway at Harvey
Harahan	Town on Louisiana Highway 48
Metairie Cemetery	Metairie Road (continuation of City Park Avenue) and Pontchartrain Boulevard, Metairie
Lafitte Village	Six miles south of Lafitte on Louisiana Highway 45
Lafitte Cemetery	Just south of Bayou des Oies on Louisiana Highway 45
Lafitte	Town on Louisiana Highway 45
Kenner Plantation	Site of the town of Kenner, Louisiana Highway 48
Kenner or Cannes Brulees	On Louisiana Highway 48
Ames Plantation Site	Louisiana Highway 18, Marrero
Harvey	Town on Louisiana Highway 18 between Marrero and Gretna
Fort Banks Site	On the Mississippi River
Magnolia Lane	River Road (LA 18) above Westwego at Nine Mile Point, 1 mi N of the Huey Long Bridge
McDonough Cemetery	In Gretna at the parish line
Westwego	Town on Louisiana Highway 18 at US Highway 90 acress the Mississippi River from New Orleans

Name(s)	Location
JEFFERSON PARISH (Cont'd)	
Marrero or Amesville	Town on Louisiana Highway 18
Our Lady of Grand Isle Church Bell	Grand Isle
Grand Terre Island	Barataria Pass
Fort Livingston	On the southern point of Grand Terre Island, directly opposite Grand Isle, accessible only by boat across Barataria Pass
Cheniere Caminada	Just before Grand Isle on Louisiana Highway 1 on Caminada Bay
Bayou Rigaud	Grand Isle
Barataria Lighthouse	Beside Fort Livingston on Grand Terre Island
Seven Oaks	Louisiana Highway 18 above Westwego
House and Sugar Mill Ruins	Visible from US Highway 90
Harvey's Castle Site or Jefferson Parish Courthouse or Columbia Gardens	Harvey Locks, Harvey
Gretna or Mechanicsham and McDonoughville	On the west side of the Mississippi River adjoining Algiers on the southwest
Elmwood	Off La. 48 near Harahan (near Huey Long Bridge)
Derbigny	On River Road (La. 18) above Westwego near Oak Avenue
Tchoupitoulas Plantation House or Soniat House or Colonial Country Club	Off La. 48 and Country Club Drive below Kenner (1 mile above Harahan)

Name(s)	Location
JEFFERSON PARISH (Cont'd)	
Indian Mounds	Isle Bonne, at the confluence of Bayou Barataria and Bayou Villars
Indian Mound	Fleming Plantation, east bank of Bayou Barataria at the juncture of Bayou Villar
Fleming Plantation and Sugar House	East bank of Bayou Barataria at the juncture of Bayou Villar
Chauvin Plantation Sites	Southport vicinity
Berthoud Cemetery	Off Louisiana Highway 45
Grand Isle	
Grandpere	
Avondale Plantation Site	
Camp Parapet Powder Magazine	Location on US Highway 90
Whitehall Plantation or Magnolia School	On US 90 and Central Avenue across river from New Orleans
Waggaman	
Manila Village	On the west bank of the river
Bayou Brulean	
ORLEANS PARISH	
<u>National Register of Historic Places</u>	
The Cabildo	Jackson Square (Chartres and St. Peter Streets), New Orleans
Lafitte's Blacksmith Shop	941 Bourbon Street, New Orleans
George Washington Cable House	1313 Eighth Street, New Orleans

APPENDIX E (Cont'd)

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Mayor Girod House (Napoleon House)	500 Chartres Street, New Orleans
Jackson Square (Place d'Armes)	Bounded by Decatur, St. Peter, St. Ann, and Chartres Streets, New Orleans
Pilot House (Ducayet House)	1440 Moss Street, New Orleans
French Market (Old Vegetable Market)	1000 Decatur Street, New Orleans
Lafayette Cemetery No. 1	1400 Washington Avenue, New Orleans
Christian Woman's Exchange (Hermann-Grima House)	818-820 St. Louis Street, New Orleans
Lower Garden District	Bounded by the Mississippi River, the Central Business District, lower St. Charles Avenue, and the Garden District in New Orleans
The Historic New Orleans Collection, The Kemper and Leila Williams Foundation, Mericult House	533 Royal Street, New Orleans
Fort Pike	North of New Orleans Off US 90
Perseverance Hall	901 St. Claude Avenue, New Orleans
Bank of Louisiana	334 Royal Street, New Orleans
St. Alphonsus Church (Roman Catholic)	2029 Constance Street, New Orleans
St. Charles Line (Streetcar)	St. Charles and Carrollton Avenue and route to New Orleans
Turpin-Kofler-Buja House	2319 Magazine Street, New Orleans

APPENDIX E (Cont'd)

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Big Oak-Little Oak Islands	Northeast part of New Orleans; Little Oak - 2.6 miles east of Little Woods, 0.6 miles northwest of Blind Lagoon; Big Oak - east side of Roger's Lagoon, 1.7 miles east of Little Woods
The Garden District	Bounded by the upper side of Josephine St., the lakeside of Magazine St., the lower side of Louisiana Ave., the riverside of Carondelet St. in New Orleans
French Market-Old Meat Market (Halle Des Boucheries)	800 Decatur Street, New Orleans
Presbytere	713 Chartres Street, New Orleans
Old Ursuline Convent (The Archbishopric)	1114 Chartres Street, New Orleans
Madame John's Legacy	632 Dumaine Street, New Orleans
Vieux Carre Historic District	Bounded by the Mississippi River, Rampart Street, Canal Street, and Esplanade Avenue, New Orleans
St. Mary's Assumption Church	2030 Constance Street, New Orleans

Louisiana State Plan (not listed in National Register)

Arsenal, State Museum	615 St. Peter Street, New Orleans
Site of Felix de Armas Home	513 Royal Street, New Orleans
Slidell House	312 Royal Street, New Orleans
Antoine's	713 St. Louis Street, north of Royal, New Orleans

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Algiers	That section of New Orleans directly across the Mississippi (on the west bank) from downtown New Orleans and the Vieux Carre
The Absinthe House	238 Bourbon Street, New Orleans - corner of Bienville
Audubon Cottages	505 Dauphine Street and St. Louis Street, New Orleans
Audubon Park	247 acres between St. Charles Street and the river, opposite the campus of Tulane University, New Orleans
Aurora	Located on River Road in Aurora Gardens sector of Algiers
Baker D'Aquins House	720-724 Toulouse St. New Orleans
Bayou St. John Hotel Ruins	Lake Pontchartrain and Bayou St. John
Beauregard House	1113 Chartres Street, New Orleans
General P.G.T. Beauregard Statute/Monument	At the entrance to City Park at Esplanade Avenue, New Orleans
Judah P. Benjamin House	327 Bourbon Street, New Orleans
Brulator House	520 Royal Street, New Orleans - corner of Toulouse
Briggs-Staub House	2603 Prytania Lane, New Orleans
Brevard, Albert Hamilton House	1239 First Street, New Orleans
Bosworth-Hammond House	1126 Washington Avenue, New Orleans
Bosque House	619 Chartres Street, New Orleans

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Boimore-Schloeman Building	509-511 Royal Street, New Orleans
Beauregard Square or Place Congo	North Rampart Street, between St. Peter and St. Ann Streets, New Orleans
Christ Church Cathedral	2919 St. Charles Avenue, New Orleans
Charity Hospital	Tulane Avenue at North Claiborne Avenue, New Orleans
Central Congregational Church	South Liberty Street and Cleveland Avenue, New Orleans
Castillion House (Tremoulet's Hotel)	Decatur and St. Peter Streets, New Orleans
Casa Flinard	723 Toulouse Street, New Orleans
Soniot-Soulet Plantation Home	1321 Annunciation Street, New Orleans
Cafe Toulousin	732 Toulouse Street, New Orleans
Westfelt Home	2340 Prytania
Confederate Memorial Museum	
The College of Orleans	New Orleans
Coffini Cottage	726-728 Toulouse Street, New Orleans
The Henry Clay Monument	In the corner of Lafayette Square, New Orleans
Civic Center	929 Camp Street, New Orleans
City Park	Bayou St. John to Orleans Boulevard, Robert E. Lee Boulevard to City Park Avenue, New Orleans
Colonel Robert Short House	1448 Fourth Street, New Orleans

APPENDIX E (Cont'd)

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Church of the Immaculate Conception	132 Baronne Street, New Orleans
US Customhouse - Site of Fort St. Louis	423 Canal Street and occupies a block bounded by Canal, Decatur, Iberville, and North Peter Streets, New Orleans
The Court of the Two Sisters	613 Royal Street, New Orleans
Counting House of William Nott and Company (Spanish Comandancia)	519 Royal Street, New Orleans
Cottage	1436 Pauger Street, New Orleans
Cottage	941 Bourbon Street, New Orleans
The Cornstalk Gate and Barrier	In front of 915 Royal Street, New Orleans
Convent of Notre Dame (St. Joseph's Orphan Asylum)	835 Josephine Street, New Orleans
Office of Consolidated Association of Planters of Louisiana	714 Toulouse Street, New Orleans
First Presbyterian Church	630 South Street, opposite Lafayette Square, New Orleans
Fernandez-Tissot House	1400 Moss Street, New Orleans
Duplantier Family Tomb, St. Louis Cemetery No. 2	North Claiborne Street, New Orleans
Grinnan-Henderson House	2221 Prytania Street, New Orleans
Greenwood Cemetery	Canal and City Park Avenue, New Orleans
Grailhe Family Tomb, St. Louis Cemetery No. 2	North Claiborne Street, New Orleans

APPENDIX E (Cont'd)

Name(s)	Location
ORLEANS PARISH (Cont'd)	
The Gaz Bank (sic) - The Planter's Bank	339 Royal Street, New Orleans
Gally House	536-542 Chartres Street, New Orleans
General Andrew Jackson Statue	Jackson Square, New Orleans
Site of Jayme Jorda's Home	521-523 Royal Street, New Orleans
House	934 Royal Street, New Orleans
House	524 Governor Nichols Street, New Orleans
Hibernia Tower of the Hibernia Bank Building	812 Gravier Street, New Orleans
Lafcadio Hearn House	516 Bourbon Street, New Orleans
Ursuline College	
Tulane University	St. Charles Avenue, New Orleans
Troxler Cottage	919 St. Philip Street, New Orleans
Judah Touro House	On Toulouse At Royal, New Orleans
Pharmacie Dufilho	
The Dueling Oaks	City Park, Bayou St. John west to Orleans Boulevard, New Orleans, Robert E. Lee Boulevard to City Park Avenue
Isaac Delgado Museum of Art	LeLong Avenue in City Park, New Orleans
The DeBore Plantation	Now partially occupied by Audubon Park (between St. Charles Avenue and the river), New Orleans

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Lavinia C. Dabney House	2265 St. Charles Avenue, New Orleans
Cypress Grove Cemetery	Canal and City Park Avenue, New Orleans
Gallier Hall or the Old City Hall	Facing Lafayette Square on 545 St. Charles Avenue, New Orleans
Site of the French Opera House	Toulouse at Bourbon Streets, New Orleans
Jackson Barracks	Louisiana Highway 39 - extending from the highway to the river, between Delery Street and the St. Bernard Parish line
The Haunted House	1140 Royal Street, New Orleans
Fort McComb State Monument	About 150 yards from the west end of the Chef Menteur Bridge on US 90
Forsythe House	1134 First Street, New Orleans - Garden District
The First Skyscraper or the Le Monnier House or Sieur George's House	640 Royal Street, New Orleans
La Rionda Cottage	1218-1220 Burgundy Street, New Orleans
Lake Pontchartrain	Lake
Lafayette Square	On St. Charles Street, New Orleans
Jean Lacoste Cottage	526 Bourbon Street, New Orleans
The Labranche House	700 Royal Street, New Orleans
Kohn-Anglade House	508-516 Bourbon Street, New Orleans

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Site of Jean Joseph Jourdan House	500 Bourbon Street, New Orleans
The Louise S. McGehee School for Girls	2343 Prytania Street, New Orleans
John McDonough Statue/Monument	Lafayette Square, New Orleans
Loyola University in New Orleans	6863 St. Charles Avenue, New Orleans
Louisiana Sugar Exchange	North Front and Bienville Streets, New Orleans
Louisiana State Bank	403 Royal Street, New Orleans
LePrete Mansion	716 Dauphine Street at Orleans, New Orleans
General Robert E. Lee Statue - Lee Circle	St. Charles Street and Howard Avenue, New Orleans
Lee Circle	St. Charles and Howard Avenues, New Orleans
New Orleans	City
Mortgage Office	334 Royal Street, New Orleans
Miltenberger House	910 Royal Street at Dumaine, New Orleans
Michel-Pitot House	1370 Moss Street, New Orleans
Merchant's Exchange	126 Royal Street, New Orleans
Maspero's Exchange	440 Chartres Street, New Orleans
Old US Mint	Esplanade Avenue and Decatur Street, New Orleans
Site of the Old Lafon Sugar Mill	On Highway 90
Old Bank of Louisiana	403 Royal Street, New Orleans

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Vincent Nolte's House	535-541 Royal Street (706-710 Toulouse Street), New Orleans
New Orleans Baptist Theological Seminary	3939 Chef Menteur Highway, New Orleans
Peychaud House (Service Wing)	727 Toulouse Street, New Orleans
Peychaud's Apothecary	437 Royal Street, New Orleans
Site of Pension Boulenger	727-733 St. Louis Street, New Orleans
Patti's Court	631 Royal Street, New Orleans
The Patio Royal	417 Royal Street, New Orleans
Our Lady of Guadaloupe Church (R.C.) - formerly St. Anthony of Padua, also the Mortuary Chapel	411 North Rampart Street, New Orleans
Orleans Ballroom or Quadroon Ballroom Site	717 Orleans Street, near St. Ann Street, New Orleans
David Olivier House	4111 Charles Street, New Orleans
Robinson-Jordan House	1415 Third Street, New Orleans
Preservation Hall	726 St. Peter Street, New Orleans
Pontalba Buildings	Along two Sides of Jackson Square at right angles to Chartres Street, New Orleans
Pocyfarre Houses	734-740 Toulouse Street (540-544 Bourbon Street), New Orleans
Pirate's Alley or Orleans Alley	Beside St. Louis Cathedral, New Orleans
Site of Grandchamp's Pharmacy	501 Royal Street, New Orleans
St. John the Baptist Roman Catholic Church	1117-39 Dryades Street, New Orleans

APPENDIX E (Cont'd)

Name(s)	Location
ORLEANS PARISH (Cont'd)	
St. Anthony's Garden	Behind the St. Louis Cathedral
St. Anthony's Alley	Beside the Cathedral of St. Louis, New Orleans
St. Alphonsus Church	2030 Constance Street, New Orleans
"Row of Houses"	1107-1133 Decatur Street, New Orleans
Rouzan Residence	522 Bourbon Street, New Orleans
Rouquette House	413 Royal Street, New Orleans
Widow Roche's House	505 Royal Street, New Orleans
Old Sazerac Coffee House	116 Royal Street, rear, New Orleans
St. Paul's Evangelical Lutheran Church	Port and Burgundy Street, New Orleans
St. Patrick's Roman Catholic Church	724 Camp Street, New Orleans
St. Mary's Dominican College	7214 St. Charles Avenue, New Orleans
Site of the Old St. Louis Hotel	Corner of Royal and St. Louis Streets, New Orleans
St. Louis Cemetery No. 2	302 North Claiborne, New Orleans
Cathedral of St. Louis (a basilica)	Facing Jackson Square on 711 Chartres Street, New Orleans
The Pierre Thomas House	712 Royal Street, New Orleans
Temple Sinai	6221 St. Charles Avenue, New Orleans
The Suicide Oak	City Park, New Orleans
Spanish Fort	Bayou St. John at Lake Pontchartrain

APPENDIX E (Cont'd)

Name(s)	Location
ORLEANS PARISH (Cont'd)	
Spanish Custom House	1300 Moss Street, New Orleans
ST. BERNARD PARISH	
National Register of Historic Places	
Chalmette National Historical Park	6 miles southeast of New Orleans between Louisiana 1 and Mississippi River
Louisiana State Plan (not listed in National Register)	
LeBeau House	Just off La. 39 in Arabi (on Friscoville Avenue and Pontalba Street)
Caernarvon	Town on Louisiana Highway 39 below the junction with Louisiana Highway 46; at the parish line
Bienvenue Plantation Site	On the edge of the Chalmette battlefield, Chalmette
Rene Beauregard House or Bueno Retiro	Now the visitors' center of the Chalmette National Historical Park, Chalmette
Bayou Bienvenue	From Lake Borgne toward the Mississippi
Arabi	Town (suburb) south of New Orleans
The American Sugar Refinery	North Peters Street, Arabi
Kenilworth Plantation House	On La. 46, 5 miles east of Poydras
Fort Martello or Tower Duprez or Tower Dupre or Tower Philippon	At the Lake Borgne end of the Lake Borgne Canal

APPENDIX E (Cont'd)

Name(s)	Location
ST. BERNARD PARISH (Cont'd)	
De la Croix Island	At the end of Louisiana Highway 300
Creedmore Plantation Sugar House Site	Out of St. Bernard
Contreras Site	On Louisiana Highway 46
Conseil Plantation Site	Off Louisiana Highway 39 above Violet, Louisiana
Chalmette Plantation Site	Site of the Battle of New Orleans
Chalmette National Military Cemetery	On the edge of Chalmette National Historical Park, Chalmette
Pakenham Oaks	Grounds of Versailles Plantation, Chalmette
Old Courthouse	St. Bernard (junction of Louisiana Highway 39 and 46)
Marker from War of 1812	On Louisiana Highway 39 south of the junction with Louisiana Highway 47
Maraux House or Chateau des Fleurs	224 Angela Avenue, Arabi
Site of the Old Macarty House	Now a part of the Chalmette Slip
Site of La Maison des Jalousies	North Peters Street, Arabi
Violet	Town on Louisiana Highway 39
The Lacoste House	Off Louisiana Highway 39 below Chalmette
The Rodriguez Canal	On the boundary between the Chalmette and Macarty Plantations, now a part of the Chalmette National Historical Park, Chalmette

Name(s)	Location
ST. BERNARD PARISH (Cont'd)	
Reggio	Village on Louisiana Highway 300 off Louisiana Highway 46
Proctor's Landing	
Poydras Plantation Site (Julien Poydras)	On Louisiana Highway 39 - at the junction with Louisiana Highway 46
Poydras	Town on Louisiana Highway 39 at Louisiana Highway 46
Philippon Plantation Slave Quarters	Just above Poydras (junction with Louisiana Highway 46) on Louisiana Highway 39
The Paris Road or Chemin de Paris	Now on Louisiana Highway 47
Three Oaks Plantation House	North Peters Street, Arabi
Terre aux Beoufs	Louisiana Highway 46 runs through this area
Solis Plantation Site	Louisiana Highway 300 above Delacroix
St. Bernard Cemetery	Opposite St. Bernard Catholic Church, out of St. Bernard
St. Bernard	Town at the junction of Louisiana Highways 46 and 39
The Old Roy Estate	North Peters Street, Arabi
Yscloskey or Proctorville	Town on Louisiana Highway 46
Ruins of Versailles Plantation House	Below Chalmette battlefield, Chalmette
The Turner House	St. Bernard (junction of Louisiana Highways 39 and 46)

APPENDIX E (Cont'd)

Name(s)	Location
ST. CHARLES PARISH	
National Register of Historic Places	
Keller (Homeplace) Plantation	On Louisiana 18, 1/2 mile south of the Hahnville Post Office
Louisiana State Plan (not listed in National Register)	
D'Estrahan	
Bonnet Carre Spillway	Between the area of Louisiana Highway 48 and Lake Pontchartrain
"La Garconniere," Barbara Plantation	Barbara Plantation, 1 1/2 miles east of St. Rose on Louisiana Highway 1
Indian Mounds	US 90 between Paradis and Des Allemands
Helena	Located on the River Road at Killona
Hahnville	Town on Louisiana Highway 18
Goldmine	Located on the River Road below Edgard
Glendale	On the River Road 1 1/2 miles below Lucy
Ellington Manor	Near US 90, near Luling, 5 miles southeast of Hahnville
Destrehan Plantation House	At Destrehan on Louisiana 48
Saint Rose (town)	
Pecan Grove Plantation House	Above Saint Rose on Louisiana Highway 48
Paradis	

Name(s)	Location
ST. CHARLES PARISH (Cont'd)	
Ormond Plantation House	1 1/2 miles above Destrehan on Louisiana Highway 48
The Locke Breaux Live Oak	At Taft, on Louisiana Highway 18
Little Red Church or the St. Charles Borromeo Church	Above Destrehan on Louisiana Highway 48
Dr. Lehmann House	Hahnville
Trepagnier Site	Out of Norco

ST. TAMMANY PARISH

National Register of Historic Places

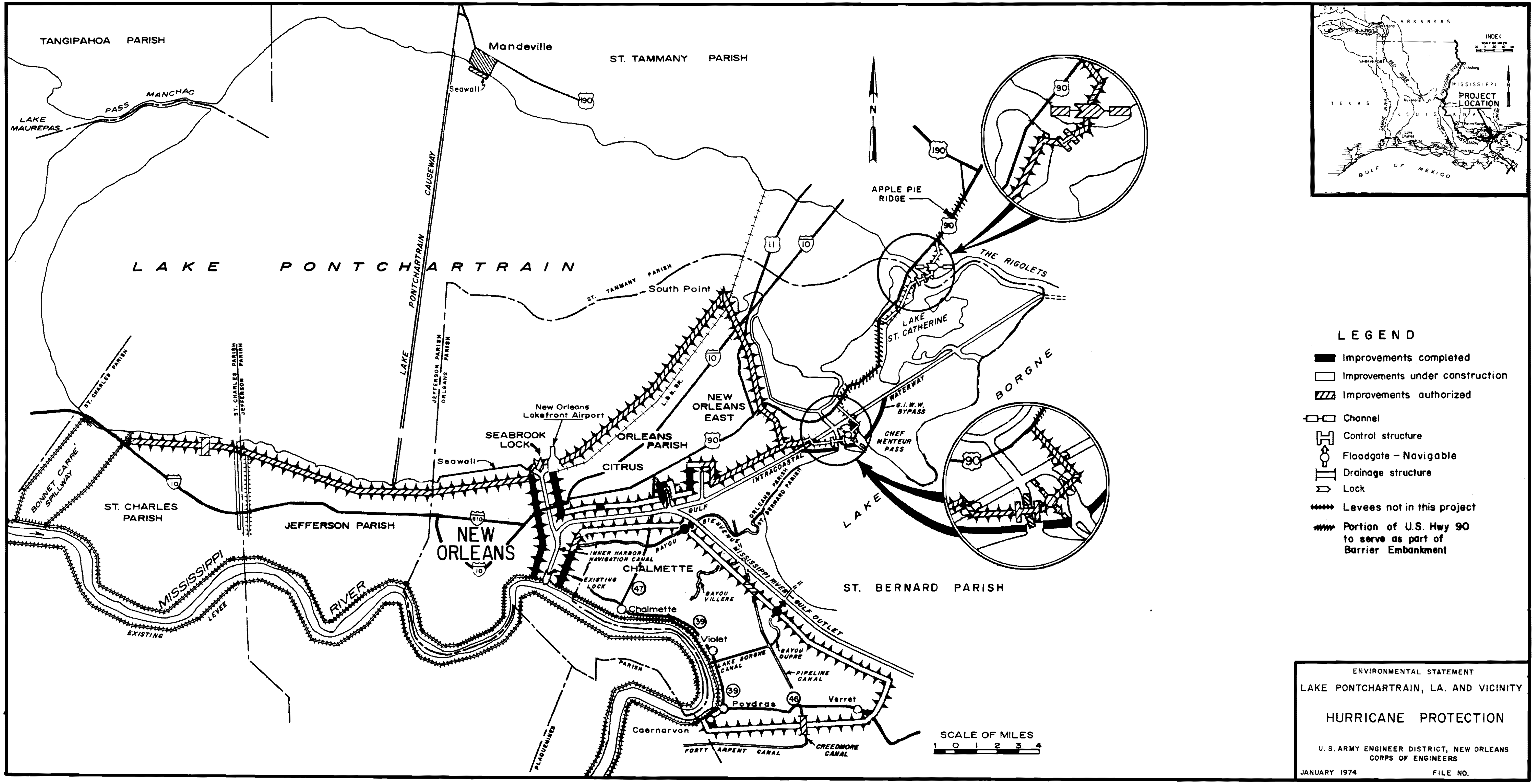
None listed

Louisiana State Plan (not listed in National Register

Site of an Old Brick Foundry	The Leche Estate outside of Covington
Bonfouca	North of US 190 between Slidell and Lacombe
Indian Village	About 4 miles off Salt Bayou Road (Louisiana Highway 1075) which is near Slidell
Honey Island Swamp	Between the Pearl River and the town of Pearl River on US 11
Fontainbleau Plantation	What is now Fontainebleau State Park and the adjoining State Conservation Department's game preserve
Fairview Residence	Near Madisonville
Covington or Wharton	Town

APPENDIX E (Cont'd)

Name(s)	Location
ST. TAMMANY PARISH (Cont'd)	
Claiborne	Eastern suburb of Covington
Chinchuba	About 7 miles east of Covington on US 190
Cemetery	About 4 miles from Slidell on Salt Bayou Road (Louisiana Highway 1075)
Slidell	Town
St. Tammany Parish	Parish
Rouquette Monument	In a cemetery outside Lacombe
Site of the Town of Ramsay	Louisiana Highway 439 near Covington
Pearl River	At US Highway 90
Military Road	Louisiana Highway 36
Mandeville	Town
Madisonville	Town at junction of Louisiana Highways 22 and 21



ENVIRONMENTAL STATEMENT

LAKE PONTCHARTRAIN, LA. AND VICINITY

HURRICANE PROTECTION

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

JANUARY 1974 FILE NO.

FIGURE 1

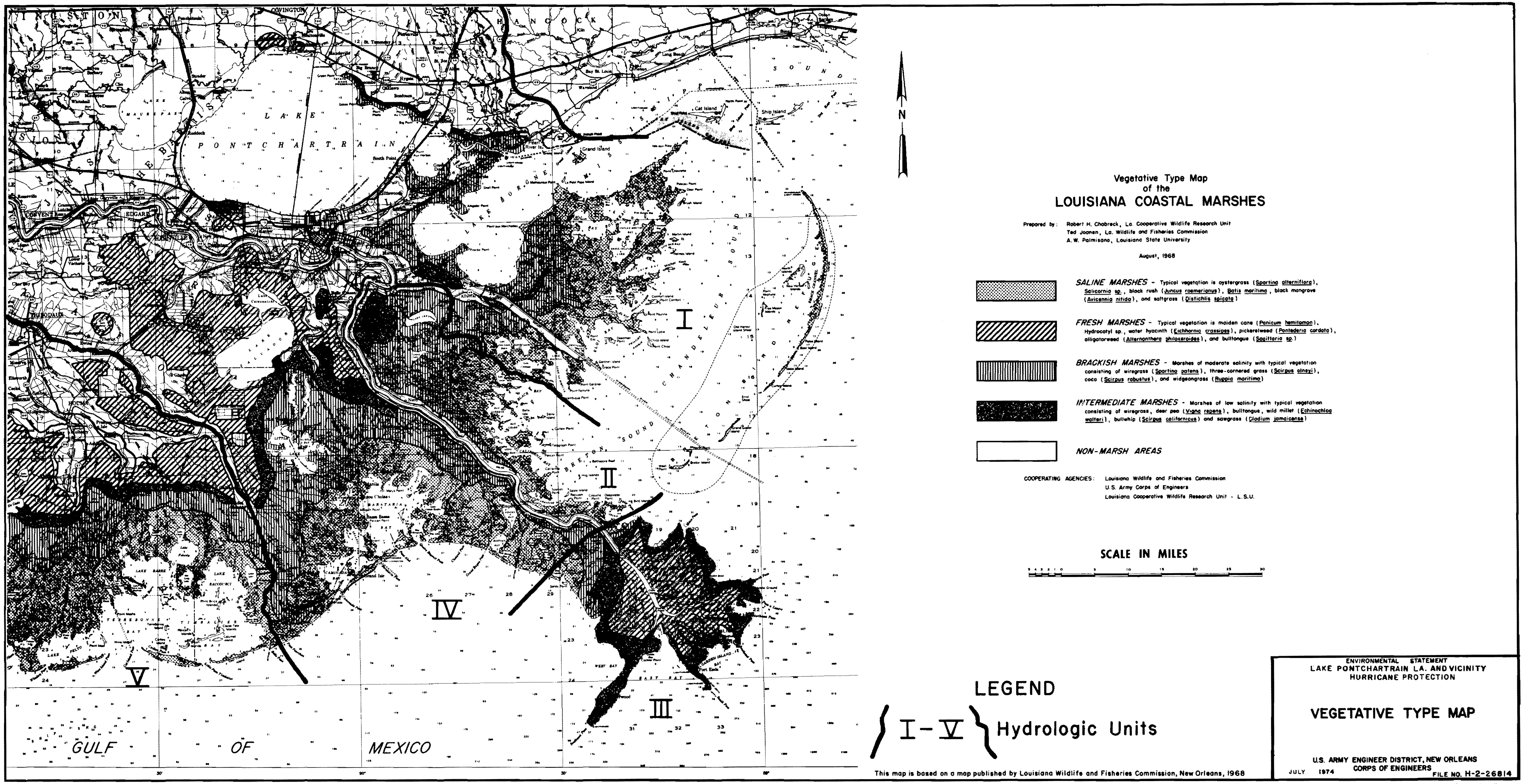

N
LAKE PONTCHARTRAIN
LAKE BORGNE
CHANDELEUR SOUND
BRETON SOUND
GULF OF MEXICO
I
II
III
IV
V
Vegetative Type Map
of the
LOUISIANA COASTAL MARSHES
Prepared by: Robert H. Chabreck, La. Cooperative Wildlife Research Unit
Ted Joanen, La. Wildlife and Fisheries Commission
A.W. Palmisano, Louisiana State University
August, 1968
SALINE MARSHES - Typical vegetation is oystergrass (Spartina alterniflora), Salicornia sp., black rush (Juncus roemerianus), Batis maritima, black mangrove (Avicennia nitida), and saltgrass (Distichlis spicata)
FRESH MARSHES - Typical vegetation is maiden cane (Panicum hemitomon), Hydrocotyl sp., water hyacinth (Eichhornia crassipes), pickerelweed (Pontederia cordata), alligatorweed (Alternanthera philoxeroides), and bulltongue (Sagittaria sp.)
BRACKISH MARSHES - Marshes of moderate salinity with typical vegetation consisting of wiregrass (Spartina patens), three-cornered grass (Scirpus olneyi), coco (Scirpus robustus), and widgeongrass (Ruppia maritima)
INTERMEDIATE MARSHES - Marshes of low salinity with typical vegetation consisting of wiregrass, deer pea (Vigna repens), bulltongue, wild millet (Echinochloa walteri), bullwhip (Scirpus californicus) and sawgrass (Cladium jamaicense)
NON-MARSH AREAS
COOPERATING AGENCIES: Louisiana Wildlife and Fisheries Commission
U.S. Army Corps of Engineers
Louisiana Cooperative Wildlife Research Unit - L.S.U.
SCALE IN MILES
LEGEND
I-V Hydrologic Units
This map is based on a map published by Louisiana Wildlife and Fisheries Commission, New Orleans, 1968
ENVIRONMENTAL STATEMENT
LAKE PONTCHARTRAIN LA. AND VICINITY
HURRICANE PROTECTION
VEGETATIVE TYPE MAP
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JULY 1974
FILE NO. H-2-26814

FIGURE 2

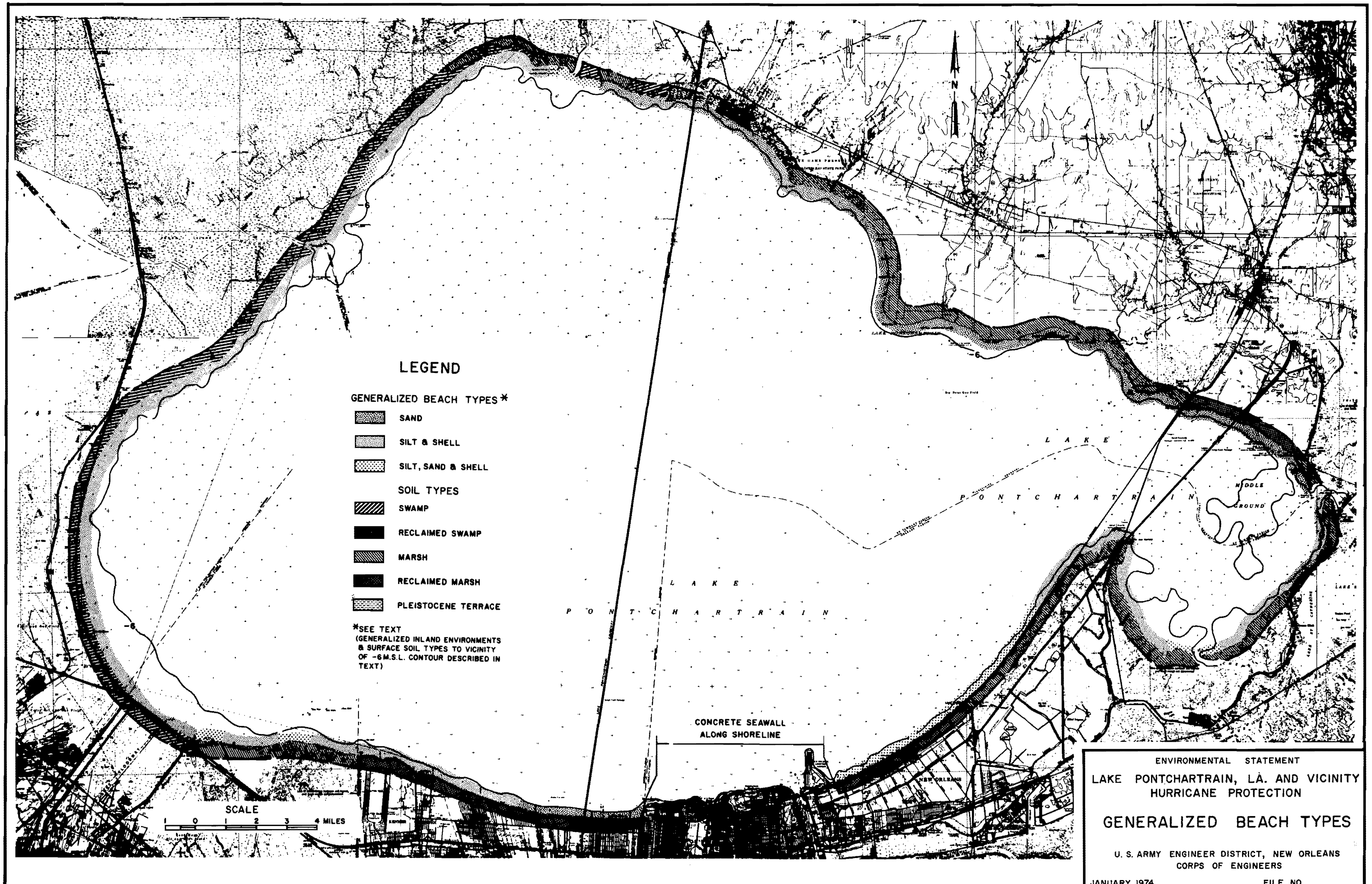
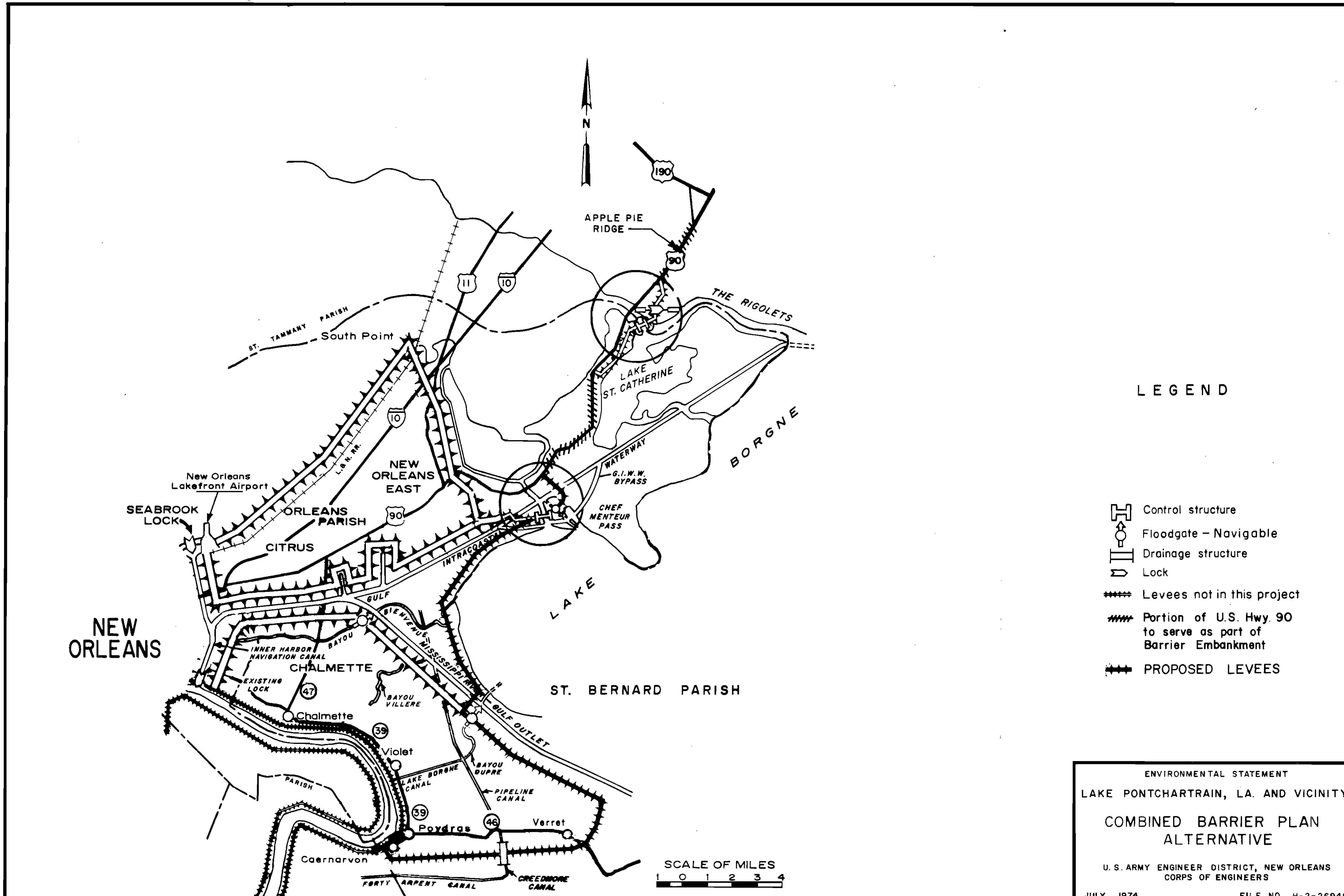

LEGEND
GENERALIZED BEACH TYPES*
SAND
SILT & SHELL
SILT, SAND & SHELL
SOIL TYPES
SWAMP
RECLAIMED SWAMP
MARSH
RECLAIMED MARSH
PLEISTOCENE TERRACE
*SEE TEXT
(GENERALIZED INLAND ENVIRONMENTS
& SURFACE SOIL TYPES TO VICINITY
OF -6 M.S.L. CONTOUR DESCRIBED IN
TEXT)
L A K E
P O N T C H A R T R A I N
MIDDLE GROUND
CONCRETE SEAWALL
ALONG SHORELINE
NEW ORLEANS
SCALE
1 0 1 2 3 4 MILES
N
ENVIRONMENTAL STATEMENT
LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION
GENERALIZED BEACH TYPES
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
JANUARY 1974
FILE NO.

FIGURE 3



ENVIRONMENTAL STATEMENT

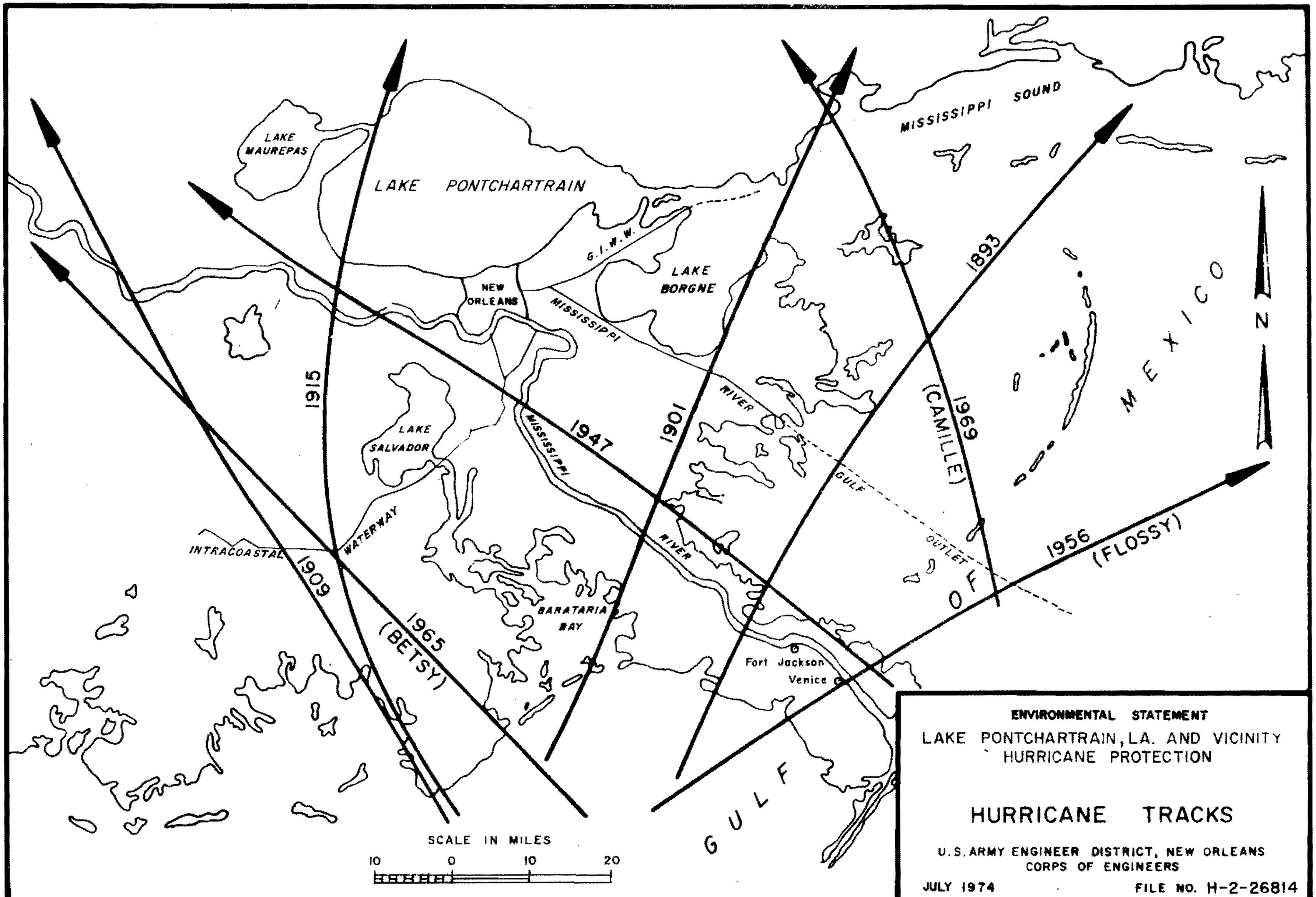
LAKE PONTCHARTRAIN, LA. AND VICINITY

COMBINED BARRIER PLAN ALTERNATIVE

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

JULY 1974 FILE NO. H-2-26948

FIGURE 4



ENVIRONMENTAL STATEMENT

LAKE PONTCHARTRAIN, LA. AND VICINITY
HURRICANE PROTECTION

HURRICANE TRACKS

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

JULY 1974 FILE NO. H-2-26814

FIGURE 5