VOLUME 1

MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2

APPENDIX A - PROBLEM IDENTIFICATION

APPENDIX B - FORMULATION, ASSESSMENT, AND EVALUATION OF DETAILED PLANS

APPENDIX C - ENGINEERING INVESTIGATIONS

APPENDIX D - NATURAL RESOURCES

VOLUME 3

APPENDIX E - SOCIAL AND CULTURAL RESOURCES

APPENDIX F - ECONOMICS

APPENDIX G - RECREATION

APPENDIX H - WATER QUALITY

APPENDIX I - SECTION 404 (b) (1) EVALUATION REPORT

APPENDIX J - CONSISTENCY DETERMINATION
LOUISIANA COASTAL ZONE MANAGEMENT PROGRAM

APPENDIX K - FRESHWATER DIVERSION STRUCTURE OPERATION CRITERIA AND
COMPREHENSIVE MONITORING SYSTEM

VOLUME 4

APPENDIX L - PUBLIC VIEWS AND RESPONSES

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

LMNPD-P

September 1984

LOUISIANA COASTAL AREA, LOUISIANA

Feasibility Report on Freshwater Diversion

to Barataria and Breton Sound Basins

SYLLABUS

Louisiana's estuaries and wetlands are among the most productive in the nation in terms of fish and wildlife. With 41 percent of the nation's wetlands, Louisiana provides 25 percent of the commercial fish harvest and 40 percent of the fur harvest. Numerous migratory waterfowl and nongame birds that use the Mississippi Flyway spend all or a portion of their migration or overwintering time in the coastal wetlands. The capacity of the estuaries and wetlands to support the abundant and diverse fish and wildlife populations is seriously threatened by habitat changes associated with saltwater intrusion. The deterioration of habitat conditions and the consequent effect on fish and wildlife productivity is expected to continue.

To address this problem, an investigation was conducted to determine the feasibility of reducing saltwater intrusion to improve fish and wildlife productivity. Barataria Bay and Breton Sound Basins, in the lower Mississippi River delta region, contain two of Louisiana's highly productive estuaries and were selected for study. Due to the limited purpose and geographic area, the interim report is only a partial response to the Louisiana Coastal Area study authorization.

The study area includes 13 percent of the nation's wetlands and provides habitat for many important commercial and sport fish and wildlife species. The area supplies about 25 percent of the national oyster and shrimp harvest and 26 percent of the fur harvest. The wetlands and estuaries have been adversely affected by saltwater intrusion that is expected to become more severe in the future.

To find a solution to this problem, a number of measures were considered. The measure that provides the best solution to saltwater intrusion is freshwater diversion. This measure would establish favorable salinity conditions, enhance vegetative growth, reduce land loss, and

increase production of commercial and sport fish and wildlife. A total of 16 plans to divert freshwater into the area were evaluated.

The recommended plan would divert freshwater into the Breton Sound Basin at Big Mar and the Barataria Basin at Davis Pond. The total first cost of the plan is estimated at $47,400,000 with annual charges of $4,760,000 including interest at 8 1/8 percent, amortization over 50 years, and operation and maintenance. The average annual benefits attributed to the plan are estimated at $15,760,000. The benefit-cost ratio is 3.3 to 1.

The plan would reduce saltwater intrusion, save about 99,200 acres of marsh, and increase oyster production by 16,400,000 pounds, which represents a 25-percent increase in the national oyster harvest. The plan also provides many intangible benefits. Habitat conditions for noncommercial and nongame species and productivity of wooded swamps and associated freshwater fish and wildlife, especially in Jean Lafitte National Park, and Salvador Wildlife Management Area, would be improved. The potential for recreation would be increased as well as business opportunities in commercial and sport fisheries and wildlife industries, and related support industries.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

Number

EXHIBITS

LOUISIANA COASTAL AREA, LOUISIANA

Feasibility Report on Freshwater Diversion

to Barataria and Breton Sound Basins

Environmental Impact Statement

This report presents the findings of studies to control saltwater intrusion in the Barataria and Breton Sound Basins. The report is in three volumes. The first volume, the main report and Environmental Impact Statement, is a concise, nontechnical summary of the study results. It includes an overview of the plan formulation process, an environmental impact statement, and the recommended plan. Volumes 2 and 3 are technical appendixes that document and support the study findings. The appendixes contain the technical data, information, and pertinent references necessary for an informed technical review.

STUDY AUTHORITY

Study of the Louisiana coastal area was authorized by resolutions of the Committees on Public Works of the US Senate and House of Representatives. The Senate resolution was sponsored by Senator Russell B. Long and the late Senator Allen J. Ellender and adopted on 19 April 1967. The resolution reads:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the reports of the Chief of Engineers on the Mermentau River and Tributaries and Gulf Intracoastal Waterway and connecting waters, Louisiana, published as Senate Document Numbered 231, Seventy-ninth Congress, on the Bayou Teche, Teche-Vermilion Waterway and Vermilion River, Louisiana, published as Senate Document Numbered 93, Seventy-seventh Congress, on the Calcasieu River salt water barrier, Louisiana, published as House Document Numbered 582, Eighty-seventh Congress, and on Bayous Terrebonne, Petit Caillou, Grand Caillou, DuLarge, and connecting channels, Louisiana, and the Atchafalaya River, Morgan City to the Gulf of Mexico, published as House Document Numbered 583, Eighty-seventh Congress, and other pertinent reports including that on Bayou Lafourche and Lafourche-Jump Waterway, Louisiana, published as House Document Numbered 112, Eighty-sixth Congress, with a view to determining the advisability of improvements or modifications to existing improvements in the coastal area of Louisiana in the interest of hurricane protection, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resource purposes."

The House of Representatives Committee on Public Works adopted an identical resolution on 19 October 1967. Sponsors were US Representatives Edwin Edwards, Speedy O. Long, John R. Rarick, Joe D. Waggoner, Edwin E. Willis, and the late F. Edward Hebert, Hale Boggs, and Otto E. Passman.

Preliminary investigations under the overall study identified saltwater intrusion as a major problem in the Louisiana coastal area. Federal, state, and local agencies expressed considerable interest in accelerating studies that involved solutions to the problem. The Mississippi

and Louisiana Estuarine Areas study was authorized in September 1976. The study is investigating the feasibility of providing freshwater into Lakes Maurepas, Pontchartrain, and Borgne and the Mississippi Sound areas to improve wildlife and fisheries. The similar purpose and the geographic overlap of the two studies required that they be coordinated to develop a comprehensive plan for salinity control in the coastal area. Therefore, an interim report addressing saltwater intrusion under the Louisiana Coastal Area study was approved by 3d indorsement, file LMVPD-P, dated 17 December 1980, to letter, file LMNPD-P, dated 29 May 1980, subject "Louisiana Coastal Area Study."

STUDY PURPOSE AND SCOPE

The study area for this interim report encompasses the lower Mississippi River delta region in southeastern Louisiana. The area, shown on plate 1, covers roughly 2.3 million acres and is bounded by the Mississippi River, Bayou La Loutre, and the Mississippi River-Gulf Outlet on the north and east, by Bayou Lafourche on the west, and by the Gulf of Mexico on the south. There are three major hydrologic features in the area: the Mississippi River, the Barataria Bay estuary west of the river, and the Breton Sound estuary east of the river. The Mississippi River and its levees divide the area into the two nontributary watersheds. The Barataria Bay estuary is a triangular area about 40 miles wide at the Gulf of Mexico that extends 90 miles inland to Donaldsonville, Louisiana, at Mississippi River mile 176. The Breton Sound estuary, also triangular, is about 20 miles wide at the gulf coastline and extends 50 miles inland to Caernarvon, Louisiana, at river mile 83. Ten parishes are completely or partially in the study area: Ascension, Assumption, Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, and St. John the Baptist. Terrebonne and St. Tammany parishes, adjacent to the study area, are economically significant to the area and are included in statistical data for population, employment, income, and recreational use. Four of the

parishes, Orleans, Jefferson, St. Bernard, and St. Tammany, make up the New Orleans Standard Metropolitan Statistical Area (SMSA).

The purpose of this study is to determine the extent of saltwater intrusion in the Barataria and Breton Sound Basins, and to ascertain the feasibility of measures that would reduce saltwater intrusion and improve the habitat and the productivity of fish and wildlife resources. With this specific and limited purpose, the study responds to only a portion of the water and related land resources problems, needs, and opportunities in the coastal area. The report is an interim response to the Louisiana Coastal Area study authorization.

In support of the overall Louisiana Coastal Area study effort, a number of broad scope investigations were conducted to provide basic information on the entire coastal area. The investigations are described in the section, "Prior Studies, Reports, and Existing Water Projects." These studies served as an extensive data base for the interim report. The information was used to identify historical trends and existing conditions in the study area environment, to provide insight for projecting future conditions, and to assist in identifying problems.

Study efforts for this report involved use of available data and information, ground reconnaissance of the area as needed, and office studies. The existing and projected 50-year environmental conditions related to saltwater intrusion with and without Federal improvements were assessed. The problems, needs, and opportunities associated with saltwater intrusion were assessed. The feasibility of engineering improvements was determined and social, cultural, economic, and environmental impacts were evaluated. The study also reevaluated the Mississippi Delta Region project authorized by the Flood Control Act of 1965 but not constructed.

PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

A number of studies and reports on water resources development in coastal Louisiana have been prepared by the Corps of Engineers, other Federal, state, and local agencies, research institutes, and individuals. Several Federal and non-Federal projects that influence water resources have been constructed in the area. A summary of the more relevant studies, reports, and projects are listed in the following paragraphs. A more detailed listing is included in Appendix A, Problem Identification.

Several broad scope studies were performed as part of the authorized Louisiana Coastal Area study. They are:

o The Louisiana Wildlife and Fisheries Commission and the Cooperative Wildlife Research Unit, Louisiana State University, with support from the Corps of Engineers, investigated vegetation, water, and soil characteristics and conducted an inventory of wildlife in the coastal area. As a result of this effort, a vegetative type map of the Louisiana marshes and five reports were published, the last in September 1972.

o The National Marine Fisheries Service, under contract to the Corps, analyzed the relationship between commercial fish production and characteristics of the estuarine environment, and established resources and resource development needs as related to estuarine ecology. The studies were completed in May 1972.

o The US Fish and Wildlife Service conducted a statewide survey in 1970 to determine participation in fishing, hunting, and wildlife-oriented activities in the coastal area in the 1968-69 season. The survey was conducted under contract to the Corps.

o The Center for Wetland Resources, Louisiana State University, performed studies of the hydrologic and geologic characteristics of coastal Louisiana under a contract with the Corps. The studies examined and identified trends in the coastal area resulting from natural processes and works of man, identified significant environmental parameters, determined freshwater requirements to implement changes for fish and wildlife enhancement, and developed management and structural approaches to solving problems in the estuarine environment. The findings and recommendations of the studies are contained in a series of 18 reports the last published in October 1973.

o The Corps of Engineers, in participation with an interagency group, conducted a fish and wildlife study of the Louisiana coastal area and Atchafalaya Basin Floodway in support of several ongoing studies including the Louisiana Coastal Area study. The fish and wildlife study incorporated information from the previous studies and included a preliminary determination of the cyclic quantities of supplemental freshwater needed to optimize productivity of fish and wildlife resources and the possible options for supplying this water to each estuarine area.

Other pertinent studies, reports, and projects not prepared under the Louisiana Coastal Area study include the following:

o A report on the Mississippi River and Tributaries project published as House Document No. 308, 88th Congress, 2d Session, recommended construction of the Mississippi Delta Region project. The project provided for four salinity control structures to introduce freshwater into the delta region. These improvements were authorized by the Flood Control Act of 1965 but have not yet been constructed.

o A report entitled "Barataria Bay, Louisiana," was published as House Document No. 82, 85th Congress, 1st Session. The project provides for a 12- by 125-foot channel approximately 37.0 miles long beginning at the Gulf Intracoastal Waterway and extending to Grand Isle, Louisiana.

These improvements were authorized by the River and Harbor Act of 3 July 1958. Enlargement of the channel between mile 0.0 and the -15 foot contour in the gulf to 15- by 250- feet was approved in January 1978. All work has been completed.

o A report, "Mississippi River-Gulf Outlet," was published as House Document No. 245, 82nd Congress, 1st Session. The report recommends an additional outlet from New Orleans to the Gulf of Mexico, a channel 36 feet deep and 500 feet wide. The improvements were authorized by the River and Harbor Act of 29 March 1956. Construction was initiated in March 1958 and the major channel was completed in July 1963.

o A report entitled "Louisiana-Texas Intracoastal Waterway, New Orleans, La. to Corpus Christi, Tex." was published as House Document No. 230, 76th Congress, 1st Session. The report and prior River and Harbor Acts provide for the construction of a 384.1 mile channel 12 deep and 125 feet wide from the mouth of the Rigolets to the Sabine River. The project was authorized for construction by the River and Harbor Act of 23 July 1942. The main stem of the project was completed in 1944.

o A report entitled "Deep-Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana," was completed in July 1981. The report recommends deepening the Mississippi River to a project depth of 55 feet from the Gulf of Mexico to the Ports of New Orleans and Baton Rouge. The report was approved by the Board of Engineers for Rivers and Harbors in March 1982, and the Office of the Chief of Engineers (OCE) in April 1983. The report is being reviewed by the Office of the Secretary of Army. A general design memorandum (GDM) on dredging the Mississippi River, Venice to the gulf was approved by OCE in March 1984. A GDM on dredging the Mississippi River, mile 173 to Venice is scheduled for completion in August 1985.

o A report entitled "New Orleans-Baton Rouge Metropolitan Area, Louisiana," was completed in September 1981. The report contains a comprehensive plan for development and conservation of water and related land resources in the 21-parish area. The report includes all parishes in the current study and was incorporated into this report where appropriate.

o The Plaquemines Parish Mosquito Control District prepared a "Management Plan for the Breton Sound Estuary," dated January 1981. The plan is concerned with improving the estuarine environment by reducing saltwater intrusion, enlarging nursery and harvesting areas, and retarding the rate of land loss.

o The Louisiana Department of Natural Resources released a report, "Recommendations for Freshwater Diversions to Louisiana Estuaries East of the Mississippi River," in June 1982. The diversions were recommended for environmental resource management. The report evaluates and recommends the Mississippi Delta Region project site in the upper Breton Sound Basin under review in the present study.

o Local interests have constructed salinity control structures to divert freshwater at Bayou Lamoque, Little Coquille, Bohemia, and White's Ditch (plate 2).

PLAN FORMULATION

Formulation of plans was conducted in accord with the US Water Resources Council "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies." Plan formulation is directed at achieving the national economic development (NED) objective, which is consistent with protecting the nation's environment in accord with national environmental statutes, applicable executive orders, and other Federal planning requirements, and is responsive to state and local concerns. The NED objective is achieved by increasing the value

of the national output of goods and services and reasonably maximizing net economic benefits. Benefits are maximized with due consideration for enhancing environmental quality, regional development, and social concerns.

During the plan formulation process, historical trends and existing conditions are used as a base for forecasting future conditions. In an assessment of the nature and extent of changing conditions, the problems, needs, and opportunities for improving conditions are identified and the specific planning objectives defined. Management measures that address the objectives are evaluated and the most feasible measures are incorporated into an array of specific plans. The plans are then assessed and evaluated in terms of their engineering feasibility and their adverse and beneficial effects on the NED objective. The effects on environmental quality are also evaluated. Finally, the plans are compared and a trade-off analysis is performed to select the plan that best addresses the NED objective, and to provide the rationale for the recommended plan.

EXISTING CONDITIONS

CLIMATE

Climatic conditions in the area are influenced by tropical air masses from the Gulf of Mexico in April through September and by cold air masses from the northern continental United States, October through March. The result is a humid, subtropical climate with mild winters and long, hot summers. The average annual temperature is 68° F.

Major rainstorms are associated with tropical disturbances and hurricanes in summer and early fall, and with frontal activity of extratropical cyclones in late fall, winter, and spring. Convective thundershowers produce intense but localized rain in late spring and summer. Westerly winds in summer and northerly winds in winter frequently

interrupt the normal pattern and bring drier weather. Rainfall is abundant and averages about 61.2 inches a year.

In the normal cycle, rainfall is at a minimum of 13.7 inches in the fall, increases to 14.4 inches in the winter, declines to 13.9 inches in the spring, and rises to a maximum of 19.2 inches in the summer. Although the rainfall is high according to national averages, there are periods when the amount is below normal and is exceeded by water losses due to evaporation and transpiration. When rainfall is 10 percent below normal for several continuous months, a drought is said to exist. This condition occurs about 25 percent of the time. Rainfall shortages from 2 to 5 inches are estimated to occur more than 50 percent of the time.

WATER RESOURCES

Surface drainage in the Barataria and Breton Sound Basins is away from the natural levees of the Mississippi River through numerous interconnected bayous, canals, lakes, bays, and sounds to the Gulf of Mexico. Surface runoff from leveed urban areas is evacuated by pumps to the adjacent wetlands. Tides influence surface drainage as far inland as Lac Des Allemands in the Barataria Basin and Lake Lery in the Breton Sound Basin. Mean tide elevation at Grand Isle is about 0.9 feet above National Geodetic Vertical Datum (NGVD) and daily tides range from 0.2 feet to 2.2 feet. The area generally has one high tide and one low tide a day. The Mississippi River discharges the headwater flows from about 41 percent of the contiguous 48 states. Discharge at Baton Rouge ranges from 1,500,000 cfs once every 16 years, on the average, to a low of 75,000 cfs recorded once during the period 1930 to the present. The average annual discharge is 450,000 cfs.

Salinities in the estuaries are related to the seasonal changes in gulf tides, rainfall, freshwater runoff, evaporation, and winds. In general, salinities are low in late fall and winter, coinciding with high rain-

fall-runoff and low tides. Through the spring and summer, salinities increase progressively and reach a maximum in late summer and early fall, coinciding with high tides and high evaporation rates. Seasonal salinities range between 6 and 21 parts per thousand (ppt) in Barataria Bay and Breton Sound and decrease gradually inland. In Bayou Barataria near Lafitte, average monthly salinities range from 1.1 to 3.3 ppt. The area has experienced a long-term rise in salinity levels. Increased salinity levels are readily detected in shifts in vegetative types. As salinities increase, plants with high salinity tolerance replace plants with low salinity tolerance. Comparing marsh vegetation maps that depict 1945 and 1968 conditions indicates that the saline marshes moved inland an average of 2.1 miles and the brackish marshes 3.8 miles as a result of increased salinities.

Water quality of the Mississippi River is affected by the inflow of municipal and industrial effluents. Sampling data indicate that pesticides, nutrients, heavy metals, and fecal coliform bacteria are areas of possible concern along with lower temperatures and increased turbidity. Water quality in the Barataria and Breton Sound Basins is affected by the inflow of freshwater, domestic and industrial effluents, urban stormwater runoff, sewage from homes and camps, runoff from agricultural and silvicultural areas, and waste from water-oriented recreation and commercial vessels. Water quality in the upper Barataria Basin is generally characterized by low dissolved oxygen concentrations in some streams, high nutrient concentrations, and occasional high fecal coliforms, pesticides, and heavy metal concentrations. In water bodies near developed areas, concentrations of these pollutants exceed applicable state water quality standards or exceed the US Environmental Protection Agency water quality criteria recommended for freshwater and marine aquatic life. In the lower Barataria Basin and the Breton Sound Basin, water quality is somewhat better and pesticides and heavy metal concentrations are detected less frequently.

LAND RESOURCES

The land forms in the study area were created as the Mississippi River migrated back and forth across what is now coastal southeast Louisiana, depositing sediment. Continued sediment deposition created delta lobes that slowly extended gulfward. During the delta building process, an intricate network of distributaries, channels, levees, and inter-distributaries were formed. Some distributaries were favored by the river while others were abandoned. In recent years, sediment deposition has only occurred at the Plaquemines or modern "birdfoot" delta. Where sediment deposition ceased, the natural forces of subsidence, compaction, and erosion allowed the gulf to advance over the delta and form lakes, bays, and sounds.

The nature of the land formation has, to a large extent, determined the size and use of the land. The 1.3 million acres of land are characterized by low relief with the most prominent topographic features, the Mississippi River levees, standing significantly above the surrounding wetlands. Elevations vary from approximately 30 feet above NGVD on the crest of the levees to at NGVD or below in the wetlands. Wetlands make up nearly 67 percent of the land area. The remaining 33 percent is distributed between residential, industrial, extractive, agricultural, pasture, forest, and open and barren lands. Residential (7.3%), industrial (0.7%), and agricultural (14%) lands are generally located on the natural levees and abandoned distributaries of the river and, to a lesser extent, in reclaimed wetlands adjacent to the levees and distributaries.

Recent studies have indicated that the average land loss rate for coastal Louisiana has increased from 16.5 square miles per year to more

than 39 square miles per year (Wicker, 1980). Marsh loss rates range from a "low" (0-1 ac/square mile/yr) in the upper basins and along the Mississippi River levee to very severe (>4 ac/square mile/yr) in the lower basins (plate 3). Between 1956 and 1978, the birdfoot delta experienced a net loss of approximately 67,000 acres of marsh. Between the mid-1950's and 1978, estimated marsh loss rates for the Barataria and Breton Sound Basins were 9.9 and 2.3 square miles/year, respectively.

The shoreline retreated at a rate of 13.7 to 16.2 feet per year between 1812 and 1954 (Gagliano et al., 1970). The loss is the result of compaction, subsidence, erosion, and saltwater intrusion. Land loss has been accelerated by construction of numerous leveed, forced drainage systems and canals for navigation, drainage, and mineral exploration. Between the period 1940-1970, a total of 71.2 square miles of canals were dredged in Barataria Basin and 12.9 square miles in Breton Sound Basin (Gagliano et al., 1970). The canals have lengthened the tidal shoreline 1,557 miles in Barataria Basin and 561 miles in Breton Sound Basin.

BIOLOGICAL RESOURCES

Coastal marshes cover approximately 657,400 acres or about 50 percent of the land area. Thirty-one percent of the marsh is saline, 37 percent is brackish, and 32 percent is fresh-intermediate. Wooded swamps of cypress and tupelogum border the marshlands and represent 13 percent of the land area. Bottomland hardwood forests cover 4 percent of the land area, mostly along the Mississippi River and its abandoned distributary ridges. Portions of these forests are seasonally flooded. Common trees associated with bottomland hardwoods are various types of oak, ash, pecan, and maple. Agricultural, pasture, forest, and open and barren lands make up nearly 25 percent of the land area. These land types provide a diverse habitat for many species of wildlife.

Fishery resources embrace freshwater and marine species. Commercial freshwater species include catfish, gars, buffaloes, freshwater drum, and red swamp crawfish. Sport freshwater species include large mouth bass, crappie, catfish and various species of sunfish. The majority of the freshwater fishery is in the Barataria Basin and includes catfish, gar, bass, crappie, buffalo, and red swamp crawfish. The marine or estuarine-dependent species that use the area support an extensive commercial fisheries industry that provides about 7 percent of the nation's seafood production. Commercially important species are shrimp, oysters, menhaden, blue crab, Atlantic croaker, seatrout, spot, and red drum.

Included in the wildlife resources are game and nongame animals and commercially important furbearers and alligators. Several endangered or threatened species are found in the area. Because of the abundance of nutria and muskrat in the coastal area, Louisiana leads the nation in fur production. Bottomland hardwoods and wooded swamps provide habitat for the white-tailed deer, squirrels, rabbits, and raccoon, all popular game animals. Both birdwatchers and sportsmen enjoy the great variety of birds in the marshlands. In addition to resident species, various migratory waterfowl winter in the marshes. The wetlands provide wintering habitat for over two-thirds of the waterfowl using the Mississippi Flyway.

The unique wildlife diversity of the area has been recognized by both Federal and state agencies. The Louisiana Department of Wildlife and Fisheries operates several wildlife management areas totalling 86,000 acres within the study area. The US Fish and Wildlife Service manages the 48,800-acre Delta-Breton National Wildlife Refuge, a portion of which is in the study area.

CULTURAL RESOURCES

The study area has a rich cultural heritage, a result of the variety and abundance of natural resources that provided early settlers with food, work, recreation, and travel routes. Many features of great cultural value have survived the years including plantations, churches, forts, historic shipwrecks, village sites, and shell middens. Over 250 known archeological sites are in the area and, of these, 10 are on the National Register of Historic Places. Most of the sites are located along the Mississippi River. Two are located off the natural levee, Fort Livingston and the Bayou Des Coquilles archeological site. Fort Livingston is an early 19th century fortication near Grand Isle at the mouth of Barataria Pass. The Bayou Des Coquilles site is a prehistoric archeological site in the Barataria Unit of the Jean Lafitte National Historical Park.

RECREATIONAL RESOURCES

The area resources offer a vast array of recreational opportunities. Major recreational activities are freshwater and saltwater fishing including finfishing, crawfishing, and crabbing and shrimping, and hunting, boating, swimming, and camping. Primary users of the recreational resources are residents of southeast Louisiana. However, residents from all over Louisiana and tourists from out-of-state come to the area. Though fishing is by far the most popular activity, waterfowl hunting is the most well-known. Game fish species include spotted seatrout, red drum, flounder, and Atlantic croaker. Hunting in the basins includes big game (only deer), small game, waterfowl, and migratory birds.

ECONOMY

The economy of the study area is founded on a base of natural resources

that include commercially important minerals and a variety of fish and wildlife resources. With an extensive system of navigable waterways and a strategic location, the area is a hub for foreign and domestic trade and harbors a cultural and historical heritage that ranks with the most significant in the nation.

In 1975, mineral production was valued at $3.2 billion or 37 percent of the state production ($8.5 billion). Crude petroleum and natural gas are among the state's significant mineral deposits and account for 87 percent of the 1975 value. Total petroleum production originating in the study area represented 10 percent of the nation's production while natural gas production represented 11 percent. Sulfur, salt, and natural gas liquid deposits are abundant in the area.

Other extremely important activities center around the fish and wildlife resources, which generate an annual harvest valued at $115 million. During the 1963-1978 period, the average yearly harvest of estuarine-dependent fisheries was 337 million pounds with an average annual value of $107 million. Major commercial fishery species include oysters, shrimp, and menhaden. Other fish species important to the seafood industry are blue crab, Atlantic croaker, seatrout, spot and red drum. The oyster fishery has evolved from a natural fishery to one predominated by privately leased and seeded bottoms in the more productive waters closer inshore. Average annual production of oysters in Barataria and Breton Sound Basins is 16 million pounds of meat with a value of $26 million. This production is 25 percent of the nation's total oyster harvest and 64 percent of Louisiana's production. Shrimp harvested in the area average 55 million pounds annually with a value of $63 million, nearly 25 percent of the total US reported landings. Menhaden is the principal industrial fish taken in Louisiana. The average annual menhaden harvest is 238 million pounds with a value of $14 million. The oily flesh of this species is not suitable for human consumption but it is a valuable source of oil and animal feed when

processed. The average annual harvest of other fish species was 28 million pounds with a value of $4 million. The oyster, shrimp, menhaden, and other fishery resources support a host of seafood-related industries from the obvious industries of canning, shipping, wholesaling and retailing, and restaurants to building, selling, and servicing boats and fishing gear, ice making, and operating commercial marinas.

Commercial wildlife activities in the area are associated mainly with alligators and furbearers, including muskrat, nutria, mink, raccoon, and otter. After years of closed seasons, alligator hunting is now legal. About 2,400 alligators worth $510,000 were taken annually from 1980-1982. The fur harvest represents 26 percent of the entire US fur supply. From 1940-1976, 152,000 pelts valued at $1.1 million were taken annually.

The sport fish and wildlife resources in 1978 provided an estimated 1.1 million man-days of recreation valued at $6.6 million. The most popular activities were freshwater and saltwater fishing, and sport hunting.

As a result of the intricate navigation system in the coastal area and navigation on the Mississippi River, shipping has evolved into a major industry in the area. The Port of New Orleans is the world's largest grain port. In terms of dollar value and waterborne tonnage handled, it is the largest seaport in the U.S. and the second largest in the world. Other major commodities handled include crude petroleum, fabricated steel, metallic minerals, chemicals, and refined petroleum products.

In the rural areas of the basins, somewhat removed from the movement of bulk commodities and petroleum activities, the economy depends on commercial fishing and agriculture. Major crops are sugarcane, citrus fruits, and livestock.

HUMAN RESOURCES

In 1980, the population of the area was 1,552,000, an increase of 18 percent from 1970. The majority of the residents are in the New Orleans SMSA, which accounts for nearly 76 percent of the area's total population. In 1980, eight of the 12 parishes in the study area had per capita incomes above the 1980 state average. More notably, all of the parishes had higher per capita income growth rates than the state average. This growth in income, along with the population growth, reflects the expanding coastal Louisiana petroleum industry and the related service industries. The largest source of jobs in the area in 1978 was in the retail and wholesale trade sector where nearly 150,000 people were employed. Second in employment was the service sector (134,000), which is directly related to the fact that the city of New Orleans is a tremendous tourist attraction and convention center. Other primary occupations in the order of the number employed are government, manufacturing, transportation and public utilities, construction, finance, insurance and real estate, mining, agriculture, forestry, and fisheries.

FUTURE CONDITIONS

The most probable future conditions if no Federal action is taken are determined by projecting conditions that would prevail in the study area over the planning period 1985 to 2035. All authorized projects are considered to be in place except for the Mississippi River Delta Region project and the 16- by 150-foot-channel authorized for the Gulf Intracoastal Waterway between Apalachee Bay, Florida, and the Mexican Border. These projects were considered along with other measures as possible solutions to the area's problems.

WATER RESOURCES

Between 1978 and 2035, projections are that about 280,900 acres of land would be converted to open water. Over the next 50 years, the severity of saltwater intrusion throughout the area is expected to increase. These changes are due to the continued general rise in sea level, erosion, subsidence, and manmade activities. The increased water area would provide additional avenues for saltwater to intrude into the upper estuaries. Therefore, average annual salinities in the basins are projected to significantly increase. Under drought conditions with a frequency of occurrence of once in 10 years, the 5 ppt isohaline in Barataria Basin is expected to move inland 7 miles and the 15 ppt isohaline 12 miles from the average 1980 isohaline positions. The distance between the 5 and 15 ppt isohalines is expected to narrow from 19 to 14 miles. The 5 ppt isohaline in the Breton Sound Basin is expected to move inland about 2 miles and the 15 ppt isohaline 17 miles, and the distance between the 5 and 15 ppt isohalines is expected to narrow from 21 to 7 miles (plate 4).

Water quality conditions in the Barataria Basin are expected to deteriorate in the foreseeable future with continued urbanization, drainage improvements, and loss of wetlands. The deterioration in water quality could increase the frequency with which Federal water quality criteria and state water quality standards are exceeded.

LAND RESOURCES

Land resources are projected to change in areal extent and diversity by the year 2035. Between 1978 and 2035, about 220,700 acres of land in the Barataria Basin and 60,200 acres of land in the Breton Sound Basin are expected to be converted to water. Between 1985 and 2035, land in the Barataria Basin would be lost at the estimated rate of 6 square miles a year. In the Breton Sound Basin, the land loss rate is

estimated at 1.6 square miles per year. The shoreline is expected to continue to retreat at rates of 13 to 16 feet per year. Based on historic subsidence and sea level trends, the relative elevation of land and water surfaces is projected to change by approximately 0.5 foot by 2035 (Gagliano et al., 1970).

Substantial changes in land diversity would occur as a result of projected changes in environmental parameters such as salinities and land use. Among the projected changes are reductions in fresh, intermediate, brackish, and saline marsh, wooded swamp, and bottomland hardwoods. Between 1978 and 2035, approximately 112,300 acres of wooded swamps (24 percent) and bottomland hardwoods (76 percent) are expected to be destroyed by saltwater intrusion or converted to other land uses such as agricultural, industrial, and urban. Table 1 presents the anticipated changes in habitat types in the study area. The classification of the habitat types is discussed in EIS Section 5.2.

Man's activities will continue to adversely affect the wetlands. As population and industrial activity in the study area increases, forest, agricultural lands, and to a lesser extent, wetlands would be converted to urban, suburban, and industrial uses. Since most urban expansion would radiate from existing development, much of the wetlands converted would be located adjacent to the natural levees of the Mississippi River. An estimated 34,000 acres of wetlands are expected to be converted to urban uses by 2035.

BIOLOGICAL RESOURCES

Changes in land and water resources over the next 50 years would have a direct adverse effect on the biological resources. Deteriorated and reduced habitat quality and quantity would cause a parallel decline in fish and wildlife resources. Marshlands are the primary habitat that would be affected. Approximately 42 percent of the total marsh acreage

TABLE 1

PROJECTED HABITAT TYPE CHANGES

1978-2035

Habitat Type	1978	1985	1995	2005	2015	2025	2035
			(Acres)				
Bottomland Hardwoods	53,000	48,400	42,700	37,700	33,200	29,300	25,800
Wooded Swamps	170,800	156,800	139,000	123,200	109,200	96,700	85,700
Marsh							
Fresh/Intermediate	210,200	175,100	134,900	103,800	79,900	61,500	47,400
Brackish	242,700	244,900	241,700	233,500	221,900	208,300	193,600
Saline	204,300	193,300	179,200	166,600	155,100	144,800	135,500
Water							
Fresh/Intermediate	74,300	74,900	75,800	76,700	77,600	78,400	79,200
Estuarine	907,700	951,300	1,007,900	1,058,900	1,104,600	1,146,500	1,183,700
Other Land Uses 1/	436,300	454,600	478,100	498,900	517,800	533,800	548,400
TOTAL	2,299,300	2,299,300	2,299,300	2,299,300	2,299,300	2,299,200	2,299,300

SOURCE: Modified after US Fish and Wildlife (1980)

1/ Includes lands cleared and converted to agriculture, pasture, residential, urban, and industrial uses.

would be lost. Fifty-one percent of bottomland hardwoods and 50 percent of wooded swamp would be lost or converted to less desirable habitats greatly affecting the species that use these habitats.

CULTURAL RESOURCES

Future research and more extensive field investigations would probably identify additional cultural resources in the area. Known archeological sites in the wetlands would continue to be subjected to the destructive forces of erosion, wavewash, saltwater intrusion, and subsidence and some would be lost. Sites near urban areas are likely to be affected by continued urban and industrial expansion.

RECREATIONAL RESOURCES

Recreational demands are expected to increase significantly in the future. Population growth and associated industrial development would increase the competition between commercial and recreational interests for the same resource. Continued loss of productive coastal marsh fish and wildlife habitat would adversely affect future recreational opportunities.

ECONOMY

The economy of the area is expected to continue to prosper as a result of the petroleum-based activities, tourism, port activities, the extensive navigable waterways, and the tremendous biological productivity of the area. However, the industries associated with the wildlife and fisheries resources, which are of primary importance to this study, are expected to decline as a result of habitat losses. Projected habitat acreage is displayed in Table 1.

The continued loss of fish and wildlife habitat would cause the future fish and wildlife harvest to decline in value from $110 million in 1985 to $66 million in 2035 or approximately 40 percent. The commercial fisheries harvest would decrease by about 42 percent or 130 million pounds valued at $41 million over the 50-year period. The oyster harvest would be reduced by 37 percent or 5.7 million pounds valued at $8.9 million during that same period. The estimated reduction in harvest by major species is shown in table 2.

Commercial wildlife productivity would decline due to both direct loss of habitat and conversion of habitat to more saline types. Fresh/intermediate marsh areas provide more favorable habitat for furbearers and the American alligator. Over the 50-year period, the commercial wildlife harvest would be reduced by 54 percent or 74,000 pelts and hides valued at $600,000.

Habitat deterioration will reduce the productivity of the sport fish and wildlife. As sport fish populations decline, the fishermen's success and the quality of the experience would also decline. The value of sport fishing would be reduced by 39 percent or $970,000. Sport hunting opportunities would decrease by 42 percent or 160,000 man-days valued at $1.6 million. Over the 50-year period, sportfishing opportunities were assumed to remain constant because of limited access.

HUMAN RESOURCES

Area population has grown steadily. The growth is a result of rural-based industrial complexes located in small towns, an out-migration from farms and small fishing villages to small towns and urban areas, continued attractiveness of the Sunbelt region to industry and people, and the generally favorable economic growth. The trend is expected to continue. By the year 2035, the population is projected to reach 2,211,000, a 30-percent increase from 1980. The New Orleans

TABLE 2

PROJECTED DECLINE IN FISH AND WILDLIFE HARVEST
DUE TO HABITAT LOSSES

Activity	1985	1995	2005	2015	2025	2035
			(In Thousands)			
Commercial						
Oyster						
pounds	15,340	13,960	12,710	11,580	10,550	9,620
value($)	$23,920	$21,770	$19,820	$18,060	$16,450	$15,000
Shrimp						
pounds	51,530	46,570	42,100	38,080	34,460	31,200
value($)	$58,750	$53,090	$53,280	$43,420	$39,290	$35,570
Menhaden						
pounds	219,910	196,960	176,420	158,050	141,600	126,880
value($)	$13,200	$11,820	$10,590	$9,480	$8,500	$7,610
Other Fish 1/						
pounds	25,590	22,980	20,641	18,540	16,660	14,980
value($)	$7,310	$6,570	$5,910	$5,320	$4,790	$4,310
Alligator						
hides & meat	2.1	1.8	1.6	1.4	1.2	1.0
value($)	$350	$300	$250	$220	$190	$160
Furbearers 2/						
pelts & meat	134	114	97	81	71	61
value($)	$740	$620	$530	$450	$380	$330
Sport						
Fish 3/						
man-days	650	650	650	650	650	650
value($)	$2,470	$2,230	$2,030	$1,830	$1,650	$1,500
Wildlife 4/						
man-days	380	340	300	270	240	220
value($)	$3,600	$3,090	$2,830	$2,510	$2,230	$1,990
TOTAL	$110,340	$99,590	$95,240	$81,290	$73,480	$66,470

1/ Blue crab, Atlantic croaker, seatrout, spot, flounder, and red drum.
2/ Muskrat, nutria, mink, raccoon, and otter.
3/ Freshwater and saltwater fishing species.
4/ Deer, rabbits, squirrels, waterfowl, and other marsh birds.

Metropolitan Area is expected to have the largest increase in population and to maintain a significant share of the population in the future.

Employment is also expected to increase although no projections were made for the study area. An increase in the rate of growth in all sectors is anticipated except for employment in the commercial fishery industry. This sector is expected to remain stable in view of the projected decline in marsh and marsh productivity. Employment will continue to be concentrated around the New Orleans SMSA. Outside the SMSA, Lafourche and Plaquemines Parishes are likely to experience significant employment growth. Plaquemines Parish is also expected to have the highest per capita income ($55,000) and annual income growth rate (7.3 percent) in the study area by 2035. Average per capita income for all parishes in 2035 is expected to be $39,000.

PROBLEMS, NEEDS, AND OPPORTUNITIES

Over the years, natural and manmade changes produced cumulative effects that had adverse impacts on estuarine-dependent fish and wildlife resources. The changes resulted in saltwater intrusion, vegetative change, loss of habitat, reduction in nutrients, erosion, and deteriorating water quality. The interrelationship of these parameters is significant. Each factor causes or intensifies the other. The collective impact on fish and wildlife resources affects productivity, commercial harvest, and sporting opportunities in the study area. Therefore, any attempt to address one factor influences all others.

PROBLEMS

An analysis of the changes in the estuarine areas indicates that saltwater intrusion is a primary factor affecting fish and wildlife resources. Saltwater intrusion is a factor in habitat loss, erosion, and vegetative changes. As saltwater intrudes into fresher areas,

vegetation is gradually killed. Before more saline-tolerant plant species can revegetate the areas, open water is created because there is no plant root system to hold the marsh together. As the marsh and water interface increases, these areas are more easily eroded away. Saltwater intrusion contributes indirectly to reduced wildlife productivity by converting the more desirable fresh and intermediate marshes to saline marshes and directly by causing the loss of wildlife habitat.

Natural and manmade changes have reduced freshwater, sediment, and nutrient inputs to the estuarine-marsh areas. As a result, saltwater has intruded into the fresh, intermediate, and brackish water zones, and the saline zone has moved inland 2.1 miles in 23 years. Under the 10-percent drought condition, the saline zone may move inland an estimated 12-17 miles and reduce the distance between the 5 and 15 ppt isohalines an estimated 7-14 miles. Thus, the fresh, intermediate, and brackish marshes that are the most productive for fish and wildlife would decrease in the area.

Inland movement of the saline zone has caused oyster harvesting that was in lower Barataria Bay to move north into Bayou St. Denis, Grand Bayou, and Little Lake. In the past, these areas were too fresh for oysters but in recent years the increased salinities have allowed oyster production in low rainfall years. In moderate to heavy rainfall years, these areas become too fresh to support commercial quantities of oysters. The inland areas are closer to developed areas and associated wastewater discharges. Thus, the inland areas are subject to occasional contamination and closure. The historically highly productive oyster areas are experiencing considerable predation, parasitism, and disease. One of the most serious oyster predators is the southern oyster drill that is capable of invading areas with salinities as low as 15 ppt. In higher salinity areas, the oyster drill has been known to decimate oyster populations, destroying as much as 85 percent of the oysters (May and Bland, 1969).

Saline zone inland movement is significantly reducing the broad, brackish zones that are vital nursery grounds for the juvenile stage of most important commercial and sport finfish and shellfish species. As saltwater intrusion narrows the broad, brackish zones, the size of the nursery area will continue to be reduced. Biologists are in general agreement that habitat reduction would be accompanied by diminishing harvests (Craig et al., 1979). Shrimp and menhaden yields have been correlated directly to these areas of intertidal wetlands (Cavit, 1979 and Turner, 1979). The Environmental Protection Agency (1971) has indicated that none of the major commercial species would continue to exist in commercial quantities if estuaries were not available for development. Table 6-8-2 in the EIS shows pertinent information on key environmental parameters that affect important fish and shellfish resources.

Reduction in habitat and nursery area will lead to a reduction in sport and commercial fish and wildlife harvest. Most biologists believe that total estuarine-dependent commercial fisheries production in coastal Louisiana has peaked and will decline in proportion to the acreage of marsh lost (Harris, 1973). Table 2 presents the projected decline in commercial and sport fish and wildlife harvest due to habitat lost. In 1963-1978, the mean annual commercial fisheries harvest was 337 million pounds valued at $107 million. Over the 50-year period 1985-2035, saltwater intrusion is expected to cause the commercial fisheries harvest to decline by 42 percent or 130 million pounds valued at $41 million. By the year 2035, the commercial fisheries harvest would be reduced to about 183 million pounds valued at $63 million. In like manner, the commercial wildlife harvest would be reduced by 45 percent to $490,000 in 2035. The sport fish and wildlife harvest is expected to decline by 42 percent to $3.5 million.

The decline in fish and wildlife resources would result in loss of jobs

associated with the commercial and recreational fish and wildlife industries, lower economic activity, and closing of fisheries and wildlife processing plants. The sport fishing experience would suffer qualitatively and the capacity of the fisheries industries to meet the demand for seafood would be diminished.

NEEDS AND OPPORTUNITIES

Needs in the study area include:

- o Reduce salinity levels so that commercial fisheries and wildlife production can be increased.
- o Increase amounts of nutrients and sediments in the estuarine-marsh areas to enhance aquatic and marsh vegetation.
- o Increase recreational opportunities.
- o Reduce land loss.

Restoring low salinities in zones that have been eliminated or greatly reduced by saltwater intrusion would benefit juvenile white shrimp, blue crabs, menhaden, Atlantic croaker, and several other species of shellfish and finfish. The major benefits, however, would be to improve and restore the historical oyster harvesting areas. Areas where salinities are less favorable for the southern oyster drill and other oyster predators and diseases would be expanded.

In 1957 the state of Louisiana instituted a small-scale program of freshwater diversion to reduce saltwater intrusion at several locations in Breton Sound (plate 2). Recent studies have documented that freshwater diversions have increased oyster production in the Breton Sound estuary. Pollard (1973) and Dugas (1977) have reported significant

increases in oyster production. The available data indicate that the commercial harvest of oysters from Breton Sound was 580,000 pounds in 1970 but increased to 1,508,000 pounds during the 1974-75 season and to 4,158,000 pounds during the 1975-76 season. The increase in commercial harvest was attributed directly to reduced salinities. Expert opinion suggests that reducing salinities could increase oyster production by at least 100 percent (exhibits 1 and 2).

An interagency ad hoc group identified the seasonal salinity gradients necessary to maximize resource productivity and the supplemental freshwater required to maintain these gradients (US Army Corps of Engineers, 1970). After detailed study, the ad hoc group reached general agreement on salinity conditions and supplemental flows required to maintain and enhance estuarine water bodies and marshes. These conditions are based on expert judgement and general knowledge of the salinities that are considered desirable. The group identified two requirements, the first related to salinities in water bodies and the second related to salinities in the marsh.

The first requirement is to maintain a certain salinity gradient in the estuarine water bodies during specific months of the year. The desirable condition is defined by the position of the 15 ppt mean salinity isohaline constructed across the coastal zone (plate 5). During spring, summer, and fall, an average salinity of 15 ppt should be maintained at the line shown. Short duration fluctuations due to wind and tide are tolerable. The regimen is required to maximize productivity in the commercial and sport fishery resources. Maintaining desired salinity gradients in the estuarine water bodies would necessitate the largest quantity of supplemental water. The location of the recommended isohaline represents agreed upon desirable conditions and is not based on historically-documented salinity conditions. The ad hoc group noted that this location would increase the nursery areas used by marine fisheries and restore oyster reefs no longer suitable for oysters to

their former high productivity. The position of this line is widely supported by fish and wildlife experts (Exhibit 2).

The second requirement pertains to marsh salinities. The ad hoc group designated the position of the brackish-saline marsh interface as cri tical in defining salinity requirements of the marsh communities. Fresh-to-brackish marshes are the preferred habitat of important commercial and sport wildlife species. Wildlife productivity is directly correlated to plant growth and composition (Palmisano, 1973). The vitality of the plant communities depends on freshwater and nutrient inputs. To achieve these conditions, salinities should not exceed 15 ppt more than 5 percent of the time at the desired location of the marsh interface. If the condition established for the estuarine water bodies is met in the spring, summer, and fall, the condition recommended for the marsh communities will also be met. Plate 5 shows the line defining desirable salinity conditions for wildlife productivity.

The recommended isohalines were used to develop estimates of supplemental water requirements. The isohalines were compared with salinity data at key measuring stations and with water yield in the area (Gagliano et al., 1973). A water yield less than that required to maintain the desired salinity gradient indicates a shortage exists. Analyzing the shortages made it possible to estimate supplemental water requirements. The supplemental freshwater requirements determined in earlier studies were reevaluated and are presented in Section 1, Appendix C, Engineering Investigations. The current analysis indicates that to maintain the desired salinity gradients in the 10-percent drought year will require a supplemental flow of 6,600 cfs in the Breton Sound Basin and 10,650 cfs in the Barataria Basin. The water would be introduced primarily from January to April. Introducing large quantities of cool river water after April could adversely affect sensitive juvenile organisms migrating into the estuaries.

Increasing nutrients and sediments in the estuarine area would enhance the growth of marsh vegetation and slow the rate of land loss in the overall study area. Increased plant growth would result in greater production of organic detritus that is important for a high rate of fisheries production. Production of phytoplankton and zooplankton would increase in areas where turhidity is not limiting and, as a result, the harvest of sport and commercial fish and shellfish that depend on these organisms would increase.

Sport fishing and hunting is related to availability of fish and wildlife resources and access to these resources. By the year 2035, the need for boat launching ramps is expected to increase from the existing 1,050 lanes to 1,587 lanes. Estimated total hunting needs are expected to increase from 2.6 to 4.5 million man-days. By the year 2035, the projected loss in habitat would cause estimated hunting losses of 160,000 man-days. The loss of habitat does not reduce the resource base for fishing, but habitat deterioration would reduce potential fish harvest. As a result, the "expected catch" would be reduced and the quality of the fishing experience would be lowered. Sport fishing and hunting would experience loss of $2.6 million by 2035. Enhancing habitat conditions would increase sport fishing and hunting opportunities 11 percent and the value of these activities $1.4 million in 2035.

Opportunities are available in the estuarine-marsh study area to reduce salinities, increase the amount of nutrients and sediments, increase recreation potential, and reduce land loss. These opportunities can be realized by improving management practices, establishing sanctuaries, filling open water areas with dredged material to create new marsh, regulating the alteration of marsh areas, placing barriers in the marsh to reduce saltwater intrusion, and introducing freshwater to reduce salinities in the marshes and estuaries.

STUDY OBJECTIVES

The following objectives have been developed based on identified problems, needs, and opportunities, and concerns of public, state, and local interests.

o Restore and maintain favorable salinity regimes in wetlands and estuaries to increase fish and wildlife productivity.

o Increase commercial fisheries production to meet the demands for fish products, increase the number of jobs available, and stabilize the wide fluctuations in the fisheries industry.

o Increase commercial wildlife production to meet the demands for pelts and hides, increase the numher of jobs available, and stabilize the wide fluctuations in the wildlife industry.

o Improve sport fishing opportunities to satisfy a portion of the sport fishing demands and to increase the quality of the fishing experience by minimizing the reduction in the "expected catch."

o Improve sport hunting opportunities to satisfy a portion of the sport hunting needs.

o Enhance marsh and aquatic vegetation growth to reduce land loss and increase the nutrient and detritus supply for fish and wildlife productivity.

o Preserve, restore, and create natural habitats to offset potential declines in fish and wildlife populations and reduce erosion, subsidence, and avenues for saltwater intrusion.

PLANNING CONSTRAINTS

Legislative and executive authorities specify planning constraints and criteria that must be applied when evaluating alternative plans, including the range of impacts to be assessed. In developing plans, both tangible and intangible benefits and costs are considered as well as effects on the ecological, social, and economic well-being of the region. Federal participation in development requires that any plan be complete in itself, efficient and safe, economically feasible in terms of current prices, environmentally acceptable, and consistent with local, regional, and state plans.

In the estuarine-marsh complex, there is a synergistic relationship between subsidence, the rise in sea level, saltwater intrusion, erosion, freshwater, sediment, nutrients, and resource productivity. Subsidence accompanied by a rise in sea level, saltwater intrusion, and erosion have already affected the area and the fish and wildlife resources that use it. Restoring desirable habitat conditions and associating changes in the salinity gradients to increases in primary productivity of habitat types and fish and wildlife populations is a complex problem. Actual experience with altering salinity for the purpose of conserving and enhancing fish and wildlife resources is limited in scope and duration. The fact that there is a relationship between changes in physical and chemical parameters and biological communities clearly emerged as the effects of diversion for flood control were observed. Current understanding of the specific effects of diversions on biological resources is based partly on several small-scale diversions to enhance fish and wildlife but is largely the result of inductive reasoning and expert judgement.

There is no single accepted method for relating primary productivity to the harvest of fish and wildlife and the benefits derived from freshwater inputs. Studies to refine presently known information would

require several years of basic research, extensive data collection, and development of hydrologic and water quality models. The effort could take many years to accomplish. In view of this constraint, the most reasonable approach was to limit the study effort to review and evaluation of existing information and available data. These sources were used to the maximum practical extent. To overcome deficiencies in other available information required some state-of-the-art research. New methodologies were developed to predict future conditions with and without a project and to evaluate commercial and recreational fish and wildlife benefits attributable to the project. Much of this effort relied on the expert judgement of personnel from the Corps and other Federal, state, and local agencies.

The widely varying salinity requirements of many fish and wildlife species is another constraint. For example, brown shrimp prefer relatively higher salinities than white shrimp. Salinity requirements vary with the life stage of most estuarine-dependent species. Wildlife also have differing salinity requirements. The majority of important wildlife species require fresher habitats, but some species prefer more saline areas. Therefore, it was necessary to determine a salinity regime best overall for fish and wildlife production. Achieving salinity gradients to improve wildlife could reduce the width of the salinity zone that fish require. Attaining the desired salinity gradient for fish would increase the wildlife-preferred habitat. Moving salinity gradients further gulfward would maximize benefits to wildlife but severely reduce fish nursery areas. Thus, a major constraint was to maintain the 15 ppt isohaline for fishery resources at the position shown on plate 5 from April through September in a 10-percent drought year when salinities would be high.

The water quality of the Mississippi River, the source of supplemental water, is a major concern. Numerous chemical compounds are discharged daily into the river. Knowledge of short and long term effects of the

contaminants on fish and wildlife is very limited. Assessing these impacts with any degree of certainty would require some basic research, extensive data collection, and development of hydrologic and water quality models. This effort would take many years. In view of the data gaps and uncertainties, this study relied on the review of available information and professional opinion in evaluating potential impacts.

Water temperature is also a constraint. The Mississippi River is generally cooler than the receiving waters from January through July. Water temperatures can affect migration and growth rates in sensitive juvenile aquatic organisms. Since large numbers of juvenile organisms arrive in the estuaries during April, a major constraint was to avoid thermal shock to immigrating juveniles by stopping or severely limiting the quantity of diverted water after April, or by introducing the water into the upper end of the estuaries, which would allow time for the water to warm.

ALTERNATIVE PLANS

MANAGEMENT MEASURES

Measures identified that could address one or more of the planning objectives are:

- Divert freshwater.
- Construct saltwater barriers.
- Fill open water areas with dredged material.
- Regulate alteration of wetlands.
- Establish sanctuaries.

- o Manage fish and wildlife.

Table 3 shows the planning objectives that each measure would meet.

The measures include suggestions made by participants at public meetings and hy representatives of interested Federal, state, and local agencies at coordination meetings. Each measure could be accomplished in numerous ways and combinations hetween measures could produce innumerable alternative plans. Therefore, each measure was subjected to analysis and screening prior to developing specific plans.

Freshwater Diversion. Diversion by gravity flow control structures, siphons, or pumping was considered. Siphons were determined to be impractical due to the quantity of flow needed (6,600 cfs in Breton Sound and 10,650 cfs in Barataria Basin) and accompanying head loss. Pumping stations are more costly to construct, operate, and maintain than gravity flow structures. Thus, gravity flow control structures were chosen for further consideration.

Twenty-one potential freshwater diversion sites were assessed. During initial plan formulation, twenty possible sites were identified for assessment. In the final plan formulation iteration, another site was added in response to public input. The site added is designated "the Davis Pond site." The sites (shown on plate 6) represent locations where connections to the river currently exist, previously existed, or where development is sparse. The four sites identified in the authorized Mississippi Delta Region project were included as potential sites. They are the Bohemia and Caernarvon sites in the Breton Sound Basin and the Myrtle Grove and Homeplace sites in the Barataria Basin. Based on the assessment in table 4, six sites were selected for detailed analysis in specific plans. The sites were Big Mar, Bayou Lasseigne, Bayou Fortier, Davis Pond, Oakville, and Myrtle Grove (See plate 7).

TABLE 3

MANAGEMENT MEASURES AND PLANNING OBJECTIVES THEY MEET

Measure	Planning Objectives						
	Preserve & Restore Wetlands	Enhance Vegetative Growth	Favorable Salinity Gradients	Increase Commercial Fisheries Production	Increase Wildlife Production	Improve Sport Fishing Opportunities	Improve Sport Wildlife Opportunities
Freshwater Diversion	Md+	Mj+	Mj+	Mj+	Mj+	Mj+	Mj+
Saltwater Barriers	Md+	Mn+	Md+	Mn+	Md+	Mn+	Md+
Regulate Alteration of Wetlands	Md+	0	Mn+	Md+	Md+	Md+	Md+
Fill Open Water Areas	Mn+	Mn+	Mn+	Mn+	Mn+	Mn+	Mn+
Establish Sanctuaries	Mn+	0	0	Mn+	Mn+	Mn+	Mn+
Manage Fish and Wildlife	0	Mn+	0	Mn+	Mn+	Mn+	Mn+

Type of Contribution: Mj = Major; Md = Moderate; Mn = Minor; 0 = No Effect; (+) Positive; and (-) Negative.

TABLE 4

SUMMARY ASSESSMENT OF FRESHWATER DIVERSION SITES

Potential Environmental Effects

Potential Site/ Receiving Water Body	Habitat Altered				Water Quality Degraded		Probability of Altered Cultural Resources	Resource Productivity Improved			LA Scenic Rivers & Streams Altered
	Benthic	Bottomland Hardwood & Wooded Swamp	Marsh	Developed & Agricultural	Marine	Freshwater		Marine Fishery	Freshwater Fishery	Wildlife	
	(Channel Miles)	(Acres)	(Acres)	(Acres)							
BRETON BASIN											
Caernarvon Canal/ Lake Lery	5.3	61	258	12	Major	Moderate	High	Moderate	Minor	Major	None
Below Caernarvon/ Big Mar	1.3	14	68	7	Moderate	Major	High	Major	Moderate	Major	None
Bohemia/ American Bay											
BARATARIA BASIN											
Bayou Becnel/ Lac Des Allemand	6.1	152	46	122	Minor	Moderate	High	Major	Major	Major	Possible
Johnson/ Lac Des Allemands	6.1	197	46	122	"	"	"	"	"	"	"
Bayou Lasseigne/ Lac Des Allemands	5.9	122	91	61	"	"	"	"	"	"	"
Bayou Fortier/ Lac Des Allemands	7.0	243	122	91	"	"	"	"	"	"	"
Davis Pond/ Lake Cataouatche	2.2	212	168	40	"	Minor	"	Moderate	Moderate	Moderate	None
Lanoux Canal/ Lake Cataouatche	6.4	91	243	91	Moderate	"	"	"	"	"	"
Sellers Canal/ Lake Cataouatche	6.1	91	243	91	"	"	Low	"	"	"	"
Saul'a Canal/ Lake Cataouatche	7.4	61	319	61	"	"	High	"	"	"	"
Willswood Canal/ Lake Cataouatche	6.3	137	228	31	"	"	"	"	"	"	"
Waggaman Canal/ Lake Cataouatche	6.4	122	228	46	"	"	"	"	"	"	"
Avondale Canal/ Lake Cataouatche	4.0	31	182	46	"	"	"	"	"	"	"
Bayou Segnette/ Lake Cataouatche	8.0	183	213	91	"	"	Low	"	"	"	"
Harvey Lock/ Bayou Barataria	15.0	325	109	-	Moderate	Minor	"	Minor	Minor	Minor	Minor
Algiers Lock/ Bayou Barataria	16.9	252	109	-	"	"	"	"	"	"	"
Hero Canal/ Bayou Barataria	10.0	237	109	-	"	Moderate	High	"	"	"	"
Oakville/ Bayou Barataria	2.5	192	109	23	"	"	"	"	"	"	"
Myrtle Grove/ Wilkinson Canal	8.4	20	211	70	Major	Major	"	"	"	"	"

TABLE 4 (CONTINUED)

SUMMARY ASSESSMENT OF FRESHWATER DIVERSION SITES

Potential Economic and Social Effects

Potential Site/ Receiving Water Body	Lands Removed From Production	Residences(R)/ Businesses(B) Relocated	Transportation & Utilities Disrupted	Social & Esthetic Quality Degraded	Fish & Wildlife Harvest Improved	
					Commerical	Sport
	(Acres)					
BRETON BASIN						
Caernarvon Canal/ Lake Lery	12	4R & 10B	Minor	Moderate	Moderate	Moderate
Below Caernarvon Big Mar	7	-	Minor	Minor	Major	Major
BARATARIA BASIN						
Bayou Becnel/ Lac Des Allemands	122	-	Minor	Minor	Major	Major
Johnson/ Lac Des Allemands	122	-	Minor	Minor	Major	Major
Bayou Lasseigne/ Lac Des Allemands	61	-	Minor	Minor	Major	Major
Bayou Fortier/ Lac Des Allemands	91	-	Moderate	Minor	Major	Major
Davis Pond/ Lake Cataouatche	40	-	Major	Moderate	Major	Major
Lanoux Canal/ Lake Cataouatche	91	-	Major	Moderate	Moderate	Moderate
Sellers Canal/ Lake Cataouatche	91	-	Major	Moderate	Moderate	Moderate
Saul's Canal/ Lake Cataouatche	61	1B	Major	Moderate	Moderate	Moderate
Willswood Canal/ Lake Cataouatche	31	-	Major	Moderate	Moderate	Moderate
Waggaman Canal/ Lake Cataouatche	46	3R	Major	Moderate	Moderate	Moderate
Avondale Canal/ Lake Cataouatche	46	5R	Major	Moderate	Moderate	Moderate
Bayou Segnette/ Lake Cataouatche	91	35R & 10B	Major	Major	Moderate	Moderate
Harvey Lock/ Bayou Barataria	-	32B	Major	Minor	Minor	Minor
Algiers Lock/ Bayou Barataria	-	13B	Moderate	Minor	Minor	Minor
Hero Canal/ Bayou Barataria	90	2R & 7B	Minor	Minor	Minor	Minor
Oakville/ Bayou Barataria	23	3B	Minor	Minor	Minor	Minor
Myrtle Grove/	70	7R	Minor	Moderate	Minor	Minor

TABLE 4 (CONTINUED)

SUMMARY ASSESSMENT OF FRESHWATER DIVERSION SITES

Potential Site Location Effects and Cost

Potential Site/ Receiving Water Body	Disadvantages Navigation (N)& Drainage (D) Canals	Advantages Hydraulic Efficiency Detention & Dispersion of Freshwater	Cost
BRETON BASIN			
Caernarvon Canal/ Lake Lery	Alter 1N & 2D. Opposed by local interests.	Moderate	Least
Below Caernarvon Big Mar	Alter 1D canal.	Maximum	"
Bohemia/ American Bay	Lower end of basin, least effective in producing benefits.	Minimum	"
BARATARIA BASIN			
Bayou Becnel Lac Des Allemands	Eroding bend & potential liquification failure. Alter 2D canals.	Maximum	"
Johson/ Lac Des Allemands	Eroding bend. Alter 2D canals.	"	"
Bayou Lasseigne/ Lac Des Allemands	Alter 1D canal.	"	"
Bayou Fortier/ Lac Des Allemands	Alter 2D canal.	"	"
Davis Pond/ Lake Cataouatche	Alter 1N & 4D canals.	Moderate	Moderate
Lanoux Canal/ Lake Cataouatche	Alter 4D canals. 1 pumped drainage system.	"	"
Sellers Canal/ Lake Cataouatche	" "	"	"
Saul's Canal/ Lake Cataouatche	" "	"	"
Willswood Canal/ Lake Cataouatche	Alter 3D canals. 1 pumped drainage system.	"	"
Waggaman Canal/ Lake Cataouatche	Alter 4D canals. 1 pumped drainage system.	"	"
Avondale Canal/ Lake Cataouatche	Alter 3D canals. 1 pumped drainage system.	"	"
Bayou Segnette/ Lake Cataouatche	Alter 1N & 2D canals.	"	"
Harvey Lock/ Bayou Barataria	Alter 2N canals.	Maximum	Most
Algiers Lock Bayou Barataria	" "	"	"
Hero Canal/ Bayou Barataria	Alter 2N canals. Opposed by local interests.	"	"
Oakville/ Bayou Barataria	Alter 1N & 1D canal.	"	"
Myrtle Grove/ Wilkinson Canal	Alter 3N & 1D canals.	"	"
Homeplace/ Adams Bay	Lower end of basin, least effective in producing benefits.	Minimum	Least

The Big Mar site in the Breton Sound Basin was chosen because it would be less costly and would have a shorter conveyance channel with fewer adverse impacts on the environment and existing development than the alternate Caernarvon Canal site. Adverse effects on water quality would be less severe and natural dispersion would be greater. Local officials have also expressed support for the Big Mar site.

The Bayou Lasseigne and Bayou Fortier sites in upper Barataria Basin were chosen because freshwater introduced into Lac Des Allemands would affect the largest area, have the slowest runoff rate and longest detention time, and produce the most intangible benefits. Other sites in the vicinity are located in an eroding bend of the river and would have more severe design and foundation problems with erosion, seepage, settlement, and the potential for liquification-type failure, and would be more costly.

The Davis Pond site in middle Barataria Basin would allow quicker reaction to saltwater intrusion. The site has the potential for minimizing adverse environmental impacts and has public support. A major disadvantage is the proximity of the site to an urbanizing area. The Oakville and Myrtle Grove sites were retained because these locations offer the advantage of being able to react quickly to saltwater intrusion and would have fewer impacts on urban areas than the other sites at the lower end of the basin.

Saltwater Barriers. A preliminary analysis indicated that this measure would require a navigation lock in Barataria Bay Waterway costing about $36 million, a pneumatic barrier with sector gates in Bayou Perot costing about $12 million, and navigable weirs and stoplog structures in several oilfield and other canals costing about $680,000 for each canal. The barriers were determined to be too costly, would interfere with fish migrations, and would provide fewer benefits than freshwater diversion. Thus, the measure was eliminated from further consideration.

Fill Open Water Areas. Placing dredged material in open water areas would make minor contributions to preserving wetlands, enhancing vegetative growth, increasing wildlife production, improving sport wildlife opportunities, increasing commercial fish production, and improving sport fish opportunities. The measure, presently being implemented to a limited extent by the US Army Corps of Engineers, is only a partial solution to loss of land and habitat types. A comprehensive solution to the problem will require that this measure be investigated in combination with measures to reduce erosion and subsidence and to divert very large quantities of sediment-laden water. Such a comprehensive study is proposed under the overall Louisiana Coastal Area study. Thus, the measure was not considered further in this interim report addressing saltwater intrusion.

Regulate Alteration of Wetlands. Federal, state, and local agencies have recognized the importance of this measure in preserving and protecting the environment. These agencies have implemented numerous regulatory programs to protect the public interest. The US Army Corps of Engineers administers a major regulatory program under authorities in Sections 9, 10, and 13 of the River and Harbor Act of 1899, Section 404 of the Clean Water Act of 1972 as amended, and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended. The US Environmental Protection Agency, Department of Commerce, and Department of the Interior also administer regulatory programs. In addition, the State of Louisiana has an approved coastal resources program that regulates development in the coastal zone. The program is administered by the state and parish governments. The Federal, state, and local regulatory programs are comprehensive and effectively regulate alterations of the wetlands. Continued administration of these programs will aid in meeting study objectives.

Establish Sanctuaries. This measure would provide some protection for fish and wildlife populations and critical habitat. However, imple menting it would decrease commercial and sport harvest. Other measures offer better means for achieving the planning objectives without reducing harvest. Thus, this measure was eliminated from further consideration.

Manage Fish and Wildlife. This measure would make minor contributions to enhancing vegetative growth, increasing fish and wildlife production, and improving sport fish and wildlife opportunities. It would make no contribution to preserving wetlands and creating favorable salinity gradients. The measure does not address the major problems associated with habitat losses. Thus, it was not considered further.

DEVELOPMENT OF ALTERNATIVE PLANS

Freshwater diversion to Breton Sound Basin at the Big Mar site and to Barataria Basin at the Bayou Lasseigne, Bayou Fortier, Davis Pond, Oakville, and Myrtle Grove sites is the specific management measure used to develop plans. Innumerable plans are possible by combining various flows and sites. Achieving the desired salinity conditions from April through September was the basic condition for development of plans. The condition requires a maximum flow of 6,600 cfs to the Breton Sound Basin and 10,650 cfs to the Barataria Basin from January through April. With this condition, the number of possible plans is substantially reduced.

Further analysis determined that only the Big Mar, Bayou Lasseigne, and Bayou Fortier sites could meet the requirements of the condition. The Davis Pond site is not able to meet these requirements. After diversion is stopped at the end of April, the diverted water cannot maintain desired salinities beyond August. The requirements could be met at the Davis Pond site by extending the diversion period through May. However, in order to extend the diversion period, the cooler river water must be

allowed to warm to avoid thermal shock to migrating juvenile estuarine organisms. At the Davis Pond site, the water could be detained in a 7,425-acre overflow area and allowed to warm before entering Lakes Cataouatche and Salvador. Thus, the diversion period could be extended through May.

Plans including the Oakville or the Myrtle Grove sites would be unable to meet the requirements in the Barataria Basin after diversion is stopped at the end of April. The detention time of the flow would not be adequate to maintain the desired salinities from June through September. At these two sites, it would be necessary to extend the diversion period through July. The extended diversion period would have serious adverse impacts on highly sensitive juvenile estuarine organisms. Combining these two downstream sites with upstream sites would be effective. However, the flow contributed by the Oakville and Myrtle Grove sites could not exceed 50 percent of the total flow diverted.

In developing possible combinations of flows and sites, flows of 33, 50, 67, and 100 percent of the optimum 10,650 cfs flow to Barataria Basin were used for the Bayou Lasseigne and Bayou Fortier sites. Flows of 33 and 50 percent of the optimum 10,650 cfs flow were used in plans that included the Oakville and Myrtle Grove sites. In an early plan formulation iteration, combining flows from sites in the upper and lower basin proved less desirable than diverting flow from a single upper basin site. Based on that analysis, it was also concluded that combining lower basin sites with the Davis Pond site would be less desirable. Therefore, the Davis Pond site was evaluated for only the optimum flow. All plans include the Big Mar site with a diversion of optimum flow, 6,600 cfs, to Breton Sound Basins. Table 5 shows the 16 alternative combinations of sites and flows that were developed. The 16 plans provide an array of alternatives for maximizing net benefits. In addition to the 16 action alternatives, a no-action plan was carried forward.

TABLE 5

ALTERNATIVE COMBINATIONS OF SITES AND FLOWS

	Breton Sound	Barataria Basin				
	Big Mar	Oakville	Myrtle Grove	Davis Pond	Bayou Fortier	Bayou Lasseigne
Alternative Combinations	Percent of Flow					
1	100	0	0	0	67	33
2	100	0	0	0	33	67
3	100	0	0	0	50	50
4	100	0	0	0	100	0
5	100	0	0	0	0	100
6	100	50	0	0	50	0
7	100	50	0	0	0	50
8	100	33	0	0	67	0
9	100	33	0	0	0	67
10	100	33	0	0	33	33
11	100	0	50	0	50	0
12	100	0	50	0	0	50
13	100	0	33	0	67	0
14	100	0	33	0	0	67
15	100	0	33	0	33	33
16	100	0	0	100	0	0

PRESENTATION AND ASSESSMENT OF PLANS

In the 16 plans evaluated, three basic approaches to diverting freshwater into Barataria Basin were used. Plans 1 through 5 represent one approach: divert all flow into Lac Des Allemands in upper Barataria Basin. Plans 6 through 15 use another approach: divide the diversion between sites in upper Barataria Basin and sites in the lower basin. Plan 16 uses a third approach: divert all flows into Lake Cataouatche, which is hetween the upper and lower Barataria Basin sites. All 16 plans include diversion of flow into Breton Sound Basin through Big Mar. Tables 6, 7, and 8 summarize the plans and assess significant impacts and the contributions of each plan to the national economic development objective and to environmental quality, social well-being, and regional development. All plan benefits and costs are based on October 1983 price levels and were evaluated using the current interest rate of 8 1/8 percent and a 50-year project life. However, because the Big Mar site in the Breton Sound Basin is, in essence, the Caernarvon site in the authorized Mississippi Delta Region project, the Big Mar site was also evaluated using the 3 1/4 percent interest rate specified in the authorizing document for the Mississippi Delta Region project, the Flood Control Act of 1965 (H. D. Number 308, 88th Congress, 1st Session).

The sites in each plan have similar features including a multiple box culvert control structure, inlet and outlet channels, and disposal areas for excavated materials along both sides of the channels. At the Big Mar, Bayou Lasseigne, Bayou Fortier, and Davis Pond sites, the control structures would be in the Mississippi River levee. At the Oakville and Myrtle Grove sites, the structures would be located landward of the levee because there is not enough riverside berm to permit economical construction. The channels would be excavated by dragline or hydraulically dredged in open water areas. Equal amounts of excavated

TABLE 6

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

PLANS 1-5

Item	Existing Conditinn 1980	Future Condition (No Action) 2035	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5
I. PLAN DESCRIPTION			Big Mar - 6,600 CFS Bayou Fortier - 7,100 CFS Bayou Lasseigne-3,550 CFS	Big Mar - 6,600 CFS Bayou Fortier - 3,550 CFS Bayou Lasseigne-7,100 CFS	Big Mar - 6,600 CFS Bayou Fortier - 5,325 CFS Bayou Lasseigne-5,325 CFS	Big Mar - 6,600 CFS Bayou Fortier 10,650 CFS	Big Mar- 6,600 CFS Bayou Lasseigne-10,650 CFS
II. SIGNIFICANT IMPACTS							
1. National Economic Development (NED) 1/							
a. Total average annual benefits			$15,760,000	$15,760,000	$15,760,000	$15,760,000	$15,760,000
b. Total average annual costs			5,320,000	5,210,000	5,320,000	4,700,000	4,400,000
(1) Interest and amortization			4,796,000	4,686,000	4,790,000	4,229,000	3,929,000
(2) Operation and maintenance			524,000	524,000	530,000	471,000	471,000
c. First Cost			$53,900,000	$52,700,000	$53,900,000	$47,600,000	$44,200,000
d. Net annual NED benefits			10,440,000	10,550,000	10,440,000	11,060,000	11,360,000
e. Benefit-Cost ratio			3.0	3.0	3.0	3.4	3.6
2. Environmental Quality (EQ)							
a. Wetlands	881,100 acres of wetlands (657,400 acres of marsh).	488,100 acres of wetlands (376,500 acres nf marsh).	827 acres of wetlands affected. 99,162 acres of marsh saved.(1,2,3,5,9)	Similar to plan 1	Similar to plan 1.	Similar to plan 1.	Similar to plan 1.
b. Water bodies 2/	982,000 acres of canals, lakes, bays, & sound.	1,262,900 acres of water.	180 acres altered. 15 sq mi delta formed.(1,2,3,5,9)	Similar to plan 1.	Similar to plan 1.	Similar to plan 1.	Similar to plan 1.
c. Water Quality*	Fresh to saline, warm. Trace metals-nucrients, fecal coliform bacteria occasionally exceed criteria.	Basin water quality degraded. 15 ppc isohaline 12 miles norrh in Barataria Bay, 17 miles in Breton Sound.	Divert into fresh lakes. Cool, increased turbidity, possible bioaccumulation of pollutants, fecal coliform (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
d. Prime and unique farmland* and other lands.	Sugarcane land. Other includes disposal & developed areas.	Farmland converted to other uses in vicinity of urbanizing areas.	121 acres of farmland & 11 acres of other. (1,2,3,5,9)	Similiar to plan 1.	Similar to plan 4.	Similar to plan 1.	Similar to plan 1.
e. Endangered species	Bald eagle & brown pelican nest in area; Arctic peregrine falcon visitor.	Species adversely affected by habitat deterioration.	Poor water quality could affect species. (1,2,3,5,9)	Same as plnn 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Fish and Wildlife	$115,000,000 total income.	$66,000,000 total income.	$107,000,000 total income. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. National Register of Historic Places	None	None	None	None	None	None	None
3. Social Well-Being							
a. Community Cohesion*	Unique cultural heritage & lifestylee dependent on fishing & trapping.	Preservation of lifescyles & community cohesion difficult.	Help meintain traditional lifestyles. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Community growth*	Dependent nn the fish & wildlife industries.	Population & opportunities would declina.	Increase opportunities. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5
c. Displacement of People*			None	None	None	None	None
Businesses			None	None	None	None	None
d. Leisure*	1,065,000 man-days of sport fishing & hunting.	868,000 man-days of sport fishing & hunting.	961,000 man-days of sport fishing & hunting. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
e. Property values*		Continued decline.	Slight increase.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Tax Revenues*		Taxes derived from fish & & wildlife activities would decline.	Reduced loss of taxes derived from wildlife activities. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. Transportation*			Minor disruption of vehicular traffic during construction. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
h. Noise*			Minor increase in noise levels during construction. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
i. Quality of community life			Increased opportunities aid in maintaining quality of life.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
4. Regional Development (RD)							
a. Employment and income		Continued decline in employment, & income in fish & wildlife related industries.	Minor increase during construction, operation, maintenance. Long-term increase in fish & wildlife related industries. (1,2,3,5,9)	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Regional growth and businesses activity		Continued decline in activities related to fish and wildlife.	Revitalize declining fish & wildlife related industries.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
III. Plan Evaluation							
1. Contribution to Planning Objectives							
a. Increase fish and wildlife production (NED) 1.			Average annual net increase $15,760,000	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Preserve and wetlands, enhance vegetative growth, establish favorable salinity gradients, improve sport fish and wildlife opportunities (EQ)			Positive contribution.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
2. Net Effects							
a. Net NED average annual benefits			$10,440,000	$10,550,000	$10,440,000	$11,060,000	$11,360,000
b. Net EQ effects			Highly positive	Highly positive	Highly positive	Highly positive	Highly positive
c. Net Social Well-Being Effects			Slightly positive	Slightly positive	Slightly positive	Slightly positive	Slightly positive
d. Net Regional Development Effects			Slightly positive	Slightly positive	Slightly positive	Slightly positive	Slightly positive

TABLE 6 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 1-5

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5
3. Plan Response to Associated Evaluation Criteria							
a. Acceptability			Local interests oppose Lac Des Allemands site.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Efficiency			Less efficient than plans 4,5 & 16 due to coordination in maintaining best flow combination. More efficient than plans 6-15.	Same as plan 1.	Same as plan 1.	More efficient than 1, 2, & 3; comparable to plan 5 & 16; more efficient than plans 6-15.	Most efficient plan
c. Geographic scope			Maintains desired conditions over largest area.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
d. NED benefit-cost ratio			3.0	3.0	3.0	3.4	3.6
e. Reversability			Less reversible than plans 4, 5, 16, same 2-3, 6-9, 11-14, more reversible than 10 & 15.	Same as plan 1.	Same as plan 1.	Most reversible.	Same as plan 4.
4. Rankings of plans a. NED Objectives			14	12	15	6	1 NED plan.
b. EQ objectives			6	5	4	3	1
c. Social Well-Being			6	5	4	3	1
d. Regional Development			6	5	4	3	1
IV. IMPLEMENTATION RESPONSIBILITY							
1. First Cost a. Federal			$40,400,000	$39,500,000	$40,400,000	$35,700,000	$33,200,000
b. Non-Federal			13,500,000	13,200,000	13,500,000	11,900,000	11,000,000
c. Total			53,900,000	52,700,000	53,900,000	47,600,000	44,200,000
2. Annual Cost a. Federal			3,600,000	3,510,000	3,590,000	3,170,000	2,950,000
b. Non-Federal			1,720,000	1,700,000	1,730,000	1,530,000	1,450,000
c. Total			5,320,000	5,210,000	5,320,000	4,700,000	4,400,000

Index of footnotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan. 2. Impact is expected within 15 years following plan implementation. 3. Impact is expected in a longer time frame(15 or more years following implementation)

Uncertainty

4. The uncertainty associated with the impact is 50% or more. 5. The uncertainty is between 10% and 50%. 6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account. 8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation. 11. Impact will not occur because necessary additional actions are lacking.

Section 122

*. Items specifically required in Section 122 and ER 1105-2-240.

1/ Based on October 1982 price levels and amortization over 50 years or 7 7/8% interest.
2/ All plans include a 3 sq mi delta formed in Big Mar.

TABLE 7

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

PLANS 6-10

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10
I. PLAN DESCRIPTION			Big Mar - 6,600 CFS Oakville - 5,325 CFS Bayou Fortier-5,325 CFS	Big Mar - 6,600 CFS Oakville - 5,325 CFS Bayou Lasseigne-5,325 CFS	Big Mar - 6,600 CFS Oakville - 3,550 CFS Bayou Fortier-7,100 CFS	Big Mar - 6,600 CFS Oakville - 3,550 CFS Bayou Lasseigne-7,100 CFS	Big Mar- 6,600 CFS Oakville- 3,550 CFS Bayou Fortier- 3,500 CFS Bayou Lasseigne - 3,550 CFS
II. SIGNIFICANT IMPACTS							
1. National Economic Development (NED) 1/							
a. Total average annual benefits			$15,760,000	$15,760,000	$15,760,000	$15,760,000	$15,760,000
b. Total average annual costs			4,680,000	4,530,000	4,740,000	4,600,000	5,280,000
(1) Interest and amortization			4,176,000	4,026,000	4,238,000	4,098,000	4,727,000
(2) Operation and maintenance			504,000	504,000	502,000	502,000	553,000
c. First Cost			$47,000,000	$45,300,000	$47,700,000	$46,100,000	$53,100,000
d. Net annual NED benefits			11,080,000	11,230,000	11,020,000	11,160,000	10,480,000
e. Benefit-Cost ratio			3.4	3.5	3.3	3.4	3.0
2. Environmental Quality (EQ)							
a. Wetlands	881,100 acres of wetlands 657,400 acres of marsh)	488,100 acres of wetlands (376,500 acres of marsh).	591 acres altered, 99,162 acres marsh saved. (1,2,3,5)	Similar to plan 6.	Similar to plan 6.	Similar to plan 6.	Similar to plan 6.
b. Water bodies	982,000 acres of canals, lakes, bays, & sound.	1,262,900 acres of water.	266 ac altered. 3.5 sq mi delta formed. (1,2,3,5,9)	Similar to plan 6.	Similar to plan 6. 4 sq mi delta formed.	Similar to plan 8.	Similar to plan 6.
c. Water Quality*	Fresh to saline, warm. Trace metals, nutrients, fecal coliform bacteria occasionally exceeded criteria.	Water quality degraded. 15 ppt isohaline 12 miles north in Barataria Bay, 17 miles in Breton Sound.	Divert into fresh brackish waters. Cool, increased turbidity, possible bioaccumulation of pollutants, fecal coliform bacteria. (1,2,3,5,9)	Same as plan 6.	Same as plan 6.	Same as plan 6.	Same as plan 6.
d. Prime and unique farmland* and other lands.	Sugarcane land. Other includes disposal & developed areas.	Farmland converted to other uses in nearby urbanizing areas.	60 acres of farmland & 43 acres of others. (1,2,3,5,9)	Similar to plan 6.	Similar to plan 6.	Similar to plan 6.	Similar to plan 6.
e. Endangered species	Bald eagle & brown pelicau nest in area; Arctic peregrine falcon visitor.	Species adversely affected by habitat deterioration.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Fish and Wildlife	$115,000,000 total income.	$66,000,000 total income.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. National Register of Historic Places	None	None	None	None	None	None	None
3. Social Well-Being							
a. Community Cohesion*	Unique cultural heritage lifestyles dependent on fishing & trapping.	Preservation of lifestyles & community cohesion difficult.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Community growth*	Dependent on the fish & wildlife industries.	Population & opportunities would decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.

TABLE 7 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 6-10

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10
c. Displacement of People* Businesses			None Relocate 3 businesses (1,2,3,5,9)	None Same as plan 6.	None Same as plan 6.	None Same as plan 6.	None Same as plan 6.
d. Leisure*	1,065,000 man-days of sport fishing & hunting.	869,000 man-days of sport fishing & hunting.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
e. Property values*		Continued decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Tax Revenues*		Taxes derived from fish & & wildlife activities would decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. Transportation*			Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
h. Noise*			Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
i. Quality of community life			Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
4. Regional Development (RD)							
a. Employment and income		Continued decline in employment, & income in fish & wildlife related industries.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Regional growth and businesses activity		Continued decline in activities related to fish and wildlife.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
III. Plan Evaluation							
1. Contribution to Planning Objectives							
a. Increase fish and wildlife production (NED)			Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Preserve and restore wetlands, enhance vegetative growth, establish favorable salinity gradients, improve sport fish and wildlife opportunities (EQ)			Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
2. Net Effects							
a. Net NED average annual benefits			$11,080,000	$11,230,000	$11,020,000	$11,160,000	$10,480,000
b. Net EQ effects			Moderately positive	Moderately positive	Moderately positive	Moderately positive	Moderately positive
c. Net Social Well-Being Effects			Slightly positive	Slightly positive	Slightly positive	Slightly positive	Sightly positive
d. Net Regional Development Effects			Slightly positive	Slightly positive	Slightly positve	Slightly positive	Slightly pnsitive

TABLE 7 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 6-10

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 6	Plan 7	Plan 8	Plan 9	Plan 10
3. Plan Response to Associated Evaluation Criteria							
a. Acceptability			Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Efficiency			Less efficient than plans 1-5, & 16 same as 7-9, more than 10-15.	Same as plan 6.	Same as plan 6.	Same as plan 6.	Less efficient than plans 1-9 & 11 -14, & 16 same as plan 15.
c. Geographic scope			Maintains desired conditions in a slightly smaller area.	Same as plan 6.	Same as plan 6.	Same as plan 6.	Same as plan 6.
d. NED benefit-cost ratio			3.4	3.5	3.3	3.4	3.0
e. Reversability			Less reversible than 4, 5, 16. Same as 1-3, 7-9, 11-14, more than 10 & 15.	Same as plan 6.	Same as plan 6.	Same as plan 6.	Least reversible.
4. Rankings of plans							
a. NED Objectives			5	2	8	3	13
b. EQ objectives			11	10	8	7	9
c. Social Well-Being			11	10	8	7	9
d. Regional Development			11	10	8	7	9
IV. IMPLEMENTATION RESPONSIBILITY							
1. First Cost							
a. Federal			$35,200,000	$34,000,000	$35,800,000	$34,600,000	$39,900,000
b. Non-Federal			11,800,000	11,300,000	11,900,000	11,500,000	13,200,000
c. Total			47,000,000	45,300,000	47,700,000	46,100,000	53,100,000
2. Annual Cost							
a. Federal			3,130,000	3,020,000	3,180,000	3,070,000	3,550,000
b. Non-Federal			1,550,000	1,510,000	1,560,000	1,530,000	1,730,000
c. Total			4,680,000	4,530,000	4,740,000	4,600,000	5,280,000

Index of footuotes:

Timing

1. Impact is expected to occur prior to or during implementation of the plan. 2. Impact is expected within 15 years following plan implementation. 3. Impact is expected in a longer time frame(15 or more years following implementation)

Uncertainty

4. The uncertainty associated with the impact is 50% or more. 5. The uncertainty is between 10% and 50%. 6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account. 8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation. 11. Impact will not occur because necessary additional actions are lacking.

Section 122

*. Items specifically required in Section 122 and ER 1105-2-240.

1/ Based on October 1982 price levels and amortization over 50 years at 7 7/8% interest.

2/ All plans include a 3 sq mi delta formed in Big Mar.

TABLE 8

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 11-13

Item	Existing Condition 1980	Future Conditions (No Action) 2035	Plan 11	Plan 12	Plan 13
I. PLAN DESCRIPTION			Big Mar - 6,600 CFS Myrtle Grove - 5,325 CFS Bayou Fortier-5,325 CFS	Big Mar - 6,600 CFS Myrtle Grove - 5,325 CFS Bayou Lasseigne-5,325 CFS	Big Mar - 6,600 CFS Myrtle Grove - 3,550 CFS Bayou Fortier-7,100 CFS
II. SIGNIFICANT IMPACTS [1/]					
1. National Economic Development (NED)					
a. Total average annual benefits			$15,760,000	$15,760,000	$15,760,000
b. Total average annual costs			4,810,000	4,650,000	4,870,000
(1) Interest and amortization			4,306,000	4,146,000	4,368,000
(2) Operation and maintenance			504,000	504,000	502,000
c. First Cost			$48,400,000	$46,700,000	$49,100,000
d. Net annual NED benefits			10,950,000	11,110,000	10,890,000
e. Benefit-Cost ratio			3.3	3.4	3.2
2. Environmental Quality (EQ)					
a. Wetlands	881,100 acres of wetlands (657,400 acres of marsh).	488,100 acres of wetlands (376,500 acres of marsh).	669 acres altered. 99,162 acres marsh saved. (1,2,3,5,9)	Similar to plan 11.	Similar to plan 11.
b. Water bodies [2/]	982,000 acres of canals, lakes, bays, & sound.	1,262,900 acres of water.	391 ac altered. 3.5 sq mi delta formed. (1,2,3,5,9)	Similar to plan 11.	Similar to plan 11. 4 sq mi delta formed.
c. Water Quality*	Fresh to saline warm. Trace metals, nutrients, fecal coliform bacteria occasionally exceed criteria.	Water quality degraded. 15 ppt isohaline 12 miles north in Barataria Bay, 17 miles in Breton Sound.	Divert into fresh/saline waters. Cool, increased turbidity, possible bio-accumulation of pollutants, & fecal coliform bacteria. (1,2,3,5,9)	Same as plan 11.	Same as plan 11.
d. Prime and unique farmland* and other lands.	Sugarcane land. Other includes disposal & developed areas.	Farmland converted to other uses near urban areas.	84 acres of farmland. 56 acres of other. (1,2,3,5,9)	Similar to plan 11.	Similar to plan 11.
e. Endangered species	Bald eagle & brown pelican nest in area. Arctic peregrine falcon visitor.	Species adversely affected by habitat deterioration.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Fish and Wildlife	$115,000,000 total income.	$66,000,000 total income.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. National Register of Historic Places	None	None	None	None	None
3. Social Well-Being					
a. Community Cohesion*	Unique cultural heritage & lifestyles dependent on fishing & trapping.	Preservation of lifestyles & community cohesion difficult.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Community growth*	Dependent on fish & wildlife industries.	Population opportunities would decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 11	Plan 12	Plan 13
c. Displacement of People* Businesses			Relocate 7 camps. None	Same as plan 11. None	Same as plan 11. None
d. Leisure*	1,065,000 man-days of sport fishing & hunting.	869,000 man-days of sport fishing & hunting.	Same as plan 1.	Same as plan 1.	Same as plan 1.
e. Property values*		Continued decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Tax Revenues*		Taxes derived from fish & wildlife activities would decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. Transportation*			Same as plan 1.	Same as plan 1.	Same as plan 1.
h. Noise*			Same as plan 1.	Same as plan 1.	Same as plan 1.
i. Quality of community life			Same as plan 1.	Same as plan 1.	Same as plan 1.
4. Regional Development (RD)					
a. Employment and income		Continued decline in employment, income in fish & wildlife related industries.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Regional growth and businesses activity		Continued decline in activities related to fish & wildlife.	Same as plan 1.	Same as plan 1.	Same as plan 1.
III. Plan Evaluation					
1. Contribution to Planning Objectives					
a. Increase fish and wildlife production (NED)			Same as plan 1.	Same as plan 1.	Same as plan 1.
h. Preserve and restore wetlands, enhance vegetative growth, establish favorable salinity gradients, improve sport fishing and wildlife opportunities.			Similar to plan 1.	Similar to plan 1.	Similar to plan 1.
2. Net Effects					
a. Net NED average annual benefits.			$11,040,000	$11,200,000	$10,980,000
b. Net EQ effects.			Slightly positive	Slightly positive	Slightly positive
c. Net Social Well-Being Effects			Slightly positive	Slightly positive	Slightly positive
d. Net Regional Development Effects			Slightly positive	Slightly positive	Slightly positive
3. Plan Response to Associated Evaluation Criteria					
a. Acceptability			Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Efficiency			Less efficient than plans 1-5, 16, same as 7-9, 12-14, more than 10 & 15.	Same as plan 11.	Same as plan 11.
c. Geographic scope			Maintains desired conditions in a smaller area.	Same as plan 11.	Same as plan 11.
d. NED benefit-cost ratio			3.4	3.5	3.3
e. Reversability			Same as plan 6.	Same as plan 6.	Same as plan 6.
4. Rankings of plans					
a. NED Objectives			10	4	11
b. EQ objectives			16	15	13
c. Social Well-Being			16	15	13
d. Regional Development			16	15	13

TABLE 8 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 11-13

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 11	Plan 12	Plan 13
IV. IMPLEMENTATION RESPONSIBILITY					
1. First Cost					
a. Federal			$36,300,000	$35,000,000	$36,800,000
b. Non-Federal			12,100,000	11,700,000	12,300,000
c. Total			48,400,000	46,700,000	49,100,000
2. Annual Cost					
a. Federal			3,230,000	3,110,000	3,280,000
b. Non-Federal			1,580,000	1,540,000	1,590,000
c. Total			4,810,000	4,650,000	4,870,000

Index of footnotes:

Timing:
1. Impact is expected to occur prior to or during implementation of the plan. 2. Impact is expected within 15 years following plan implementation. 3. Impact is expected in a longer time frame(15 or more years following implementation).

Uncertainty

4. The uncertainty associated with the impact is 50% or more. 5. The uncertainty is between 10% and 50%. 6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account. 8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation. 11. Impact will not occur because necessary additional actions are lacking.

Section 122

*. Items specifically required in Section 122 and ER 1105-2-240.

1/ Based on October 1982 price levels and amortization over 50 years at 7 7/8 % interest.

2/ All plans include a 3 sq mi delta formed in Big Mar.

TABLE 8 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 14-16

Item	Existing Condition 1980	Future Conditions (No Action) 2035	Plan 14	Plan 15	Plan 16
I. PLAN DESCRIPTION			Big Mar - 6,600 CFS Myrtle Grove - 3,550 CFS Bayou Fortier-7,100 CFS	Big Mar - 6,600 CFS Myrtle Grove - 3,550 CFS Bayou Fortier- 3,550 CFS Bayou Lasseigne-3,550 CFS	Big Mar - 6,600 CFS Davis Pond - 10,650 CFS
II. SIGNIFIGANT IMPACTS					
1. National Economic Development (NED) 1/					
a. Total average annual benefits			$15,760,000	$15,760,000	$15,760,000
b. Total average annual costs			4,720,000	5,400,000	4,760,000
(1) Interest and amortization			4,218,000	4,747,000	4,515,000
(2) Operation and maintenance			502,000	553,000	545,000 Excludes dredging maintenance
c. First Cost			$47,500,000	$54,500,000	$47,400,000
d. Net annual NED benefits			11,040,000	10,360,000	11,000,000
e. Benefit-Cost ratio			3.3	2.9	3.3
2. Environmental Quality (EQ)					
a. Wetlands	881,100 acres of wetlands (657,400 acres of marsh).	488,100 acres of wetlands. (376,500 acres of marsh).	Similar to plan 11.	Similar to plan 11.	305 acres altered, 99,162 marsh saved. (1,2,3,5,9)
b. Water bodies 2/	982,000 acres of canals, lakes, bays, & sound.	1,262,900 acres of water.	Similar to plan 13.	Similar to plan 13.	218 acres of water altered. 6 sq mi delta formed.(1,2,3,5,9) (1,2,3,5)
c. Water Quality*	Fresh to saline, warm. Trace metals, nutrients, fecal coliform bacteria occasionally exceed criteria.	Water quality degraded. 15 ppt isohaline 12 miles north in Barataria Bay, 17 miles in Breton Sound.	Same as plan 11.	Same as plan 11.	Divert in fresh lake. Cool, increased turbidity, possible bioaccumulation of pollutants, fecal coliform bacteria. (1,2,3,5,9)
d. Prime and unique farmland* and other lands.	Sugarcane land. Other includes disposal & developed areas.	Farmland converted to other uses near urban areas.	Similar to plan 11.	Similar to plan 11.	36 acres of farmland, 4 acres of other. (1,2,3,5,9)
e. Endangered species	Bald eagle & brown pelican nest in area, Arctic peregrine falcon visitor.	Species advarsely affected by habitat deterioration.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Fish and Wildlife	$115,000,000 total income.	$66,000,000 total income.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. National Register of Historic Places	None	None	None	None	None
3. Social Well-Being					
a. Community Cohesion*	Unique cultural heritage & lifestyles dependent on fishing & trapping.	Preservation of lifestyles & community cohesion difficult.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Community growth*	Dependent on fish & wildlife industries.	Population opportunities decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.

TABLE 8 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 14-16

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 14	Plan 15	Plan 16
c. Displacement of People* Businesses			Same as plan 11. None	Same as plan 11 None	None Same as plan 1.
d. Leisure*	1,065,000 man-days of sport fishing & hunting.	869,000 man-days of sport fishing & hunting.	Same as plan 1.	Same as plan 1.	Same as plan 1.
a. Property values*		Continued decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.
f. Tax Revenues*		Taxes derived from fish & wildlife activities would decline.	Same as plan 1.	Same as plan 1.	Same as plan 1.
g. Transportation*			Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Noise*			Same as plan 1.	Same as plan 1.	Same as plan 1.
i. Quality of community life			Same as plan 1.	Same as plan 1.	Same as plan 1.
4. Regional Development (RD)					
a. Employment and income		Continued decline in employment, income in fish & wildlife related industries.	Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Regional growth and businesses activity		Continued decline in activities related to fish & wildlife.	Same as plan 1.	Same as plan 1.	Same as plan 1.
III. Plan Evaluation					
1. Contribution to Planning Objectives					
a. Increase fish and wildlife production (NED)			Same as plan 1.	Same as plan 1.	Same as plan 1.
b. Preserve and restore wetlands, enhance vegetative growth, establish favorable salinity gradients, improve sport fishing and wildlife opportunities.			Similar to plan 1.	Similar to plan 1.	Similar to plan 1.
2. Net Effects					
a. Net NED average annual benefits.			$11,130,000	$10,450,000	$10,790,000
b. Net EQ effects.			Slightly positive	Slightly positive	Moderately positive
c. Net Social Well-Being Effects			Slightly positive	Slightly positive	Slightly positive
d. Net Regional Development Effects			Slightly positive	Slightly positive	Slightly positive
3. Plan Response to Associated Evaluation Criteria					
a. Acceptability			Same as plan 1.	Same as plan 1.	Local interests support plan.
b. Efficiency			Same as plan 11.	Least efficient.	More efficient than plans 1-3, same as plans 4,2,5, more efficient than plans 6-15.
c. Geographic scope			Same as plan 11.	Same as plan 11.	Same as plan 6.
d. NED benefit-cost ratio			3.3	2.9	3.3
e. Reversability			Same as plan 6.	Same as plan 10.	
4. Rankings of plans					
a. NED Objectives			7	16	9
b. EQ objectives			12	14	2
c. Social Well-Being			12	14	2
d. Regional Development			12	14	2

TABLE 8 (CONTINUED)

SUMMARY PRESENTATION AND ASSESSMENT OF DETAILED PLANS

Plans 14-16

Item	Existing Condition 1980	Future Condition (No Action) 2035	Plan 14	Plan 15	Plan 16
IV. IMPLEMENTATION RESPONSIBILITY					
1. First Cost					
a. Federal			$35,600,000	$40,900,000	$35,600,000
b. Non-Federal			11,900,000	13,600,000	11,800,000
c. Total			47,500,000	54,500,000	47,400,000
2. Annual Cost					
a. Federal			3,160,000	3,640,000	3,160,000
b. Non-Federal			1,560,000	1,760,000	1,600,000
c. Total			4,720,000	5,400,000	4,760,000

Index of footnotee:

Timing:
1. Impact is expected to occur prior to or during implementation of the plan. 2. Impact is expected within 15 years following plan implementation. 3. Impact is expected in a longer time frame(15 or more years following implementation).

Uncertainty

4. The uncertainty associated with the impact is 50% or more. 5. The uncertainty is between 10% and 50%. 6. The uncertainty is less than 10%.

Exclusivity

7. Overlapping entry; fully monetized in NED account. 8. Overlapping entry; not fully monetized in NED account.

Actuality

9. Impact will occur with implementation. 10. Impact will occur only when specific additional actions are carried out during implementation. 11. Impact will not occur because necessary additional actions are lacking.

Section 122

*. Items specifically required in Section 122 and ER 1105-2-240.

1/ Based on October 1982 price levels and amortization over 50 years at 7 7/8 % interest.

2/ All plans include a 3 sq mi delta formed in Big Mar.

material would be placed on both sides of the channel to a maximum height of 15 feet at the Bayou Lasseigne, Bayou Fortier, Oakville, and Myrtle Grove sites and primarily on one side of the channel at Big Mar. At Davis Pond, excavated material would be used to construct levees along the diversion channel and guide levees for the 7,425-acre marsh overflow area, and to create 175 acres of marsh. Five weirs would divert the outflow into the Salvador Game Management Area and Lake Cataouatche. The pertinent features of the plans are discussed in Appendix B, Plan Formulation, and Appendix C, Engineering Investigations.

Each plan includes a water quality and biological monitoring program to assess the impacts of various toxic compounds in the water on the fish and wildlife resources and on humans. The water quality monitoring program will measure the concentration of contaminants in the river water and the distribution and concentration of these substances in the receiving areas. The biological monitoring program will detect the presence of compounds in selected fish and wildlife species, assess potential bioaccumulation problems, and insure the safety of humans.

The benefits produced by each plan are based primarily on retarding saltwater intrusion, expanding nursery grounds, enhancing vegetation growth, and reducing land loss. The improved habitat conditions would increase fish and wildlife productivity. The increase in productivity would produce tangible average annual benefits valued at $15,760,000. Commercial fisheries and wildlife account for $15,190,000 and sport fishing and hunting for $570,000. Oysters account for 90 percent of the tangible benefits. However, oysters are only an indicator species of the wide ranging benefits to be derived from freshwater diversions.

Available literature and discussions with knowledgeable persons in the fish and wildlife industries indicate that freshwater diversion would have a beneficial effect on productivity in the entire marsh-estuarine complex. Diversion of nutrient-rich waters and sediment would enhance aquatic and marsh vegetation growth and decrease the rate of land loss. Revitalized plant growth would reduce marsh loss 35 percent, resulting in a net savings of 99,200 acres of marsh by the year 2035. This would increase commercial wildlife production 33 percent and the net average annual value of production by $290,000. Increased plant growth would result in greater production of detritus essential for a high rate of fisheries production. The nutrient flow would also increase phytoplankton and zooplankton production and lead to a greater harvest of the fish and shellfish directly or indirectly dependent on these organisms. The freshwater would expand the low salinity zones that juvenile fish and shellfish use in the marshes and estuaries. Enhanced habitat conditions are expected to increase commercial fisheries production 21 percent and the net average annual value of production by $14,900,000. The average annual benefits to sport fish and wildlife would increase 11 percent or $570,000.

The plans would produce a number of other tangible and intangible benefits that were not quantified. These benefits include improved water circulation and dissolved oxygen content, increased plant species diversity, improved habitat for nongame and noncommercial species, improved productivity of wooded swamps and associated freshwater fish and wildlife species, and increased potential for recreation beyond those monetary benefits claimed for sport fishing and hunting, such as nature-oriented photography and viewing. Other benefits include minimizing the loss of the marsh's capacity to buffer hurricane tides and to treat waste. Implementing the plans would enhance property values, and increase business opportunities in fish- and wildlife-related industries and tax revenues derived from these sources.

Adverse environmental impacts would be related to construction and operation of the diversion facilities. Direct construction impacts include the conversion of existing terrestrial and aquatic habitats to channels, levees, and dredged material disposal areas, disturbance of cultural remains, and loss of sport fishing and hunting opportunities. The primary operational impacts are associated with alteration of water quality gradients, hydraulic regime and sedimentation patterns, and accelerated aging of the receiving water body. Specific water quality impacts include a decrease in temperatures and an increase in pollutants, fecal coliform bacteria, and sedimentation. Over a 50-year period, a delta would form in Lac Des Allemands, the Davis Pond overflow area, and in Big Mar. The deltas would destroy some fisheries habitat but would provide habitat for wildlife. The diverted flow would raise the mean water level of the receiving water body but would have an insignificant impact on mean high water levels. The diversions will increase sedimentation in the Mississippi River, Southwest Pass.

Adverse impacts could result from a major accidental discharge of a highly toxic compound at one of the industries along the river or from a vessel collision. If the spill occurred upstream of a structure and was not immediately reported, some of the toxic substance would enter the structure. The gates of the structure could be electronically closed in about one hour or manually closed in 6 hours. In the event of failure to close the structure, large quantities of the contaminant would enter the receiving area and could possibly have a catastrophic impact.

Adverse social impacts are related to noise and disruption of vehicular traffic during construction. Plans 6 through 15 would cause permanent displacement of a small number of residences and businesses. All plans would cause permanent loss of some farmland. Beneficial contributions of the plans include long-term moderate increases in community cohesion and growth, leisure, property values, tax revenues, and quality of life. All plans would aid in preserving a unique cultural heritage and lifestyle associated with fishing and trapping.

Adverse impacts of the plans on regional development would include displacement of businesses and farms. Employment and income would increase slightly during construction, operation, and maintenance, and moderately after construction. Other long-term contributions are increased business opportunities in fish and wildlife-related industries.

TRADE-OFF ANALYSIS

PLAN COMPARISON

The estimated first costs for the plans range from $44,200,000 for Plan 5, the lowest cost plan, to $54,500,000 for Plan 15, the highest cost plan. The average annual costs of the plans range from $4,310,000 for Plan 5 to $5,400,000 for Plan 15. Included in the annual costs are the operation and maintenance (O&M) costs. The annual O&M costs range between $471,000 for Plan 5 and $553,000 for Plan 15. This cost includes the O&M for structures, channels and levees, a comprehensive monitoring system, and increased maintenance dredging in the Mississippi River, Southwest Pass.

The benefits attributed to all plans are the same when expressed in monetary terms. Benefits are based on increased production of oysters, which accounts for 90 percent of the benefits, and on other fish and wildlife species productivity and marsh savings, which account for the remaining 10 percent of the benefits. These benefits have an average annual value of $15,760,000. Based on the monetary benefits, all 16 freshwater diversion plans are economically justified. The benefit-to-cost (B/C) ratio ranges from a high of 3.6 for Plan 5 to a low of 2.9 for Plan 15.

All plans produce numerous unquantified benefits. The plans would result in saving 99,200 acres of marsh. The magnitude of unquantified

benefits varies with the plans. All plans would improve general water circulation and dissolved oxygen in the receiving water body. The improved circulation and higher turbidity should improve dispersion of nutrients throughout the basins. This would increase productivity of phytoplankton and zooplankton, the major part of the base of the food chain that supports commercial, sport, nongame, and noncommercial fish and wildlife species. The flows could possibly accelerate aging of Lac Des Allemands, Lake Cataouatche, and Big Mar. The degree to which the benefits occur varies from plan to plan according to the point of diversion and the quantity of flow diverted.

Plans that introduce substantial quantities of flow to the upper basins produce the most unquantified benefits because they are more hydraulically efficient, have the longest detention time, and provide for maximum dispersion, benefiting the largest area. In Plans 1 through 5, all flows are diverted near the head of the basins. Thus, these plans produce the maximum unquantified benefits. Plans 6 through 15, which divert flow into the upper and lower basin, would also produce unquantified benefits but to a lesser extent. Plan 16, which introduces water in the middle of the basin, produces slightly fewer benefits than Plans 1 through 5 since the area benefited is only slightly less.

The point of diversion and the quantity diverted are factors in the adverse impacts on environmental quality. Diversion into Big Mar would decrease water temperatures and cause retention of 5 to 10 percent of the pollutants and 70 to 99 percent of the sediment. The remaining materials would be carried in suspension into the receiving waterways. Over a 50-year period, a 3-square mile delta would form in Big Mar. Big Mar would remove about 33 percent of the fecal coliform bacteria and the remaining bacteria would die off at a rate of 70 to 80 percent per day in the receiving waterways and marshes. Changes in water temperatures, pollutants, sedimentation, and fecal coliform bacteria will vary with the plan for Barataria Basin. All plans would remove 15,383 acres of

leased oyster grounds from production.

Plans 1 through 5 would cause major water quality impacts in Lac Des Allemands. The diverted flow would decrease water temperatures and cause retention of 5 to 20 percent of the pollutants and 70 to 90 percent of the sediment in the lake. The remaining material would be carried in suspension through the basin. Over a 50-year period, a delta would form covering about 3 square miles of lake bottom and destroying some fisheries habitat. The lake would remove nearly 60 percent of the fecal coliform bacteria and the remainder would die off before reaching Lake Salvador. The long detention and wide dispersion of the diverted water through the basin will moderate water quality impacts on extremely sensitive estuarine organisms. The flows would raise the elevation of Lac Des Allemands 2 to 3 inches, but would have an insignificant impact on mean high water levels. Thus, Plans 1 through 5 would have the most adverse water quality impacts on Lac Des Allemands.

Plans 6 through 15 would reduce the quantity of flow through Lac Des Allemands and the intensity of the water quality impacts on the lake. However, these plans would decrease water temperatures and increase the levels of pollutants, sediment, and fecal coliform bacteria entering the warm, brackish-to-saline water bodies that are the prime shellfish nursery areas. The decrease in water temperature and increase in pollutants and turbidity could adversely affect migration patterns and growth rates of some estuarine-dependent organisms. The diverted water could overfreshen some oyster areas and some oyster reefs could be covered by sediment. The oysters would accumulate coliform bacteria, requiring affected areas to be closed during diversion. The farther downstream river water is introduced, the greater the intensity of adverse water quality impacts. Plans 6 through 10 have the possibility of moderate water quality impacts. Plans 11 through 15, for all practical purposes, discharge directly into oyster-producing areas and would have the possibility of maximum adverse impacts. Thus, Plans 6 through 15 would

reduce the adverse impacts on Lac Des Allemands but would substantially intensify the adverse impacts on the prime estuarine nursery grounds.

Plan 16 bypasses Lac Des Allemands but would have some adverse water quality impacts on Lakes Cataouatche and Salvador. The river water would be dispersed through the Davis Pond overflow area. The water would warm and, after mixing in Lake Cataouatche, the temperature would be nearly the normal temperature of the lake. About 5 to 20 percent of the pollutants and 60 to 90 percent of the sediment would be deposited in the overflow area. The remaining material would be carried in sus pension through the basin. Over a 50-year period, a delta would form in the overflow area covering about 4 square miles of water bottoms. Flooding the overflow area January through May could have some minor impacts on vegetative growth. However, drawdown of the overflow area by June will allow ample time for regeneration of many marsh species. About 39 percent of the fecal coliform bacteria would be removed in the overflow area, 57 percent in Lake Cataouatche, and the remaining 4 percent would die off in Lake Salvador. The flows could raise water levels in Lake Cataouatche 3 to 4 inches and Lake Salvador about one inch but would have an insignificant impact on mean high water levels. Thus, Plan 16 would not adversely affect Lac Des Allemands and would have the least water quality impact on the extremely valuable estuarine nursery areas.

Other impacts on environmental quality caused by construction are similar with slight differences in magnitude between plans. (See tables 6, 7, and 8). Plans 1, 2, 3, and 10 through 15 would have the most direct construction impacts. Plans 4 through 9 would have moderate impacts and Plan 16 the least impacts.

The major adverse social impacts are caused by Plans 6 through 15. Plans 1 through 5 and 16 would have the least adverse impacts and produce more beneficial impacts due to the greater areas affected.

Similarly, Plans 1 through 5 and 16 would provide nearly the same beneficial contributions to regional development. Plans 6 through 15 would provide the least benefits.

The plans were also examined to determine whether changes in design and construction could contribute to the national objective of water conservation. Water conservation for this purpose was defined as any beneficial reduction in water use or in water losses. It was determined that water use or losses would not be affected by the plans and no practical opportunities for water conservation are provided. Discharge of the design flow would have insignificant effects on Mississippi River navigation and flood control. During extreme low flow periods, diversions would be curtailed to ensure availability of water for municipal purposes.

RATIONALE FOR RECOMMENDED PLAN

All plans include a site in the Breton Sound Basin. Therefore, plan selection is primarily concerned with choosing a site in the Barataria Basin. In selecting a plan, major consideration must be given to cost, site location, adverse impacts, the area enhanced, and public support.

Plans 1 through 5 divert all flows into Lac Des Allemands in upper Barataria Basin. These plans include the least costly plan, Plan 5, but could adversely affect the catfish fishery important to the local economy. Plans 1 through 5 would enhance the largest area and produce the most unquantified benefits, but few benefits accrue in the receiving area. Plans 1 through 5 lack public support.

Plans 6 through 15 divide the flows between sites at Lac Des Allemands and sites in the lower basin. These plans would slightly reduce the adverse impacts on the Lac Des Allemands catfish fishery but would produce significant adverse impacts on the environment and social and

cultural resources in the lower basin. Plans 6 through 15 would enhance a smaller area and produce the fewest unquantified benefits. Plans 6 through 15 are not desirable.

Plan 16 diverts all flows through a 7,425-acre marsh and swamp overflow area bordering Lake Cataouatche in the mid-Barataria Basin. Flows diverted into the middle of the basin would bypass Lac Des Allemands and the important catfish fishery. Of all the plans, this plan has the least potential for adversely affecting the environment. Plan 16 would enhance a slightly smaller area and produce slightly fewer unquantified benefits than Plan 1 through 5, but the plan enjoys public support.

Plan 5 maximizes contributions to the NED account for commercial and sport fish and wildlife enhancement. A summary comparison of the economic analyses of the plans shows that Plan 5 is the least costly, has the greatest benefit-to-cost ratio, and provides the maximum benefits over cost (See table 9). The plan would involve less disruption of existing facilities than the other freshwater diversion plans.

From an overall viewpoint, the two most desirable plans are Plan 5 and Plan 16. Although Plan 5 is the least costly and produces the most unquantified benefits, the plan could cause significant adverse impacts and local interests oppose it. However, Plan 16 produces only slightly fewer unquantified benefits, the fewest environmental impacts, and the plan enjoys public support. An important feature of Plan 16 is the overflow area. Using this area would reduce adverse impacts and make direct contributions to the immediate receiving area and the state-owned Salvador Wildlife Management Area. Providing a similar overflow area for Plan 5 would require using agricultural lands. This would result in a loss of production and would substitute one impact for another, increasing the cost of Plan 5. The attributes of Plan 16 outweigh those of Plan 5. Thus, Plan 16 was selected as the recommended plan.

TABLE 9

SUMMARY OF ECONOMIC ANALYSES OF ALTERNATIVES

Plans	First Cost	Average Annual Costs	Average Annual Benefits	Benefit to Cost Ratio	Net Benefits*
			Thousands of Dollars		
1	53,900	5,320	15,760	3.0	10,440
2	52,700	5,210	15,760	3.0	10,550
3	53,900	5,320	15,760	3.0	10,440
4	47,600	4,700	15,760	3.4	11,060
5	44,200	4,400	15,760	3.6	11,360
6	47,000	4,680	15,760	3.4	11,080
7	45,300	4,530	15,760	3.5	11,230
8	47,700	4,740	15,760	3.3	11,020
9	46,100	4,600	15,760	3.4	11,160
10	53,100	5,280	15,760	3.0	10,480
11	48,400	4,810	15,760	3.3	10,950
12	46,700	4,650	15,760	3.4	11,110
13	49,100	4,870	15,760	3.2	10,890
14	47,500	4,720	15,760	3.3	11,040
15	54,500	5,400	15,760	2.9	10,360
16	47,400	4,760	15,760	3.3	11,000

*Net benefits are the difference in average annual benefits and average annual costs.

DESCRIPTION OF RECOMMENDED PLAN

PLAN OF IMPROVEMENT

The plan of improvement has two major elements. One element, on the east bank of the Mississippi River, consists of a control structure and appurtenant channel to divert river flow into the Breton Sound Basin at Big Mar in the vicinity of Caernarvon, Louisiana (plate 8). The other element, on the west bank of the river, consists of a control structure and appurtenant channel to divert river flow into Barataria Basin at Davis Pond (plate 9).

The Breton Sound diversion facilities on the east bank at Big Mar are:

- a 100-foot-long multi-cell box culvert control structure with nine 5- by 20-foot cells in the Mississippi River levee,
- an inlet channel 800 feet long with a bottom width of 200 feet and side slopes of 1 vertical on 3 horizontal,
- an outlet channel 8,100 feet long with a bottom width of 180 feet and side slopes of 1 vertical on 3 horizontal,
- a 45-acre dredged material disposal area,
- a 2,000-acre overflow area, and
- a 2-mile dike with a 5-foot crown, side slopes of 1 vertical on 3 horizontal, and elevations of 3-5 feet NGVD along the west bank of Caernarvon Canal to prevent diverted flows from entering the canal.

The Barataria Basin diversion facilities on the west bank at Davis Pond are:

- a 240-foot-long multi-cell box culvert control structure with six 15- by 15-foot cells in the Mississippi River levee,
- an inlet channel 520 feet long with a bottom width of 200 feet and side slopes of 1 vertical on 3 horizontal,
- an outlet channel 11,250 feet long with a bottom width of 200 feet and side slopes of 1 vertical on 3 horizontal,
- levees with a 10-foot crown, side slopes of 1 vertical on 3 horizontal, elevations of 3-6 feet NGVD 2.1 miles along the channel, and 13.3 miles of guide levees along overflow area,
- a 175-acre dredged material disposal area,
- a 7,425-acre overflow area,
- 5 weirs, 250 feet long with a low sill elevation of -3 NGVD and elevation of 2 feet NGVD,
- a new drainage canal 4,000 feet long with a bottom width of 5 feet and side slopes of 1 vertical on 3 horizontal along east side of Willowdale Boulevard,
- a pumping station with a capacity of 260 cfs at the intersection of the new drainage canal and the access canal south of US Highway 90, and an additional pump with a capacity of 100 cfs at the St. Charles Parish pumping station on Cousin Canal, and
- clearing and snagging 7.9 miles of drainage canals.

DESIGN AND STRUCTURE CONSIDERATIONS

The facilities are designed to divert a total Mississippi River flow of 17,250 cfs (6,600 cfs to Breton Sound from January through April and 10,650 cfs to Barataria Basin from January through May). The structures and channels require approximately 148 acres of real estate and an additional 537 acres for levees and disposal of dredged material. At the Davis Pond site, excess dredged material would be placed in open water areas to create 175 acres of marsh. Sections of three roads, three railroads, and ten pipelines require altering and modifying. The structures were sized to minimize annual maintenance dredging. However, some maintenance dredging would be required in an average year.

STRUCTURE OPERATION CONSIDERATIONS

Structure operation would depend on whether freshwater is needed to supplement rainfall to maintain the desired salinities April through September. In a normal 10-year rainfall cycle, the 10-percent drought would occur only once, moderate rainfall about 6 years in 10, and heavy rainfall 3 years in 10. Thus, supplemental water would be required in seven of the ten years. In the 10-percent drought year, the peak flow of 10,650 cfs would be diverted at Davis Pond and 6,600 cfs at Big Mar. In the six moderate rainfall years, the flows would range between 3,000 and 9,400 cfs at Davis Pond and 1,800 and 5,800 cfs at Big Mar. In the three heavy rainfall years, runoff would be sufficient to main tain the desired salinity conditions. In these heavy rainfall years, the structures would remain closed to prevent adding to natural flood conditions. Proper operation of the structures would forestall any contribution to natural flooding. Daily operation of the structures would be guided by a comprehensive monitoring system.

A comprehensive monitoring system is essential to guide structure operation, assess the effects of the diverted water on fish and wildlife populations, and insure the safety of humans. The system requires certain hydrological, water quality, and biological data. A network of sampling stations will collect the data necessary for structure operation. The programs in the system will be conducted in three phases: preconstruction, postconstruction, and long-term. The 3-year preconstruction phase will supplement existing information and establish baseline conditions for measuring future changes. The 4-year postconstruction phase will assess the effect of the diverted waters on important hydrological and water quality parameters and the fish and wildlife populations. This information will be used to devise the operational scheme and the scope of the long-term monitoring phase. The cost of the pre- and postconstruction phases, $4,380,000, is included in the first cost of the plan. The cost of the long-term monitoring phase is included in the operation and maintenance costs. The New Orleans District and non-Federal assuring agency will establish an interagency advisory group to design and conduct the monitoring programs. The interagency group will include Federal, state, and local agencies that have responsibilities in the areas of water quality, fish and wildlife, water supply, navigation, and flood control. The monitoring programs are discussed in Appendix K, Freshwater Diversion Structure Operation Criteria and Comprehensive Monitoring System.

OPERATION AND MAINTENANCE

The operation, maintenance, and replacement cost of the diversion facilities is estimated at ~~$455~~ 545,000 annually. This cost includes major structure maintenance repair once every 15 years, an annual cost for maintaining a monitoring program, annual dredging of an estimated 19,800 cubic yards of sediment from the channels, major maintenance on 15.4 miles of levees in the 2nd, 3rd, 5th, 10th, and 20th year to maintain levee heights and cross sections, and other minor operation and

maintenance costs. The long-term monitoring system includes a network of sampling stations that will collect hydrological, water quality, and biological data necessary for structure operation. The hydrological data will include information on tides, salinity, precipitation, temperature, and wind that will form the base for the operating scheme. Important water quality parameters will be measured and biological information necessary to assess effects of the diversions on fish and wildlife populations will be collected. To operate and maintain the sampling stations will cost an estimated $255,000 annually. Gage replacement was considered to be necessary every 10 years. The design and conduct of the long-term monitoring system will be determined by the New Orleans District and non-Federal assuring agency with the cooperation of an interagency advisory group after the postconstruction monitoring phase is completed. The sponsor will provide timely reports containing collected data and analysis of structure operation and results to the New Orleans District. The district will review the reports to determine whether the structure operation manual should be modified to obtain maximum benefits.

SUMMARY OF ECONOMIC, ENVIRONMENTAL, AND OTHER SOCIAL EFFECTS

The first cost of the recommended plan is $47,700,000. The average annual cost is $4,970,000, which includes interest, amortization (50 years @ 8 1/8%), and operation and maintenance. The average annual benefits are estimated at $15,760,000 and result in a benefit-cost ratio of 3.3 to 1. Benefits for enhancement of commercial fish and wildlife are estimated at $15,190,000 and for enhancement of sport fishing and hunting are estimated at $570,000. The plan would increase oyster production by 100 percent. This additional production would increase Louisiana's annual average harvest by 64 percent and the national harvest by 25 percent. A summary of the benefits and costs for the Barataria and Breton Sound Basins is presented in the following tabulation.

SUMMARY OF ANNUAL BENEFITS AND COSTS

	First Cost	Annual Cost	Annual Benefits			B/C Ratio
			Commercial Fishing & Wildlife	Recreation	Total	
			($000)			
Barataria Basin	$32,100	$3,260	$9,450	$260	$9,710	3.0 to 1
Breton Sound	15,300	1,500	5,740	310	6,050	4.0 to 1
TOTAL	$47,400	$4,760	$15,190	$570	$15,760	3.3 to 1

In addition to the monetary benefits previously addressed, other benefits would result from project implementation. They include improved habitat for nongame and noncommercial species, improved productivity of wooded swamps, increased recreation potential, increased plant species diversity, and the effects on businesses that support commercial and recreational opportunities. Projected marsh losses would be reduced by 99,200 acres. Intangible benefits are also derived from the marsh's function as an interface between urban areas and open water areas, as a buffer zone for hurricane tides that reduces damages caused by the tidal action, and as a medium to treat waste products.

Some adverse impacts would result with project implementation. Various habitat types would be converted to open water or levee and dredged material disposal areas. Excavation for the channels and structures would require 400 acres of terrestrial habitat and 288 acres of aquatic habitat. Of the terrestrial habitat area required, 93 acres would be fresh marsh, 16 acres - intermediate marsh, 118 acres - wooded swamp, 122 acres - bottomland hardwoods, 36 acres - agricultural lands, and 15 acres - lands previously converted to other uses.

An average annual loss of 388 man-days of hunting is estimated to occur as a result of lands altered by project implementation. This loss is considered relatively minor. Short-term impacts associated with turbidity and water quality problems would occur during construction.

When one habitat is converted to another, there can be beneficial as well as adverse impacts. The disposal areas at Big Mar are likely to become shrub-scrub and eventually succeed to bottomland hardwoods similar to natural cheniers, which would be beneficial. Excess dredged material at the Davis Pond site would be placed in open water areas to create 175 acres of marsh. Filling water bodies would destroy some fisheries habitat, but would create wildlife habitat. The construction impacts on fishing resources would be both beneficial and adverse. Channel excavation would create fishing habitat. However, dredging in existing water bodies would temporarily destroy benthic populations.

No recorded archeological sites or National Register-eligible properties are located in the proposed construction right-of-way. However, the plan has a high probability of affecting cultural remains along Bayous Bois Piquant and Verret. These bayous are part of a relict crevasse system. Current knowledge of prehistoric settlement patterns suggests that this crevasse system is host to archeological sites.

Construction of the recommended plan would increase employment. After construction, business opportunities and employment would increase in the commercial and recreational wildlife and fisheries industries and support service industries. Increased real income and income distribution would accompany the increased employment and provide additional tax revenues. The plan would aid in preserving the unique cultural heritage and lifestyles of the coastal fishing and trapping communities.

PLAN IMPLEMENTATION

APPORTIONMENT OF COSTS

Traditional cost sharing policies for enhancement of fish and wildlife, the primary function of the plan, provide for first costs to be shared on a 75-percent Federal and 25-percent non-Federal basis. Non-Federal interests must also assume all costs for operation, maintenance, and replacement. This is the cost sharing basis for the similar Mississippi Delta Region project authorized by the Flood Control Act of 1965. Under this policy, the currently estimated first cost of $47,400,000 is apportioned $35,600,000, Federal, and $11,800,000, non-Federal. All of the estimated average annual operation, maintenance including increased dredging in Southwest Pass, and replacement costs of $545,000 would be borne by non-Federal interests.

DIVISION OF PLAN RESPONSIBILITIES

Prior to construction of the facilities by the Federal government, non-Federal interests must agree to comply with the following requirements:

- Provide, without cost to the United States, all lands, easements, and rights-of-way necessary for construction and operation of the works;

- Hold and save the United States free from damages due to the construction works except where such damages are due to the fault or negligence of the United States or its contractors;

- Operate and maintain the works after completion;

- Contribute 25 percent of the project construction cost associated with fish and wildlife enhancement; and

- Assure adequate public access to the project area.

In addition, the non-Federal sponsor(s) must agree to comply with the following:

- Section 221, Public Law 91-611, approved 31 December 1970, as amended;

- Section 601 of Title VI of the Civil Rights Act of 1964 (PL 88-352) that no person shall be excluded from participation in, denied the benefits of, or subjected to discrimination in connection with the project on the grounds of race, creed, or national origin, and;

- the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646.

The Federal government will credit the costs and expenses incurred in the acquisition of the required real estate interests toward the non-Federal share of the project construction cost.

The Federal government will require the right to enter at reasonable times and in a reasonable manner upon land which the sponsor owns or controls for access to the project.

As part of the operation and maintenance of the project, the non-Federal sponsor will establish an interagency advisory group to participate in decisions governing structure operation. This group should include people from the local, state, and Federal sectors who have expert knowledge of the multiple needs of fish and wildlife resources, navigation, water supply, and flood control. The sponsor must also maintain a comprehensive monitoring system to collect hydrological, water quality,

and biological data essential for determining the best use of diverted water. The design and conduct of the long-term monitoring system will be determined by the New Orleans District with the cooperation of the interagency advisory group after the postconstruction monitoring phase is completed. The sponsor will provide timely reports containing collected data and analysis of structure operation and results to the New Orleans District. The district will review the reports to determine whether the structure operation manual should be modified to obtain maximum benefits.

The State of Louisiana has expressed the intent to provide the necessary assurances for the Big Mar structure at Caernarvon by letter dated January 21, 1982, and the Davis Pond structure by letter dated March 11, 1983. St. Charles Parish, by letter dated June 7, 1984, provided a resolution supporting the Davis Pond site.

SUMMARY OF COORDINATION, PUBLIC VIEWS, AND COMMENTS

The original public meetings on the overall Louisiana Coastal area study were held in Jennings, Houma, and New Orleans in November and December, 1968. Local interests expressed a number of concerns including reducing saltwater intrusion and improving productivity in the fish and wildlife resources. At a public meeting on the related Mississippi and Louisiana Estuarine Areas study in New Orleans, February 1978, elected officials and residents of the current study area expressed a need to reduce saltwater intrusion to improve fish and wildlife productivity.

Between June 1978 and January 1982, a series of informal meetings were held with representatives of Federal, state, and local agencies. The meetings provided an opportunity to discuss the status and direction of this study, the related Mississippi and Louisiana Estuarine Areas study, and the authorized Mississippi Delta Region project. A briefing on the two studies and the project and the possible courses of action was given

at joint meetings of the Louisiana Senate and House Committee on National Resources on 25 August 1981 and 21 January 1982. The New Orleans District maintained coordination with the Administrator, Coastal Management Section, Louisiana Department of Natural Resources. The district discussed the freshwater diversion studies at the Louisiana Universities Marine Consortium symposium on coastal erosion and wetlands modification on 5 and 6 October 1981.

Several Federal, state, and local agencies actively cooperated in the study by providing advice or assistance. The National Marine Fisheries Service (NMFS) provided commercial fisheries catch statistics. The US Fish and Wildlife Services (USFWS), under an interagency agreement, cooperated with the New Orleans District in determining future habitat changes without and with the project. These two agencies were assisted by the Louisiana Department of Wildlife and Fisheries (LDWF) in conducting the impact assessment and habitat evaluation procedures and in developing methodologies for estimating benefits to commercial fish and wildlife. The USFWS and LDWF provided advice and data that were used in conducting the recreation studies and evaluating benefits to sport fishing and hunting. Representatives of these agencies and the Louisiana Office of Health and Environmental Quality and Plaquemines Parish Mosquito Control District participated in discussions to establish monitoring and operating criteria for the diversion structures.

The Draft Interim Report on Freshwater Diversion to Barataria and Breton Sound Basins was released to the public in May 1982. On 1 June 1982, the New Orleans District held a meeting at the Rivergate in New Orleans, Louisiana, to present the tentatively selected plan to the public for comment and discussion.

Approximately 140 persons attended the June public meeting and 43 persons made statements. The majority of the persons commenting on the

plan favored the concept of freshwater diversion and the tentatively selected site at Big Mar in Breton Sound Basin, but about half opposed a tentatively selected site at Bayou Lasseigne in Barataria Basin. Most of the opposition came from local officials and residents of St. Charles, St. John the Baptist, and St. James parishes. These parishes would be the most directly affected by the diversion. The comments were primarily concerned with the possibility of flooding, introducing poor quality Mississippi River water into Lac Des Allemands and the impact on the catfish industry, and the acquisition of lands necessary for the diversion facilities. Several parish officials asked the Corps to participate in their parish meetings to give local people a better opportunity to express their views.

The New Orleans District participated in parish sponsored meetings on:

9 June 1982	17 June 1982	21 June 1982
St. James Parish	St. Charles Parish	St. John the Baptist Parish
Parish Court House Vacherie, LA	St. Gertrude Church Hall Des Allemands, LA	Parish Court House Edgard, LA

The people attending these meetings represented a broad spectrum of the local residents, businesses, fishermen, landowners, and elected officials. The majority of the people were greatly concerned about possible flooding and the effects on local drainage systems, and the poor quality of the Mississippi River water and its impact on the catfish fishery in Lac Des Allemands. Other concerns that surfaced at these meetings included the possible adverse effects on jobs related to the catfish industry, siltation in Lac Des Allemands, and taking of lands proposed for industrial development.

As a result of the opposition to the Bayou Lasseigne site, the New Orleans District worked closely with the Governor's Coastal Protection Task Force and local officials to resolve the public's concerns and

identify an acceptable site in the Barataria Basin. This cooperative effort resulted in formulation of Plan 16 with a site at Davis Pond in the vicinity of Lake Cataouatche. Plan 16 addresses the major concerns of flooding, water quality degradation, and siltation. Plan 16 received the tentative endorsement of the Governor's Coastal Protection Task Force and local officials. St. Charles Parish officials held a public meeting on 20 January 1983 to discuss the Davis Pond site and obtain the views of the public. About 120 persons attended the meeting. Seven persons spoke in favor of the plan, 5 against, and 17 expressed concerns about the plan. Their primary concern was the possibility of hurricane generated tidal waters moving up the diversion channel to inundate their homes. It was explained that the diversion channel terminates in the overflow area and would not increase natural flood problems. On March 11, 1983, the State provided a letter expressing its intent to provide the necessary funds and assurances for the Davis Pond site. On May 17, 1984, St. Charles Parish officials discussed and resolved their concerns at a coordination meeting with Corps and state officials. On June 4, 1984, the St. Charles Parish Council passed a resolution approving the Davis Pond site.

The revised draft report and RDEIS was coordinated with other Federal, state, and local interests and released to the public in June 1984. A public meeting was held in July 1984 at the Jefferson Parish Court House in Gretna. About 100 persons attended the meeting. Twenty seven persons spoke in favor of the plan, two against, and two expressed concerns about the plan. Their primary concern was the possible overfreshening of the estuary. The possibility of overfreshening will be reduced by proper operation of the structure. Daily operation of the structure will be guided by a comprehensive monitoring program. Public views and comments on the rvised draft report and RDEIS received at and following the public meeting are summarized in Appendix L, Public Views and Responses.

FINAL
ENVIRONMENTAL IMPACT STATEMENT

LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION TO BARATARIA AND BRETON SOUND BASINS

LEAD AGENCY: U. S. ARMY CORPS OF ENGINEERS DISTRICT
NEW ORLEANS, LOUISIANA
SEPTEMBER 1984

PARISHES: Ascension, Assumption, Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist

ABSTRACT: The Barataria and Breton Sound Basins have experienced rapid loss of coastal wetlands due to natural processes such as subsidence and erosion, as well as man's developmental activities including leveeing, channelization, and petroleum exploration. These activities have led to a reduction in overbank flooding and natural distributary flow which historically provided fresh water, sediments, and nutrients to estuarine areas. This has resulted in conversion of fresh, intermediate, and brackish marshes to intermediate, brackish, and saline marshes, respectively, as well as loss of some areas of wooded swamp. Saltwater intrusion and loss of wetlands have adversely affected productivity of wildlife and fishery resources. Influx of saline waters is particularly harmful to the American oyster, due to increased predation. One way to ameliorate loss of wetland nursery areas and rate of saltwater intrusion is timely introduction of fresh water and associated sediments and nutrients. A total of 16 plans were formulated for diversion of fresh water into the study area. These 16 plans consist basically of combinations of six freshwater diversion sites and various magnitudes of flow. Plan 5 has been designated as the National Economic Development (NED) Plan based on the fact that it is the least costly and would provide the maximum NED benefits to the study area. However, due to significant opposition to Plan 5, it was not considered implementable. Therefore, Plan 16 has been designated as the Recommended Plan (RP). This plan would also contribute significantly to satisfaction of the planning objectives. Implementation of the RP would result in significant reductions in saltwater intrusion and save approximately 99,000 acres of wetlands and concomitant fish and wildlife productivity. Potential adverse impacts could occur due to freshwater introduction because of poor water quality in the Mississippi River as compared to adjacent estuaries.

Date: May 6, 1985

Send your comments by the date stamped above. Comments should be sent to the U. S. Army Corps of Engineers, Office of the Chief of Engineers, Casimir Pulaski Building, 20 Mass. Ave., N.W., Washington, D.C. 20314. If you would like further information on this statement, please contact Mr. Dennis L. Chew, U.S. Army Engineer District, New Orleans, LA 70160. Commercial telephone: (504) 838-2523.

NOTE: Information, displays, maps, etc. discussed in the Main Report and Appendixes are incorporated by reference in the EIS.

1. SUMMARY

1.1. MAJOR CONCLUSIONS AND FINDINGS

1.1.1. The purpose of this study was to determine the feasibility of retarding saltwater intrusion in the Barataria and Breton Sound Basins, reduce the rate of land loss, and enhance fish and wildlife production.

1.1.2. A draft environmental impact statement (DEIS) and main report on this study was released to the public in April 1982. That report recommended Plan 5 as the tentatively selected plan (TSP). This plan consisted of diverting fresh water at the Big Mar site in the Breton Sound Basin and the Bayou Lasseigne site in the Barataria Basin. Numerous public meetings were held to present the TSP. The Big Mar site had strong state and local support. However, significant local opposition surfaced with regard to the Bayou Lasseigne site in the Barataria Basin. Primary concerns included problems related to flooding and impacts of Mississippi River water on the catfish fishery in Lac des Allemands. In light of these problems, New Orleans District met with the Governor's Coastal Protection Task Force to discuss the best solution for diversion of fresh water into the Barataria Basin. Through a series of meetings, which are described in detail in Section 8 of this EIS, another plan evolved. This plan incorporates a new site known as the Davis Pond site located at river mile 118.4 and also includes the Big Mar site. The plan was designated as Plan 16 and the new TSP. A revised DEIS incorporating information concerning this new plan was released to the public in June 1984.

1.1.3. Plan 5 has been designated as the National Economic Development (NED) Plan. This designation is based on the fact that it would be the least costly and would provide the maximum benefits to the study area. This plan would provide the maximum annual excess benefits over cost.

1.1.4. Plan 16 has been designated as the recommended plan (RP) in this final report. As described in paragraph 1.1.2, Plan 5, which is the NED Plan, met with significant opposition and was not considered implementable.

1.1.5. Based on correspondence with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service, it appears that the RP would not jeopardize the existence of any endangered and/or threatened species or critical habitat, with the possible exception impacts to bald eagles in the Davis Pond overflow area due to bioaccumulation of toxic substances. This correspondence is contained in Appendix D, Section 2. New Orleans District has concluded formal consultation with the USFWS concerning this matter.

1.1.6. Based on findings of the Section 404(b)(1) Evaluation, the construction methods to be used for the RP would have the least amount of adverse impact upon the aquatic ecosystems compared to other available practical construction methods. The Section 404(b)(1) Evaluation can be found in Appendix I. Violations of the Louisiana State Water Quality Standards could occur for dissolved oxygen and total dissolved solid concentrations in shallow waters adjacent to the construction sites. However, these violations, should they occur, would be highly localized and of short duration. Considering the overall benefits to the study area, the proposed construction would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. Significant adverse effects upon aquatic ecosystem diversity, productivity and stability, and recreational, esthetic and economic values would not occur. Adverse effects that could occur as a result of the proposed dredged-material discharge would

not be significant. No developed recreational facilities are within the construction rights-of-way.

1.1.7. The proposed action would divert fresh water into the Barataria and Breton Sound Basins, which are flood plains. Other than the no action plan, no nonflood plain alternatives exist. The planning objectives involve improvement of the habitat conditions in these flood plains. The RP is consistent with the requirements of Executive Order 11988.

1.1.8. The project planning objectives include reduction in the rate of marsh loss and improvement in the quality of marsh habitat. Implementation of the RP would result in savings of 99,000 acres of wetlands over project life. The proposed action is consistent with the requirements of Executive Order 11990.

1.1.9. Based on the Consistency Determination (Appendix J), it has been determined that implementation of the RP is consistent, to the maximum extent practicable, with the State of Louisiana's approved Coastal Zone Management Program.

1.2. AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

Numerous issues have arisen that have become the subject of major controversy among public interests during the course of the study. Primary concerns included problems related to flooding and impacts of Mississippi River water quality on fish and wildlife resources. Of particular concern were impacts to the channel catfish fishery in Lac des Allemands and Lake Cataouatche and to the oyster fishery in the more inland portions of currently productive oystering areas even though decreased oyster production in some inland areas would be more than offset by increased overall production from much larger areas in the

Barataria and Breton Sound ecosystems. Local concerns over possible flooding and potential adverse impacts to the catfish fishery in and around Lac des Allemands led to selection of the Davis Pond site over the Bayou Lasseigne site. The general concensus among Federal, state, and local agencies, as well as the public, was that benefits resulting from freshwater diversion at the Davis Pond site would far outweigh any negative impacts which may occur. However, certain areas of controversy and unresolved issues have been raised including adverse impacts to oyster leases in the upper Barataria Basin and possible compensation for inland oyster leases lost due to decreased salinities, impacts on brown shrimp in the upper basins, specific identification of entities responsible for operation and monitoring of the diversion structures, and impacts of the relatively poor quality of the Mississippi River water on the receiving waterbodies and associated fish and wildlife resources.

TABLE 1.4 – RELATIONSHIP OF PLAN TO ENVIRONMENTAL REQUIREMENTS

FEDERAL POLICIES	PLAN 16
Archeological and Historical Preservation Act	Plan in FULL Compliance
Clean Air Act	Plan in FULL Compliance
Clean Water Act	Plan in FULL Compliance
Coastal Zone Management Act	Plan In FULL Compliance
Endangered Species Act	Plan in FULL Compliance
Estuary Protection Act	Plan in FULL Compliance
Farmland Protection Policy Act	Plan in FULL Compliance
Federal Water Project Recreation Act	Plan in FULL Compliance
Fish and Wildlife Coordination Act	Plan in FULL Compliance
Flood Plain Management (E.O. 11988)	Plan in FULL Compliance
Land and Water Conservation Fund Act	Plan in FULL Compliance
Marine Protection Research and Sanctuaries Act	Not Applicable
National Environmental Policy Act	Plan in FULL Compliance
National Historic Preservation Act	Plan in FULL Compliance
Prime and Unique Farmlands, CEQ, Memorandum	Plan in FULL Compliance
Protection and Enhancement of Cultural Environment (E.O. 11593)	Plan in FULL Compliance
Protection of Wetlands (E.O 11990)	Plan in FULL Compliance
River, Harbor, and Flood Contorol Act of 1970, Section 122	Plan in FULL Compliance
Water Resources Planning Act	Plan in FULL Compliance
Watershed Protection and Flood Prevention Act	Not Applicable
Wild and Scenic Rivers Act	Subject Resource Not in Study Area
STATE POLICIES	
Air Control Act	Plan in FULL Compliance
Archeological Treasure Act	Not Applicable
Historic Preservation Districts Act	Not Applicable
Louisiana Natural and Scenic Rivers Act	Plan in FULL Compliance
Protection of Cypress Trees (Act 795)	Plan in FULL Compliance
Water Control Act	Plan in FULL Compliance
LAND USE PLANS	
Louisiana Coastal Zone Management Program	Plan in FULL Compliance
The Land Use Element of the Area-Wide Comprehensive Plan	Plan in FULL Compliance

2. TABLE OF CONTENTS

LOUISIANA COASTAL AREA STUDY

INTERIM REPORT ON FRESHWATER DIVERSION
TO BARATARIA AND BRETON SOUND BASINS

3. NEED FOR AND OBJECTIVES OF ACTION

3.1. STUDY AUTHORITY

3.1.1. The Louisiana Coastal Area Study was authorized by resolutions of the Committees on Public Works of the United States Senate and the House of Representatives, adopted on 19 April 1967 and 19 October 1967, respectively. These resolutions, which are identical as to purpose and scope, authorized a study, " . . . with a view to determining the advisability of improvements or modifications of existing improvements in the coastal area of Louisiana in the interest of hurricane protection, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resources purposes." A number of broad studies concerning the entire coastal area are being conducted to provide basic information on the vital forces at work affecting the use of water, marsh, and land areas; to identify problems; and to determine their seriousness, urgency, and possible means of solution.

3.1.2. As part of the subject study, the US Army Engineer District, New Orleans (NOD) has been conducting investigations of reduction of saltwater intrusion in the interest of marsh development and general improvement of the coastal environment for the production of wildlife and fisheries resources. State and local interests have indicated keen interest in the NOD freshwater diversion studies and urge their completion at the earliest possible date. They feel that the fish and wildlife resources in most of the coastal areas are experiencing serious declines in productivity due to the loss of land, saltwater intrusion, and associated vegetative changes, and that these valuable resources can be enhanced by altering the physical and chemical parameters in the estuarine environment through the introduction of fresh water.

3.1.3. Federal, state, and local agencies expressed considerable interest in accelerating studies that involved solutions to the problem. In September 1976, the "Mississippi and Louisiana Estuarine Areas" study was authorized and funded to investigate the feasibility of providing freshwater into Lakes Maurepas, Pontchartrain, and Borgne and the Mississippi Sound areas in the interest of improving wildlife and fisheries of the area. The similar purpose of the two studies and the geographic overlap required that the studies be coordinated to develop a comprehensive plan for salinity control in the coastal areas. Therefore, an interim report addressing saltwater intrusion under the Louisiana Coastal Area study was approved by 3d indorsement, file LMVPD-P, dated 17 December 1980, to letter, file LMNPD-P, dated 29 May 1980, subject "Louisiana Coastal Area Study."

3.1.4. The study also serves as a reevaluation of the Mississippi Delta Region Project authorized by the Flood Control Act of 1965, Public Law 89-298 (House Document Number 308, 88th Congress, 1st Session). The project provides for salinity control structures, two on the east bank and two on the west bank of the river, to introduce fresh water into the delta region. This report and EIS will serve as a general reevaluation of the east and west bank sites. The report will also serve as a technical supporting document to accompany a postauthorization change report for the west bank site. Preconstruction planning and engineering for the Caernarvon (Big Mar) site is underway. Preconstruction planning and engineering for the west bank site at Davis Pond will be initiated after final action on this report and EIS.

3.2. PUBLIC CONCERNS

3.2.1. Public meetings were held on 19 November, 23 December, and 17 December 1968, at Jennings, Houma, and New Orleans, Louisiana, respectively, to discuss a variety of problems in the Louisiana Coastal Area. Numerous interests were represented in statements presented at the hearing or submitted through the mail for the record. The State of Louisiana was represented by officials of the Department of Public Works, the Louisiana Wildlife and Fisheries Commission, and other state departments. Representatives of Federal agencies, such as the Soil Conservation Service, the Bureau of Outdoor Recreation, the Federal Water Pollution Control Administration, and the Bureau of Sport Fisheries and Wildlife also attended the hearings. Others attending the hearings represented political subdivisions, civic and business organizations, private companies, water resource development organizations, and private citizens. The primary concerns were needs for navigation, hurricane protection, and fresh water. Problems for which solutions were sought included saltwater intrusion, beach erosion, silting, flood control, recreation, access, and fish and wildlife. As discussed in the previous section under study authority, this report is an interim report on retarding saltwater intrusion in the interest of decreasing land loss and concomitant declines in fish and wildlife productivity.

3.2.2. A coordination meeting was held on 23 April 1980 at the New Orleans District with representatives of Federal, state, and local agencies interested in freshwater diversion and the status of the study. Public meetings were held on the draft and revised draft reports in June 1982 and July 1984, respectively. In addition, numerous other meetings listed in Table 8-1 of this document have also been conducted. At these meetings, the major concerns over saltwater intrusion, land loss, and decreases in fish and wildlife resources were reiterated.

3.2.3. During the conduct of the study, a number of public concerns have been identified and are addressed in the EIS. These include coastal wetland deterioration; adverse and beneficial effects of freshwater diversion on estuarine ecosystems; impacts on water quality; impacts on sport and commerical fishing; project costs; real estate requirements; impacts of the diversions on local drainage and flooding; and impacts on human, cultural, and historical resources.

3.3. PLANNING OBJECTIVES

Based on the problems, needs, and opportunities identified by both public and private interests, the following planning objectives were developed: preserve, restore, and create natural habitats; enhance growth of marsh and aquatic vegetation; restore optimum salinity regimes in wetlands and estuaries; increase commercial fisheries production; increase commercial wildlife production; improve sport fishing opportunities; and improve sport hunting opportunities.

4. ALTERNATIVES

4.1. PLANS ELIMINATED FROM FURTHER STUDY

4.1.1. A total of 16 plans were formulated for diversion of fresh water into the study area. All 16 plans were carried as the final array of alternatives and are addressed in the Plan Formulation Appendix (Appendix B). It is customary for the Environmental Impact Statement (EIS) to cover the same plans as carried through the entire final plan formulation process. However, 16 plans, plus base condition and the without project (no action) alternative, are difficult to manage under the standard EIS format. Therefore, these plans have been grouped for the purpose of this EIS as described under "Plans Considered in Detail." As discussed in Section 1.1.2., Plan 16, incorporating another site in the Barataria Basin known as Davis Pond, was added to the revised DEIS and this final EIS.

4.2. WITHOUT CONDITIONS

4.2.1. If no action is taken to ameliorate the severe rate of land loss in the study area, approximately 281,000 acres, or 440 square miles of valuable, productive marshland, would be converted to open water by the year 2035 due to both the natural processes of subsidence, compaction, and erosion, and man's developmental activities to exploit the resources in the area including leveeing, channelization, and petroleum exploration. In addition, the severe trend of saltwater intrusion would continue and those areas not lost to open water would continue to be converted to more saline habitat types. The source of information and methodology employed to project future without project marsh acreages are discussed in Appendix D, Section 4.

4.2.2. The severe rates of land loss and habitat alteration would adversely affect productivity of fish and wildlife resources and lead to declines in populations of waterfowl, furbearers, and important shellfish and finfish species. By 2035, the average annual harvest of commercial fisheries would be reduced by approximately 77.5 million pounds valued at $38.5 million. The average annual net value of furbearers would be reduced by over $320 thousand. These declines in production would adversely affect employment and earnings in the commercial fisheries and wildlife industries.

4.2.3. The decreases in fish and wildlife productivity throughout the study area would cause a reduction of outdoor recreational opportunities. The supply of fish and wildlife is anticipated to decrease to a level which would support 868,582 man-days of recreation by 2035. Market area demands are projected to reach 31,221,203 man-days by 2035. Increasing future demands with a diminishing resource base would result in higher levels of need than currently exist. By 2035, the project area use would have been reduced by 196,808 annual man-days from its present use level. This loss is valued at $3,099,154 per year.

4.2.4. The population of the economic area is projected to reach 2,211,000 by the year 2035. Economic activities are expected to continue their historic trends to keep pace with a growing population.

4.2.5. Cultural resources of the study area are presently being impacted by the natural processes of erosion, wave wash, and subsidence and by the urbanization of the area. These impacts are significant and are destroying archeological and historic resources located in the marshes, along the coastlines and waterways, and in areas of planned urban development. In the future, the destructive forces of nature and urban expansion will continue to adversely impact cultural resources in the study area.

4.3. PLANS CONSIDERED IN DETAIL

4.3.1. The 16 plans considered in detail consist basically of combinations of six freshwater diversion sites and various magnitudes of flow. The 16 combinations of sites and flows and habitat acreages impacted due to direct construction are presented in Table 4-3-1 and displayed on Plate 7. A typical diversion complex would consist of a gated control structure in the mainline Mississippi River levee and attendant inflow and outflow conveyance channels.

4.3.2. Each plan involves diversion of fresh water into both the Barataria and Breton Sound Basins. All plans would achieve identical tangible (monetary) benefits. The primary quantifiable differences in the various plans are impacts due to direct construction of the diversion routes. The habitat impacts are presented in Table 4-3-1. More detailed information on construction impacts are in Section 3, Appendix D. All plans would produce identical benefits in the Breton Sound Basin, as each plan incorporates the same 6,600 cfs diversion into the basin, via Big Mar. However, the impacts of the plans differ with the various combinations of sites and flows in the Barataria Basin. It was not possible to quantify tangible differences between the plans based on available information. However, the plans are separable based on qualitative comparisons and the plan formulation process for sites in the Barataria Basin was based primarily on qualitative information. Before further discussion of plans considered in detail, it is necessary to provide an overview of the benefit analysis in the Barataria Basin.

4.3.3. The benefit analysis in the Barataria Basin involved a basin-wide approach. Project benefits are based on reducing the rates of land loss in the basin; therefore, more marsh acreage would be available with project than without project in any given year. Since it has been

TABLE 4-3-1

TOTAL IMPACTS OF DIVERSION ROUTE CONSTRUCTION

Plans 1-16

Plan	Diversion Sites	Flow (cfs)	Habitat Types: Bottomland Hardwoods	Wooded Swamp	Marsh	Water	Agriculture	Other	Total Acres Impacted
1	Big Mar Bayou Fortier Bayou Lasseigne	6,600 7,100 3,550	133	484	210	180	121	11	1,139
2	Big Mar Bayou Fortier Bayou Lasseigne	6,600 3,550 7,100	105	511	210	172	122	11	1,131
3	Big Mar Bayou Fortier Bayou Lasseigne	6,600 5,325 5,325	121	516	222	176	123	11	1,169
4	Big Mar Bayou Fortier	6,600 10,650	161	318	146	187	82	11	905
5	Big Mar Bayou Lasseigne	6,600 10,650	22	395	193	72	85	11	778
6	Big Mar Oakville Bayou Fortier	6,600 5,325 5,325	134	282	175	266	60	43	960
7	Big Mar Oakville Bayou Lasseigne	6,600 5,325 5,325	35	350	233	162	63	43	886
8	Big Mar Oakville Bayou Fortier	6,600 3,550 7,100	142	291	163	261	66	38	961
9	Big Mar Oakville Bayou Lasseigne	6,600 3,550 7,100	31	383	228	154	71	38	905
10	Big Mar Oakville Bayou Fortier Bayou Lasseigne	6,600 3,550 3,550 3,550	114	444	219	254	107	38	1,176
11	Big Mar Myrtle Grove Bayou Fortier	6,600 5,325 5,325	141	227	301	391	84	56	1,200
12	Big Mar Myrtle Grove Bayou Lasaeigne	6,600 5,325 5,325	42	295	359	287	87	56	1,126
13	Big Mar Myrtle Grove Bayou Fortier	6,600 3,550 7,100	149	252	312	395	85	56	1,249
14	Big Mar Myrtle Grove Bayou Lasseigne	6,600 3,550 7,100	38	344	377	288	90	56	1,193
15	Big Mar Myrtle Grove Bayou Lasseigne Bayou Fortier	6,600 3,550 3,550 3,550	121	405	368	388	126	56	1,464
16	Big Mar Davis Pond	6,600 10,650	122	118	109	285	36	15	685

1/ Includes cropland and pasture.

2/ Total does not include construction staging areas.

reasonably assumed that the limiting factor to fish and wildlife productivity is the quantity and quality of marsh, and not the mere areal extent of water, benefits are attributed to marsh acreage. Substantial documentation of the relationship between marsh habitat and fish and wildlife productivity is present in Section 6 of this EIS and in Appendix A. Additionally, benefits are based upon maintaining the average position of the 15 ppt isohaline at a location known as the Ford Line to maximize productivity, particularly for the American oyster, which is subject to extensive disease and predation at salinities exceeding 15 ppt. The Ford Line defines the position of the 15 ppt mean isohaline deemed desirable by fishery experts and is shown on Plate 5. Detailed discussions documenting the value of marshes to fish and wildlife productivity, impacts of increased land loss and saltwater intrusion, and the rationale and methodology for establishment of the Ford Line, are presented in the Problem Identification Appendix (Appendix A) and in Appendix D, Exhibit A.

4.3.4. Based on information presented in Appendix D, Section 4, it has been projected that with the project in place, there would be a reduction in the rate of marsh loss, with fresh/intermediate marshes experiencing the greatest reduction in loss rate (50 percent). Reductions in marsh loss are predicated upon several factors, the most important being reduction of saltwater intrusion. However, benefits would also be accrued due to increased nutrients, sediments, and flushing action in the upper basin. Benefits due to these factors require fresh water to actually flow through the marsh.

4.3.5. The 16 original plans were separated into three groups of five plans and Plan 16. The diversion sites and magnitude of flow for each plan are presented in Table 4-3-1. As discussed previously, all plans incorporate the Big Mar site in the Breton Sound Basin.

4.3.6. Plans 1-5 consist of various combinations of flows for only the two upper diversion sites, Bayou Lasseigne (river mile 140.9) and Bayou Fortier (river mile 132.0). Other than impacts due to construction of the diversion routes (Table 4-3-1), the impacts in the Barataria Basin would be identical for any of these five plans. With diversions from January through April, these plans would maintain the average position of the 15 ppt isohaline at the Ford Line from April through September. These plans would provide maximum flow of fresh water through the upper basin with flow of fresh water through extensive marshes and waterways allowing maximum benefits due to increased nutrients, sediments, and flushing action to accrue. Additionally, these plans would tend to buffer the adverse impacts due to cooler temperatures and higher levels of pollutants in Mississippi River water. This group of plans contributes more toward achieving the project objectives and intangible benefits than either of the two groups discussed in the following paragraphs. However, Plan 16, which incorporates the Davis Pond site (river mile 118.4), would achieve project objectives nearly identical to Plans 1-5. Plan 16 is further discussed in Section 4.3.9.

4.3.7. Plans 6-10 consist of various combinations of flows for the Oakville site (river mile 70.4) and the Bayou Lasseigne and Bayou Fortier sites in the upper basin. Other than impacts due to construction of the diversion routes (Table 4-3-1), the impacts in the Barataria Basin would be very similar for any of these plans. The intangible benefits attributable to these plans would be less than for Plans 1-5. With diversion from January through April, these plans would maintain the average position of the 15 ppt isohaline at the Ford line only from April through July/August. That portion of flow diverted at the lower (Oakville) site would not pass through the upper Barataria Basin, thereby depriving the upper basin of that portion of benefits attributable to increased nutrients, sediments, and flushing. Additionally, that portion of the water diverted through the Oakville

site would not be subject to the same degree of thermal and pollutant buffering as that water diverted through the upper sites. This would increase the potential for adverse impacts to the estuarine-dependent organisms utilizing the Barataria Bay estuary.

4.3.8. Plans 11-15 consist of various combinations of flows for the Myrtle Grove site (river mile 58.7) and the Bayou Lasseigne and Bayou Fortier sites in the upper basin. Other than impacts due to construction of the diversion routes (Table 4-3-1), the impacts in the Barataria Basin would be very similar for any of these plans. The intangible benefits attributable to these plans would be less than for Plans 1-5 or Plans 6-10. With diversions from January through April, these plans would maintain the average positon of the 15 ppt isohaline at the Ford line only from April through June/July. That portion of the flow diverted at the lower (Myrtle Grove) site would not pass through the upper basin at all, bypassing even more area than with the Oakville site. The upper basin would be deprived of that portion of the benefits attributable to increased nutrients, sediments, and flushing. Additionally, problems related to cooler river temperature and higher pollutant levels pose a more serious threat with Plans 11-15 than with either of the other two groups of plans. That portion of the fresh water diverted at Myrtle Grove would flow directly into the eastern portion of the lower basin. Temperature changes due to the cooler Mississippi River water would be abrupt as would the changes in pollutant levels between the river and the receiving areas. These abrupt changes could be detrimental to the estuarine-dependent species moving into this area in late winter and early spring.

4.3.9. Plan 16, which incorporates the Davis Pond site, was not analyzed in combination with other sites. However, it can be reasonably assumed that effects of combinations of Davis Pond would be very similar to those presented for Plans 1-5. The location of the 15 ppt isohaline

for 10,650 cfs flow at Davis Pond is the same as for the 10,650 cfs flow at the Bayou Lasseigne site. Therefore, the various combinations of Davis Pond with other sites could be expected to result in effects similar to those determined for Plans 1-5. Since the various combinations with the Bayou Lasseigne site were not deemed as desirable as with full flow from Bayou Lasseigne (Plan 5), it is probable that combinations with Davis Pond would likewise not prove as desirable as with the full flow from Davis Pond. Plan 16 could be expected to achieve the same overall benefits as Plan 5 for the following reasons. Reductions in marsh loss are predicated upon several factors, the most important being reduction of saltwater intrusion. Since Plan 16 would maintain basically the same isohalines as Plan 5, benefits due to curbing saltwater intrusion would be the same. As discussed previously, increased nutrients and sediments also play a role in maintaining marsh, and benefits due to those parmeters require the diverted water to flow through the marsh. These benefits are more pronounced in areas closest to the actual freshwater inflow. Plan 16 also diverts water into the upper Barataria Basin marshes, so benefits due to nutrient and sediment input would be similar to those with Plan 5. The only major difference is the actual areas and acreages of the areas receiving the bulk of the nutrient and sediment benefits. With Plan 5, these benefits would be more pronounced in the marsh around Lac des Allemands and Bayou des Allemands, whereas with Plan 16, they would be more pronounced in the Lake Cataouatche and upper Lake Salvador area, particularly in the 7,425 acre overflow area above Lake Cataouatche which is an integral component of Plan 16. Although the acreage of the areas which would receive the most nutrient and sediment benefits is somewhat smaller with Plan 16 than with Plan 5, it is not possible to quantify the difference in benefits within the degree of accuracy of the methodology used to estimate with-project reductions in rate of marsh loss. Another difference between Plans 5 and 16 warrants discussion at this point. With Plan 16, in order to maintain the 15 ppt isohaline at the same

location and for the same duration as with Plan 5, it is necessary to extend the diversion period through May. The primary reason why biologists have historically recommended stopping diversions by April were due to concerns that cooler Mississippi River water would adversely impact brown shrimp and other sensitive estuarine-dependent organisms. However, with Plan 16, water would tend to warm in the 7,425 acre overflow area and Lake Cataouatche and be nearly equilibrated in temperature before reaching those areas utilized by these organisms. Therefore, extending the diversion period by one month would not be considered a serious problem, particularly if the lift gates in the diversion structure were opened gradually.

4.3.10. The implementation responsibilities for the 16 detailed plans are summarized in Table 4-3-2.

4.3.11. Plan 5 has been selected as the NED plan, and Plan 16 as the RP. The rationale for these designations is contained on page EIS-1. A detailed description of features of the RP is contained in the accompanying Main Report.

4.3.12. Maintenance required for the RP includes routine maintenance such as ground maintenance, greasing, painting, and removing debris at the structures. Major maintenance for each structure would be required every 15 years and includes dewatering structures to replace valves, painting and repairing machinery, electrical systems, and handrails. Maintenance dredging of the conveyance channels would also be required on a periodic basis. The average annual maintenance dredging requirement is estimated to be 19,800 cubic yards for the conveyance channels. The impoundment levees at the Davis Pond site would need to have material added to them at intervals of 2, 3, 5, 10 and 20 years

after initial construction. Additional information concerning maintenance can be found in the Main Report and Appendix C, Engineering Investigations. The impacts of maintenance activities are generally discussed in Section 6 of this EIS.

4.3.13. The following table 4-4, "COMPARATIVE IMPACTS OF ALTERNATIVES," describes in a comparative form the base and without condition, the impacts of the detailed plans on significant resources, and plan economic characteristics. More detailed information on the impacts described in this table can be found in Section 6, "Environmental Effects."

TABLE 4-3-2

IMPLEMENTATION RESPONSIBILITIES

Implementation Responsibilities	Plans 1	2	3	4	5
a. First Cost					
(1) Federal	40,400,000	39,500,000	40,400,000	35,700,000	33,200,000
(2) Non-Federal	13,500,000	13,200,000	13,500,000	11,900,000	11,000,000
(3) Total	53,900,000	52,700,000	53,900,000	47,600,000	44,200,000
b. Annual Cost					
(1) Federal	3,600,000	3,510,000	3,590,000	3,170,000	2,950,000
(2) Non-Federal	1,720,000	1,700,000	1,730,000	1,530,000	1,450,000
(3) Total	5,320,000	5,210,000	5,320,000	4,700,000	4,400,000

TABLE 4-3-2 (CONTINUED)

IMPLEMENTATION RESPONSIBILITIES

Implementation Responsibilities	Plans 6	7	8	9	10
a. First Cost					
(1) Federal	35,200,000	34,000,000	34,800,000	33,600,000	38,900,000
(2) Non-Federal	11,800,000	11,300,000	11,900,000	11,500,000	13,200,000
(3) Total	47,000,000	45,300,000	47,700,000	46,100,000	53,100,000
b. Annual Cost					
(1) Federal	3,130,000	3,020,000	3,180,000	3,070,000	3,550,000
(2) Non-Federal	1,550,000	1,510,000	1,560,000	1,530,000	1,730,000
(3) Total	4,680,000	4,530,000	4,740,000	4,600,000	5,280,000

TABLE 4-3-2 (CONTINUED)

IMPLEMENTATION RESPONSIBILITIES

Implementation Responsibilities	Plans 11	12	13	14	15	16
a. First Cost						
(1) Federal	36,300,000	33,000,000	36,800,000	35,600,000	40,900,000	35,600,000
(2) Non-Federal	12,100,000	11,700,000	12,300,000	11,900,000	13,600,000	11,800,000
(3) Total	48,400,000	46,700,000	49,100,000	47,500,000	54,500,000	47,400,000
b. Annual Cost						
(1) Federal	3,230,000	3,110,000	3,280,000	3,160,000	3,640,000	3,160,000
(2) Non-Federal	1,580,000	1,540,000	1,590,000	1,560,000	1,760,000	1,600,000
(3) Total	4,810,000	4,650,000	4,870,000	4,720,000	5,400,000	4,760,000

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES

ALTERNATIVE	SIGNIFICANT RESOURCE MARSHES
Base Condition	Marshland communities dominate the natural environment of the study area. About 210,000 acres of fresh/intermediate marsh, 243,000 acres of brackish marsh, and 204,000 acres of saline marsh exist. These marshes sustain important populations of fish and wildlife and act as storm buffers protecting human population centers such as New Orleans.
Without Project (No Action)	By 2035, fresh/intermediate marsh acreage would decrease to about 47,000 acres, brackish marsh to about 194,000 acres, and saline marsh to about 135,000 acres.
Plans 1-5	Construction of diversion routes would eliminate from 140 to 222 acres. These plans would reduce marsh loss rates in the study area. About 99,000 more acres of marsh would occur in 2035 than without project. Fresh/intermediate marshes would benefit most.
Plan 6-10	Construction of diversion routes would eliminate from 163 to 233 acres. Benefits to the study area would be similar to Plans 1-5, but of a slightly lesser magnitude.
Plans 11-15	Construction of diversion routes would eliminate from 301 to 307 acres. Benefits to the study area would be similar to Plans 1-5 and 6-10, but of a slightly lesser magnitude than either group of plans.
Plan 16	Construction of diversion routes would eliminate 109 acres of marsh. However, 175 acres of marsh would be created with dredged material for a net gain of 66 acres. Benefits to the marsh in the study area would be the same as for Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE BOTTOMLAND HARDWOOD FOREST
Base Condition	About 53,000 acres occur within the study area along the Mississippi River and its active and inactive distributaries.
Without Project (No Action)	Acreage would decrease to about 26,000 acres in 2035 due to agricultural, industrial, and urban development.
Plans 1-5	Construction of diversion routes would eliminate from 22 to 161 acres. About 26,000 acres would exist in 2035.
Plans 6-10	Construction of diversion routes would eliminate from 31 to 142 acres. About 26,000 acres would exist in 2035.
Plans 11-15	Construction of diversion routes would eliminate from 35 to 149 acres. About 26,000 acres would exist in 2035.
Plan 16	Construction of diversion routes would eliminate 122 acres. About 26,000 acres would exist in 2035.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE WOODED SWAMP
Base Condition	About 171,000 acres occur in the study area inland of fresh marsh areas.
Without Project (No Action)	Acreage would decrease to about 86,000 acres by 2035 due to drainage for alternative uses and saltwater intrusion.
Plans 1-5	Construction of diversion routes would eliminate from 318 to 516 acres. Some benefits due to rejuvenating effects of diverted water on existing swamps could occur. Acreage would be about 86,000 acres in 2035.
Plans 6-10	Construction of diversion routes would eliminate from 282 to 444 acres. Benefits from potential swamp rejuvenation would be similar to Plans 1-5. Acreage would be about 86,000 acres in 2035.
Plans 11-15	Construction of diversion routes would eliminate from 227 to 405 acres. Benefits from potential swamp rejuvenation would be similar to Plans 1-5. Acreage would be about 86,000 acres in 2035.
Plan 16	Construction of diversion routes, would eliminate 118 acres. Benefits from potential swamp rejuvenation would be similar to Plans 1-5, especially in the Salvador Wildlife Management Area. Acreage would be about 86,000 acres in 2035.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE
	AGRICULTURAL LANDS
Base Condition	About 100,000 acres of croplands and 77,000 acres of pasturelands occur in the study area. Both prime and unique farmlands are present.
Without Project (No Action)	Existing acreages would decrease by 2035 due to urban and industrial expansion.
Plans 1-5	Construction of diversion routes would eliminate from 82 to 123 acres of pasture and sugarcane fields.
Plans 6-10	Construction of diversion routes would eliminate from 60 to 170 acres of pasture and sugarcane fields.
Plans 11-15	Construction of diversion routes would eliminate from 84 to 126 acres of pasture and sugarcane fields.
Plan 16	Construction of diversion routes would eliminate 36 acres of agricultural land.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE WATER BODIES
Base Condition	About 982,000 acres of fresh to saline water bodies are present in the study area.
Without Project (No Action)	Acreage of water bodies would increase by about 281,000 acres by 2035 due to deterioration of marshland areas.
Plans 1-5	Construction of diversion routes would impact from 72 to 187 acres. These plans would reduce the rate of formation of water bodies to 182,000 acres and would alter salinity regimens and water quality parameters in approximately 982,000 acres of receiving water bodies. Inland areas would become fresher as isohalines shift seaward.
Plans 6-10	Construction of diversion routes would impact from 154 to 266 acres. Impacts to receiving areas similar to Plans 1-5.
Plans 11-15	Construction of diversion routes would impact from 287 to 391 acres. Impacts to receiving areas similar to Plans 1-5.
Plan 16	Construction of diversion routes would impact 285 acres. Impacts to receiving areas similar to Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE BARRIER ISLANDS
Base Condition	The study area is fringed by the Chandeleur and Breton Islands and the Grand Isle-Grand Terre complex.
Without Project (No Action)	Erosion and subsidence of these islands would reduce their areal extent by year 2035.
Plans 1-5	No significant impacts to barrier islands would occur.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Same as Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE FISHERIES
Base Condition	Study area supports valuable commercial and sport fishery resources. Average annual landings from 1963-1978 were valued at $107 million.
Without Project (No Action)	Fishery productivity would decline due to loss of marshlands and saltwater intrusion. By 2035, value of commercial fisheries would drop from $107 to $62 million, a reduction of $45 million.
Plans 1-5	Value of commercial fishery harvest in 2035 would be $101 million, or $38.6 million greater than without project. Some potential adverse impacts to fisheries could occur due to cooler temperatures and higher levels of pollutants in the Mississippi River as compared to the receiving areas. Approximately 15,000 acres of leased oystering areas would be potentially overfreshened.
Plans 6-10	Fishery benefits and potential adverse impacts similar to Plans 1-5.
Plans 11-15	Fishery benefits and potential adverse impacts similar to Plans 1-5.
Plan 16	Fishery benefits and potential adverse impacts similar to Plans 1-5, except the overflow area would tend to warm water temperatures and partially assimilate pollutants. This would ameliorate adverse impacts to fisheries in the receiving areas.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE WILDLIFE
Base Condition	Study area supports abundant and diverse wildlife populations. Average annual value of furbearers and alligators is about $1.6 million.
Without Project (No Action)	Wildlife populations would decline due to reduced quality of wetland habitat. Average annual net value of furbearers and alligators would be reduced by about $539 thousand.
Plans 1-5	Due to reductions in rates of habitat loss and degradation, these plans would benefit wildlife populations. Total net value of furbearers and alligators would be about $543 thousand greater than without project in 2035. Some potential adverse impacts to wildlife could occur due to environmental changes resulting from diversions.
Plans 6-10	Wildlife benefits and potential adverse impacts similar to Plans 1-5.
Plans 11-15	Wildlife benefits and potential adverse impacts similar to Plans 1-5.
Plan 16	Wildlife benefits and potential adverse impacts similar to Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE ENDANGERED SPECIES
Base Condition	Two threatened and 15 endangered species are actually or potentially present in the study area.
Without Project (No Action)	The continuing trend toward decreased habitat quantity and quality would adversely impact threatened and endangered species.
Plans 1-5	Improvements in quantity and quality of habitats would benefit most species. Potential adverse impacts to bald eagles exist due to increased levels of pollutants introduced by diversion of Mississippi River water.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5, except potential impacts to brown pelicans also exist due to shorter distance between the Myrtle Grove site and the brown pelican colony on Queen Bess Island.
Plan 16	Same as Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE BLUE LIST SPECIES
Base Condition	The range of 14 species of birds listed on the 1982 Audubon Society "Blue List" includes the study area.
Without Project (No Action)	The continuing trend toward decreased habitat quantity and quality would adversely impact most Blue List species.
Plans 1-5	Improvements in quantity and quality of habitats would benefit most Blue List species. Increased pollutant levels could adversely impact some species.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Same as Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE NESTING COLONIES
Base Condition	A total of 43 sea and wading bird nesting colonies, including about 341,000 nesting adults, are located in the study area.
Without Project (No Action)	The continuing trend toward decreased habitat quantity and quality would adversely impact nesting colonies.
Plans 1-5	Improvements in quantity and quality of habitats would benefit nesting colonies overall. Increased pollutant levels could adversely impact some colonies, as could increased water levels during periods of diversion.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Same as Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE RECREATIONAL RESOURCES
Base Condition	The study area provides opportunities for a variety of consumptive and nonconsumptive recreational activities. The area supports 650,680 man-days annually of sportfishing and 414,710 man-days of hunting.
Without Project (No Action)	Recreational opportunities are related to quantity and quality of habitat. As habitats deteriorate, recreational opportunities would be lost. By 2035, project area hunting use would be reduced by 196,808 man-days compared to base condition.
Plans 1-5	Benefits in 2035 would be about $1.4 million, $992 thousand from hunting and $405 thousand from fishing. Hunting values accrue from 92,613 more man-days than without project. Fishing benefits are based on improved quality of the experience.
Plans 6-10	Similar to Plans 1-5.
Plans 11-15	Similar to Plans 1-5.
Plan 16	Similar to Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE STATE WILDLIFE MANAGEMENT AREAS AND NATIONAL PARKS
Base Condition	Three State Wildlife Management Areas (WMA's), and one National Park, containing a total of about 106,000 acres, occur in the study area.
Without Project (No Action)	As the quantity and quality of habitat is reduced over project life, the WMA's and National Park would be adversely impacted.
Plans 1-5	The WMA's and National Park would experience reductions in rates of land loss and habitat degradation.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Same as Plans 1-5, except Salvador WMA would experience significant direct benefits.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE MINERALS
Base Condition	Mineral resources consist mainly of oil, natural gas, aggregate deposits, salt, and sulphur.
Without Project (No Action)	Intensive petroleum exploration and production will occur in the future. The environment will continue to experience adverse impacts associated with canal dredging, drilling, conversion of habitat to production areas, and other activities related to the petroleum industry.
Plans 1-5	Construction of diversion routes would require relocation of five to seven oil and gas pipelines.
Plans 6-10	Construction of diversion routes would require relocation of six to eight oil and gas pipelines.
Plans 11-15	Same as Plans 6-10.
Plan 16	Construction of diversion routes would require relocation of nine oil and gas pipelines.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE
	MISSISSIPPI RIVER
Base Condition	Study area was created by the delta building processes of the Mississippi River. The river is an important navigational route and source of municipal and industrial water supply. Water quality of the river is poor.
Without Project (No Action)	River will continue to be used for navigation and water supply. Water quality will continue to degrade unless the quantity of pollutants introduced into the river is reduced.
Plans 1-5	Minimal impacts on the Mississippi River. Maximum design flow into receiving areas would represent only about 5 percent of average river flow.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Same as Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE WATER QUALITY
Base Condition	Mississippi River often contains high levels of fecal coliforms, plant nutrients, heavy metals, phenols, pesticides, polychlorinated biphenyls, and other compounds. Receiving areas generally contain lower levels of pollutants than the proposed source water. Temperature of river water is cooler than in receiving areas.
Without Project	Wastewater loading in the Mississippi River and the rest of the study area will continue to increase with expanding urbanization and industrialization, although implementation of improved treatment methods would offset long-term impacts. Water quality in the receiving areas would continue to degrade.
Plans 1-5	Diversions would result in increased mean concentrations of cadmium, mercury, nickel, selenium, zinc, nitrogen, phosphorus, hydrocarbons, and fecal coliform bacteria in Barataria and Breton Sound Basins, primarly in the upper portions of the basins that would directly receive diverted waters. Water temperature in receiving area would be lowered during diversions.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Detention basin would tend to warm water temperatures and partially assimilate pollutants.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE NATURAL AND SCENIC STREAMS SYSTEM
Base Condition	Bayou des Allemands, in the Barataria Basin, is part of the Louisiana Natural and Scenic Streams System.
Without Project (No Action)	State law should protect and preserve natural and scenic streams in Louisiana, including Bayou des Allemands.
Plans 1-5	These plans would divert up to 10,650 cfs into Lac des Allemands. A large portion of this water would flow through Bayou des Allemands. During diversion, water level in the bayou would increase 0.3 to 0.5 feet. Velocity and water quality would be altered.
Plans 6-10	These plans would divert from 3,550 to 7,100 cfs into Lac des Allemands. Impacts to Bayou des Allemands would be the same as for Plans 1-5.
Plans 11-15	Same as plans 6-10.
Plan 16	No natural or scenic streams would be impacted by this plan.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE NATIONAL REGISTER PROPERTIES
Base Condition	Within the study area, 10 properties are listed on the Register, 5 have been determined eligible for inclusion, 1 has been nominated, and 10 are pending nomination.
Without Project (No Action)	Cultural resources, including National Register Properties, are being impacted by both natural processes and urbanization in the study area. In the future, these destructive forces will continue, if not accelerate, in the area.
Plans 1-5	No National Register or Register-eligible properties would be affected. However, the future cultural resources survey may locate resources eligible for the Register in the project impact area.
Plans 6-10	Same as Plans 1-5.
Plans 11-15	Same as Plans 1-5.
Plan 16	Same as Plans 1-5.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE ARCHEOLOGICAL RESOURCES
Base Condition	Over 230 archeological sites are recorded in the study area. These sites include both prehistoric and historic cultural remains.
Without Project (No Action)	Archeological resources are being impacted by both natural processes and urbanization in the study area. In the future, these destructive forces will continue, if not accelerate, in the area.
Plans 1-5	Plans 1-4 have a relatively high probability of impacting archeological resources. Plan 5 has a low probability for such impacts and is the preferred alternative from a cultural resources viewpoint.
Plans 6-10	Plans 6-10 have a relatively high probability of impacting archeological resources.
Plans 11-15	Plans 11-15 have a very high probability of impacting archeological resources.
Plan 16	Plan 16 has a high probability of impacting archeological resources along Bayou Bois Piquant and Bayou Verret.

TABLE 4-4. COMPARATIVE IMPACTS OF ALTERNATIVES (CONTINUED)

ALTERNATIVE	SIGNIFICANT RESOURCE PLAN ECONOMICS*				
	Average First Costs	Average Annual Costs	Average Annual Benefits	B/C Ratio	Net Benefits
Base Condition	N/A	N/A	N/A	N/A	N/A
Without Project (No Action)	0	0	0	0	0
1	$53,900	$5,320	$15,760	3.0	$10,440
2	52,700	5,210	15,760	3.0	10,550
3	53,900	5,320	15,760	3.0	10,440
4	47,600	4,700	15,760	3.4	11,060
5	44,200	4,390	15,760	3.6	11,376
6	47,000	4,680	15,760	3.4	11,080
7	45,300	4,520	15,760	3.5	11,240
8	47,700	4,240	15,760	3.3	11,020
9	46,100	4,590	15,760	3.4	11,170
10	53,100	5,270	15,760	3.0	10,490
11	48,400	4,800	15,760	3.3	11,960
12	46,700	4,650	15,760	3.4	11,110
13	49,100	4,860	15,760	3.2	10,900
14	47,500	4,720	15,760	3.3	11,040
15	54,500	5,400	15,760	2.9	10,360
16	47,400	4,750	15,760	3.3	11,010

*Based on 8 1/8% interest rate; in thousands of dollars.

5. AFFECTED ENVIRONMENT

5.1 ENVIRONMENTAL CONDITIONS

5.1.1 The study area, for environmental analysis purposes, encompasses that area of southeast Louisiana, exclusive of the active Mississippi Delta, extending from Bayou Lafourche on the west to the Mississippi River-Gulf Outlet (MRGO) on the east. This area basically consists of the Barataria and Breton Sound Basins. The Mississippi River forms the northern boundary of the study area on the Barataria Basin side of the river. On the east side of the river, the northern boundary follows a natural ridge along Highway 46. The major stream in the area is the Mississippi River. Major navigational channels include the Gulf Intracoastal Waterway (GIWW), the Barataria Bay Waterway, and the MRGO. Due to its proximity to the Gulf of Mexico, the area has a subtropical marine climate.

5.1.2 The dominant habitat types in the study area are bottomland hardwood forest (natural levee forest), wooded swamp, fresh, intermediate, brackish, and saline marshes and associated fresh to saline water bodies. Barrier islands border the southern edges of the study area. Agricultural crops grown in the area include sugarcane, soybeans, cotton, corn, citrus fruits, and truck crops.

5.1.3 Important terrestrial animals in the area include nutria, muskrat, raccoon, mink, and otter which are harvested for their furs. White-tailed deer, rabbits, various small mammals, and a variety of birds, reptiles, and amphibians also occur in the study area. The American alligator is harvested throughout the area for its meat and hide, especially in the swamps and fresh/intermediate marshes. The marshes and shallow bays in the area function as nursery grounds for valuable stocks of shrimp, oysters, crabs, and finfishes. These

resources provide excellent opportunities for sport and commercial fishing. Popular recreational activities in the area include fishing, hunting, boating, camping, and picnicking.

5.1.4. Numerous historical and archeological sites occur throughout the study area, including a number of sites listed in the National Register of Historic Places.

5.1.5. The petroleum, chemical, and related industries, the port of New Orleans, and commercial fisheries form the economic base of the area. Major commodities moving through the port include grain, petroleum products, salt, and sulphur.

5.2. SIGNIFICANT RESOURCES

5.2.1. GENERAL

A given resource is considered to be significant if it is identified in the laws, regulations, guidelines or other institutional standards of national, regional, and local public agencies; it is specifically identified as a concern by local public interests; or it is judged by the responsible Federal agency to be of sufficient importance to be designated as significant. This section discusses each significant resource listed previously in table 4-4 "Comparative Impacts of Alternatives." Significant resources identified in Section 122 of the 1970 River and Harbor Act (PL 91-611) were considered and it was determined these resources would not be affected enough to warrant inclusion in table 4-4 or separate discussion in this section. Section 122 resources have been addressed in tables 6 through 8 of the Main Report and in Appendix E, Social and Cultural Resources.

5.2.2. MARSHES

5.2.2.1. The following types of marshes occur in the study area: (1) fresh marsh, with a mean salinity of 1.0 part per thousand (ppt); (2) intermediate marsh, with a mean salinity of 3.3 ppt; (3) brackish marsh, with a mean salinity of 8.2 ppt; and (4) saline marsh, with a mean salinity of 18.0 ppt.

5.2.2.2. For purposes of this study, fresh and intermediate marsh types are combined and referred to as fresh/intermediate marsh. This is because the habitat values of these marsh types are similar. Typical fresh marsh vegetation includes maidencane [1/], pennywort, water hyacinth, pickerelweed, alligatorweed, and bulltongue. These marshes are found inland from the intermediate marshes. As indicated by the name, intermediate marsh occurs in the transition zone between fresh and brackish marsh. Common vegetation in this type includes wiregrass, deerpea, bulltongue, wild millet, bullwhip, and sawgrass. A total of 210,242 acres of fresh/intermediate marsh occurs in the study area. Brackish marsh occurs at moderate salinities between the intermediate and saline marsh zones. Typical vegetation includes wiregrass, three-cornered grass, leafy threesquare, and widgeongrass. A total of 242,918 acres of brackish marsh occurs in the area. Saline marsh generally occurs along shorelines of the Gulf of Mexico, large bays, and barrier islands. The most abundant plant species in this zone are oystergrass, glasswort, black rush, saltwort, and saltgrass. Black mangrove frequently occurs in association with oystergrass, especially on the leeward side of the barrier islands. The total acreage of saline marsh in the study area is 204,255 acres.

[1/] All common and scientific nomenclature of plants mentioned in this EIS follow Montz (1975a; 1975b), and are listed in Section 1, Appendix D, Natural Resources.

5.2.2.3. Marshes provide habitats for fish and wildlife, act as storm buffers between the Gulf of Mexico and developed areas of the coastal zone, and have the capacity to absorb water pollutants. The fresher marsh types function as valuable habitat for waterfowl, furbearers, and the American alligator. The higher salinity marshes produce food and serve as nursery areas essential to the reproduction, survival, and growth of many estuarine-dependent species of fish and shellfish. Most of these species are extremely valuable commercial and recreational resources in the study area. More information concerning marshes can be found in Appendix A, Problem Identification.

5.2.3. BOTTOMLAND HARDWOOD FOREST

These forests are located along the abandoned Mississippi River distributary ridges which extend into the marshes. Portions of these forests are seasonally flooded. Common vegetation in these wetlands include water oak, Nuttall oak, green ash, pumpkin ash, bitter pecan, Drummond red maple, mayhaw, green hawthorn, waterlocust, and palmetto. Common species on higher ground within this forest type includes live oak, hackberry, sweetgum, honeylocust, and deciduous holly. Bottomland hardwood forest is the most productive wildlife habitat type present in the area. Because of its increasing scarcity and high productivity, it is an important recreational resource. A total of 52,949 acres of bottomland hardwood forest occurs in the study area. More information concerning bottomland hardwood forests can be found in Appendix A.

5.2.4. WOODED SWAMP

This habitat is typically located inland from fresh marsh areas. Typical woody vegetation includes baldcypress, tupelogum, Drummond red maple, and buttonbush. Herbaceous vegetation includes

duckweeds, alligator weed, water hyacinth, swamp lily, and lizard's tail. Wooded swamps are productive fish and wildlife habitats. They also serve an important hydrologic function by storing and regulating the flow of fresh water to marshes and estuaries seaward of them. A total of 170,780 acres of wooded swamp occurs in the study area. More information concerning wooded swamp can be found in Appendix A.

5.2.5. AGRICULTURAL LANDS

A total of approximately 100,000 acres of croplands and 77,000 acres of pastureland and rangeland occurred in the study area in 1978. The primary agricultural crops grown in the area include sugarcane, soybeans, cotton, corn, citrus fruits, and truck crops. Both prime and unique farmlands occur in the area.

5.2.6. WATER BODIES

Many fresh to saline water bodies of various sizes and depths are interspersed throughout the study area. The Barataria and Breton Sound Basins contain approximately 648,500 and 333,500 acres of water bodies, respectively. The water bodies include ponds, lakes, streams, bayous, canals, bays, sounds, tidal passes, and navigational channels. These water bodies are inhabited by a variety of adult finfish and shellfish and provide valuable nursery habitat for many important species.

5.2.7. BARRIER ISLANDS

The study area is also fringed by barrier islands along its southern boundaries. The Chandeleur Islands form the gulfward boundary of Chandeleur Sound and portions of Breton Sound in the southeastern portion of the area. The Grand Isle-Grand Terre Island complex is located along the southern edge of Barataria Bay. These islands support

sand and sand/shell beaches, low vegetated dunes, and tidal wetlands vegetated by black mangrove and oystergrass. Protected shallows found in association with these islands sometimes support beds of seagrasses, such as shoalgrass, turtlegrass, and manateegrass.

5.2.8. FISHERIES

5.2.8.1. The commercial fishery resources in the study area are primarily estuarine/marine in nature. Menhaden dominate the total poundage harvested, while shrimp rank first in total value. Other commercially important species include the American oyster, blue crab, Atlantic croaker, spotted seatrout, sand seatrout, spot, and red drum. The average catch and value of these fisheries for the years 1963-1978, based on 1983 exvessel prices, was approximately 337 million pounds valued at about $107 million. Barataria Basin leads the study area in total value and weight of landings. A wealth of information on the biology and harvest of the commercially important estuarine fishes and shellfishes has been summarized in a report prepared by the National Marine Fisheries Service (Lindall et al. 1972). The primary freshwater species which are harvested commercially in the area include red swamp crawfish, gars, bowfin, carp, freshwater drum, buffaloes, blue catfish, channel catfish, flathead catfish, and yellow bullhead. Commercial harvest values for freshwater species in the area are available only for catfish and bullheads. The average catch and value of catfish and bullheads for the years 1963-1976, based on 1977 exvessel prices, was 1,277,300 pounds valued at $462 thousand.

5.2.8.2. Sportfishing in the study area is diverse and substantial, including both fresh and saltwater fishing. Both brown shrimp and white shrimp are taken by sport trawlers, while blue crab is the only crab species taken in significant numbers by sportfishermen. Saltwater sport finfishes commonly harvested include spotted seatrout, sand seatrout, Atlantic croaker, spot, red drum, black drum, sheepshead, southern

flounder, southern kingfish, and Spanish mackerel. Freshwater sportfishing occurs in the fresh to slightly brackish waters in the upper portion of the area. Species commonly taken include largemouth bass, black crappie, white crappie, warmouth, bluegill, redear sunfish, channel catfish, blue catfish, and flathead catfish. Red swamp crawfish are also taken in the wooded swamps and fresh marshes.

5.2.8.3. The study area supports rich populations of phytoplankton, zooplankton, benthos, macroinvertebrates, and numerous small fishes. These organisms constitute vital components of the aquatic food chain.

5.2.9. WILDLIFE

5.2.9.1. The study area contains a great variety of mammals, birds, reptiles, and amphibians. Of special interest from a commercial standpoint are nutria, muskrat, mink, otter, and raccoon, which are trapped for their valuable pelts. Based on 1976-1981 average prices expressed in 1983 dollars the area produced pelts worth about $1.1 million. Other species inhabiting the area include white-tailed deer, skunks, rabbits, squirrels, armadillos, and various species of small mammals. Large populations of migratory waterfowl including snowgeese, gadwalls, pintails, mallards, blue-winged teal, green-winged teal, wigeons, mottled ducks, and lesser scaup are present in the area. These waterfowl are highly sought by sportsmen. In addition, coots, gallinules, rails, mourning doves, and snipe are important game species. Nongame wading birds, shore birds, and sea birds include egrets, ibis, herons, sandpipers, willets, black-necked stilts, gulls, terns, skimmers, grebes, loons, cormorants, and white and brown pelicans. Various raptors such as barred owls, red-shouldered hawks, marsh hawks, ospreys, Arctic peregrine falcons, and bald eagles are present. Passerine birds present include sparrows, vireos, warblers, mockingbirds, grackles, red-winged blackbirds, wrens, bluejays, cardinals, and crows. Many of these birds are present primarily during

periods of spring and fall migrations. The area provides habitat for such herptiles as salamanders, toads, frogs, turtles, and several species of poisonous and nonpoisonous snakes. The American alligator is abundant in fresh to intermediate marsh and is caught commercially for its hides and meat throughout the area. Approximately 2,387 alligators are taken in the study area annually. Based on 1983 dollars, the meat and hides have an average annual value of about $510,000.

5.2.9.2. Numerous terrestrial invertebrates occur throughout the study area. The most notable are insects, which often serve as vectors, transmitting disease organisms to higher animals, including man. Mosquitoes are the most important of the vectors in the area, although other groups, such as deerflies, horseflies, and biting midges are also considered as vectors. The area provides suitable breeding habitat for such species as Aedes sollicitans (salt-marsh mosquito), Culex salinarius, and other species of mosquitoes. Additional information concerning wildlife resources can be found in Appendix A.

5.2.10. ENDANGERED AND THREATENED SPECIES

Threatened species actually or potentially present in the area include the loggerhead sea turtle and the green sea turtle. Endangered species actually or potentially present in the area include the brown pelican, bald eagle, Arctic peregrine falcon, Eskimo curlew, Bachman's warbler, ivory-billed woodpecker, Eastern cougar, West Indian manatee, blue whale, humpback whale, sei whale, sperm whale, Kemp's ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle. Additional information concerning threatened and endangered species can be found in Appendix A and in Section 2 of Appendix D.

5.2.11. BLUE LIST SPECIES

The "Blue List," published by the National Audubon Society, lists birds that are showing indications of noncyclical population decline or range contraction, either locally or throughout their range. This list, compiled by interested observers throughout the country, serves as an early warning system to indicate those species that might be in danger of extinction in the future. The 1982 "Blue List" cites 30 species. The range of 14 of these species includes the study area.

These species are listed below:

Least Bittern
Barn Owl
American Bittern
Sharp-shinned Hawk
Hairy Woodpecker
Red-shouldered Hawk
Eastern Bluebird
King Rail
Loggerhead Shrike
Long-billed Curlew
Eastern Meadowlark
Upland Sandpiper
Dickcissel
Grasshopper Sparrow

5.2.12. NESTING COLONIES

A total of 43 sea and wading bird nesting colonies occur within the study area. These nesting colonies include approximately 341,000 nesting adults. The colonies are comprised of the following species:

Great Blue Heron	Anhinga
Great Egret	Least Tern
Cattle Egret	Black Skimmer
Little Blue Heron	Foster's Tern
Louisiana Heron	Black-crowned Night Heron
Snowy Egret	Brown Pelican
White Ibis	Laughing Gull
White-faced Ibis	Reddish Egret
Glossy Ibis	American Oystercatcher
Yellow-crowned Night Heron	

5.2.13. RECREATIONAL RESOURCES

The study area provides opportunities for a variety of outdoor-oriented recreational activities. Consumptive activities include hunting and fishing. Both fresh and saltwater sport fishing are popular in the area, as well as sport shrimping and sport crabbing. Nonconsumptive recreational activities in the area include boating, camping, picnicking, and various forms of wildlife-oriented recreation. The bottomland hardwoods, wooded swamps, marshes, and associated estuarine water bodies are heavily utilized by hunters and fishermen. The study area supports a total of 1,065,390 man-days per year of use, 414,710 man-days of hunting, and 650,680 man-days of sportfishing. These activities are valued at $6,586,516 per year, $3,918,728 for hunting, and $2,667,788 for fishing. Within the market area, the demand for sport hunting presently exceeds supply by 2,595,530

man-days. A total of 162 boat launch lanes exist in the area. Present fishing facility needs indicate that 1,050 additional lanes are required in order to satisfy current demand levels for the market area. More information on recreational resources is located in Appendix A and in all of Appendix G, Recreation.

5.2.14. STATE WILDLIFE MANAGEMENT AREAS AND NATIONAL PARKS

5.1.14.1. The 33,000-acre Bohemia Wildlife Management Area (WMA) is located near the town of Bohemia in Plaquemines Parish. The area is owned and leased by the Orleans Levee Board. Habitats are quite diverse ranging from forested ridges along the Mississippi River grading to lower saline marshes eastward. Deer populations are considered excellent. Waterfowl concentrations are good with habitat suitable for both dabbling and diving ducks available. Fox squirrel hunting occurs along the ridges characterized by oaks, sweet pecans, sycamores, and hackberry. Rails and snipe are available in the marshes. Fur species including nutria, muskrat, mink, raccoon, and opossum may be trapped, provided the proper permits are obtained. Other forms of recreation include fishing, crabbing, shrimping, boating, camping, and birdwatching. Camping is available on designated campgrounds.

5.2.14.2. The 31,000-acre Salvador WMA is located along the northwest shore of Lake Salvador in St. Charles Parish. The area consists primarily of fresh marsh providing ideal conditions for production of waterfowl food plants. Several large stands of cypress trees occur along the northern edge of the area. Wildlife species in this area include deer, rabbit, squirrel, rails, and waterfowl. Most hunting emphasis is placed on waterfowl. Excellent freshwater fishing is available as well.

5.2.14.3. The 21,621-acre Wisner WMA is located in the southeast portion of Lafourche Parish between Leeville and Grand Isle. The area is owned by the Wisner Donation Foundation and consists primarily of saline marsh with a net-work of bayous, ditches, and lagoons. Rabbit hunting is considered excellent in the area. Dove hunting is good along the beach area. Duck, rail, and snipe hunting in the area is fair. Fishing, crabbing, shrimping, boating, birdwatching, skiing, and swimming are also popular activities. No campgrounds are available.

5.2.14.4. The 8,600-acre Jean Lafitte National Park is located just south of heavily developed areas in Jefferson Parish in the Barataria Basin. The area consists primarily of swamp, marsh, and bayou country. Directly north of the park is a "park protection zone" of about 11,400 acres to help preserve the area's drainage pattern, vegetative cover, ecological and biological systems integrity, and water and air quality. The area has a major passive recreational potential for the people of Jefferson Parish.

5.2.15. MINERALS

The mineral resources in the area consist mainly of petroleum resources, scattered resources of aggregate deposits, and of deep-seated salt domes producing salt and sulphur in addition to the associated petroleum. Petroleum represented 96 percent of the mineral production in Louisiana in 1975. Petroleum resources are abundant throughout the study area. Many fields and scattered wells exist up and down the river. Salt domes producing salt, sulphur, and petroleum products are common in the northern and southern reaches of the area. The domes in the area are deep-seated making shaft or pitmining of them uneconomical. Sulphur, where it exists in commercial quantities, is produced by the Frasch method. Sand and gravel deposits are almost nonexistent in the Deltaic deposits of the Mississippi River below Baton Rouge. Numerous submarine pipelines and submarine cables are located

within the area. The vast majority of the pipelines transport oil and natural gas. Additional information on mineral resources is located in Appendix A.

5.2.16. MISSISSIPPI RIVER

The Mississippi River is of obvious significance to the study area. The area owes its existence to the delta building activities of the lower Mississippi River over the past 5,000 years. The river is an important navigational route and essential source of municipal and industrial water supply. The Mississippi River is a critical link between 12,000 miles of inland navigable waterways and the rest of the world. Waterborne commerce of the Mississippi River between Baton Rouge, Louisiana, and the Gulf of Mexico has increased from about 30 million tons in 1940 to about 402 million tons in 1981. New Orleans is the largest port in the United States, the second largest port in the world, and the world's largest grain port. Baton Rouge is the fourth largest port in the United States. Additional information concerning the Mississippi River can be found in Appendix A.

5.2.17. WATER QUALITY

5.2.17.1. Current uses of study area waters include flushing and dilution of wastewater discharges; propagation of aquatic animals, fish, and shellfish; and primary and secondary contact recreation. In 1981, an estimated 270 million gallons per day (MGD) were used for municipal water supply and 9,100 MGD were used for industrial and thermal electric purposes. Populations of cities and towns near the river and industrial development along its banks have increased greatly in recent years, with attendant increases in the quantity of wastewater discharges. Fecal coliform bacteria, which may suggest the presence of other human pathogenic bacteria and viruses, often reach high levels in the Mississippi River within the study area. Discharge of contaminated

river waters through spillways, locks, and existing diversion structures has led to closure of oyster fishing grounds by public health authorities. Such closures usually occur when the fecal coliform median most probable number (MPN) exceeds 14/100 mL, with more than 10 percent of the samples exceeding a MPN of 43/100 mL. Fecal coliform bacterial levels are expected to decline significantly in the future as secondary and tertiary sewage treatment plants planned or under construction come into operation. In addition to high levels of fecal coliforms, the Mississippi River often contains high levels of heavy metals, phenols, pesticides, polychlorinated biphenyls, and other compounds. It should be noted that even though the Mississippi River does not have the most environmentally desirable water quality, it is the only freshwater source of sufficient magnitude to accomplish project purposes.

5.2.17.2. The Barataria Basin can be characterized as two relatively distinct aquatic systems with predominately fresh waters in the basin north of the GIWW and brackish to saline waters to the south. The basin headwaters consist of numerous sluggish freshwater bayous and natural and man-made canals draining away from the Mississippi River levee and the urbanized ridges along Bayou Lafourche toward low-lying swamps and marshes. Characteristically, these streams are nutrient rich, have chronically low dissolved oxygen (DO) levels, high dissolved solids due to discharges of storm runoff and municipal and industrial wastewaters. Principal drainage is to several shallow lakes which are buffered by freshwater swamps. Lac des Allemands is the most northerly situated of the lakes. It has approximately 24 square miles of surface area, is shallow throughout, averaging about 5 feet deep, and is drained principally to the southeast by Bayou des Allemands into Lake Salvador. Lakes Salvador and Cataouatche are, for all practical purposes, one body of water being separated only by Couba Island. The combined surface area of these two lakes is about 85 square miles. Both lakes are shallow, averaging about 5 feet. Problems associated with low

DO are considerably less severe in these lakes than in the basin headwaters, but conditions are far from ideal. High concentrations of chlorides and sulfates are major problems, probably as a result of brines lost to these waters from oil and gas exploration activities, drainage from the urbanized ridges, and saltwater intrusion from the Gulf of Mexico during high tides. Lakes des Allemands and Cataouatche have been characterized as being hypereutrophic (highly nutrient enriched) due to high nitrogen and phosphorus loadings from inflows of urban stormwater and treated or partially treated municipal and industrial wastewaters. Relatively frequent algal blooms and fish kills have been reported. Principal drainage routes from Lake Salvador include Bayous Perot and Barataria. The GIWW traverses the Barataria Basin just south of Lake Salvador. It is connected to the Mississippi River to the east by the Algiers and Harvey locks. A significant amount of fresh water may enter the basin through these locks since both the Mississippi River and Bayou Lafourche have higher water surface elevations than the GIWW. In the basin south of the GIWW, surface waters grade from brackish adjacent to the GIWW to saline in the gulf. These waters are characteristically high in DO and are generally of good quality in other respects. Dominant waterbodies in this area include Little Lake, Barataria Bay Waterway, and Caminada Bay.

5.2.17.3. Surface waters of significance in the estuarine areas east of the Mississippi River include Lake Lery and Bayou Terre aux Boeufs. Lake Lery is drained primarily by Bayou Terre aux Boeufs located at the lake's southeast corner, then through numerous connecting man-made canals and small natural bayous to Breton Sound. This estuarine area is of primary importance to the state's shellfish industry. Water quality problems in this area are centered about high fecal coliform densities due to urban runoff and introduction of river waters during high stages. More information on water quality may be found in Appendix A and in all of Appendix H, Water Quality.

5.2.18. NATURAL AND SCENIC STREAMS SYSTEM

The Louisiana Natural and Scenic Streams System was established for the purposes of preserving, protecting, developing, reclaiming, and enhancing the wilderness qualities, scenic beauties, and ecological regimen of certain freeflowing rivers or segments thereof. Within the study area, Bayou des Allemands, in the Barataria Basin, is part of this system.

5.2.19. NATIONAL REGISTER PROPERTIES

5.2.19.1 The National Register of Historic Places, as published in the "Federal Register" dated 6 February 1979 and annual and weekly supplements through 30 November 1982, has been consulted to identify National Register and Register-eligible properties in the study area. In addition, the Louisiana State Historic Preservation Officer was consulted for information on historic properties pending nomination to the National Register. Within the boundaries of the study area, 10 properties are listed on the Register, 5 properties have been determined eligible for inclusion, 1 property has been nominated to the Register and 10 properties are pending nomination to the Register at the state level. However, most of these properties are located on the Mississippi River's natural levee, and therefore, would not be affected by the proposed project. Two of the National Register properties, Fort Livingston and Bayou Des Coquilles archeological site, are located in the project-affected area. Fort Livingston, which was listed in the National Register in 1974, is an early 19th century fortification constructed of cemented shell faced with brick and trimmed with granite. Located at Barataria Pass on the western tip of Grand Terre Island, Fort Livingston's architectural significance is comparable to all other American coastal forts of its era. The Bayou Des Coquilles archeological site (16Je37) was determined eligible for the National Register in 1981 and is located along Bayou Des Familles. According to

Beavers (1977), the site might have served as the primary village location for related special-activities sites. This significant archeological site is located in the Barataria Marsh unit of the Jean Lafitte National Historical Park, Louisiana.

5.2.19.2. In addition to these properties, the cultural resources survey of the selected plan, which will be conducted during the next stage of project planning, might locate additional cultural resources eligible for inclusion in the National Register.

5.2.20. ARCHEOLOGICAL RESOURCES

Over 230 archeological sites are recorded in the study area. These sites include both prehistoric and historic cultural remains. The most common types of prehistoric site in the study area are earth and shell middens, although mound sites are also represented. Historical archeological resources in the area include early settlements and the remains of historic utilization of Barataria Basin and Breton Sound. Known site locations are largely a function of where cultural resource surveys have been undertaken and, therefore, the recorded resource base represents an incomplete sample of the resources expected to exist in the study area.

6. ENVIRONMENTAL EFFECTS

6.1. GENERAL

6.1.1. This section describes the effects of the 16 plans described in Section 4.3 on each significant resource described in Section 5. Total habitat acreages impacted by direct construction of the various diversion routes for all 16 plans are presented in Table 4-3-1. Additional detailed information concerning all 16 plans can be found in the Main Report, Appendix B, Plan Formulation, and Appendix C, Engineering Investigations.

6.1.2. This section supplements table 4-4 "Comparative Impacts of Alternatives" on page EIS 23, with a more detailed description of the impacts noted in that table.

6.2. MARSHES

6.2.1. Plans 1-5

6.2.1.1. Plans 1-5 would adversely impact totals of from 146 to 222 acres of marsh. At the Bayou Lasseigne site, 40 to 67 acres would be lost to channel and 65 to 110 acres to levee/disposal area. With the Bayou Fortier site, 15 to 49 acres would be lost to channel and 25 to 81 acres to levee/disposal area. Sixteen acres of intermediate marsh would be lost in the Breton Sound Basin due to construction at Big Mar. Seven acres would be lost to channel and nine acres to levee/disposal areas.

6.2.1.2. With any of these plans, maximum reductions in rates of marsh loss would occur. These reductions would be due primarily to retarding saltwater intrusion, but some benefits would be accrued due to increased nutrients and sediments that would be introduced into the basins. Marsh

benefits would be greatest with these plans because all of the required flow (10,650 cfs) to the Barataria Basin would be diverted through the upper sites (Bayou Lasseigne and Bayou Fortier) and would pass through the Upper Basin, benefitting large areas of fresh/intermediate marsh.

6.2.1.3. Based on information presented in Appendix D, Section 4 with implementation of any of these plans, it is projected that the study area would contain a total of 99,162 acres, or 155 square miles, more marsh in year 2035 than under the without project condition.

6.2.1.4. Barataria Basin would experience substantial savings in fresh/ intermediate marsh. With these plans, there would be 59,579 more acres of this marsh type in 2035 than under the without project condition. A total of 12,998 more acres of brackish marsh and 10,113 more acres saline marsh would occur in the Barataria Basin in the year 2035. Average annual marsh savings in this basin would be 1,654 acres.

6.2.1.5. The Breton Sound Basin would experience significant gains in fresh/intermediate marsh and losses in brackish and saline marsh acreages due to seaward shifts in the isohalines. There would be 63,938 acres or fresh/ intermediate marsh compared to only 2,555 acres under the without project condition, a difference of 61,383 acres. Brackish marsh acreage would be 27,815 acres less in 2035 due to conversion of this marsh type to fresh/ intermediate marsh. It is projected that saline marsh would be eliminated in the Breton Sound Basin due to the seaward shift in isohalines and conversion of this marsh type to brackish marsh. Thus, total marsh saved in the Breton Sound Basin would be 16,472 acres, an average annual savings of 329 acres.

6.2.1.6. Detailed analyses of marsh acreages impacted by construction of various diversion routes can be found in Appendix D, Natural Resources, Section 3. Methodologies for estimating with and without

project acreages in the Barataria and Breton Sound Basins can be found in Appendix D, Section 4. Included are tables demonstrating the acreages of each marsh type over the life of the project.

6.2.2. Plans 6-10

6.2.2.1. Plans 6-10 would adversely impact totals of from 163 to 233 acres of marsh. At the Bayou Lasseigne site, 40 to 59 acres would be lost to channel and 65 to 95 acres to levee/disposal areas. With the Bayou Fortier site, 15 to 34 acres would be lost to channel and 25 to 55 acres to levee/disposal areas. With the Oakville site, 25 to 37 acres would be lost to channel and 33 to 48 acres to levee/disposal area. Sixteen acres of intermediate marsh would be lost in due to construction at Big Mar. Seven acres would be lost to channel and nine acres to levee/disposal areas.

6.2.2.2. With any of these plans, reductions in rates of marsh loss similar to those discussed in paragraph 6.2.1.3. would occur. However, total marsh benefits would not be as great as with Plans 1-5. Marsh benefits would be the same in the Breton Sound Basin, but less in the Barataria Basin. The volume of flow diverted at the Oakville site would not pass through as much of the Upper Basin as with Plans 1-5 and that portion of the benefits due to increased nutrients, sediments, and flushing action would not occur.

6.2.3. Plans 11-15

6.2.3.1. Plans 11-15 would adversely impact totals of from 301 to 377 acres of marsh. The impacts on fresh marsh due to construction of the Bayou Lasseigne and Bayou Fortier sites would be the same as Plans 6-10. With the Myrtle Grove site, approximately 90 acres would be lost to channel and 119 acres to levee/ disposal areas. Sixteen acres of

intermediate marsh would be lost due to construction at Big Mar. Seven acres would be lost to channel and nine acres to levee/disposal areas.

6.2.3.2. With any of these plans, reductions in rates of marsh loss similar to those discussed in paragraph 6.2.1.3. would occur. However, total marsh benefits would not be as great as with Plans 1-5 or 6-10. Marsh benefits would be the same in the Breton Sound Basin, but less in the Barataria Basin. The volume of flow diverted at the Myrtle Grove site would not flow through any of the upper basin and that portion of benefits due to increased nutrients, sediments, and flushing action would not occur.

6.2.4. Plan 16

6.2.4.1. Plan 16 would adversely impact 109 acres of marsh. Ninety three acres of fresh marsh would be lost due to construction of the Davis Pond site in the Barataria Basin. Sixteen acres of intermediate marsh would be lost due to construction at Big Mar. Seven acres would be lost to channel and nine acres to levee/disposal areas.

6.2.4.2. With Plan 16, 175 acres of fresh marsh would be created by filling shallow open water areas with dredged material during construction of the Davis Pond site in the Barataria Basin. Therefore, although 93 acres of fresh marsh would be lost in the construction right-of-way, there would be a net gain of 82 acres of fresh marsh during construction. In addition, it is possible that some small areas of marsh could be created by using dredged material excavated during maintenance of the lower portion of the conveyance channel.

6.2.4.3. With Plan 16, diversion would still be from the upper part of the Barataria Basin. As with Plans 1-5, maximum reductions in rates of marsh loss would occur. Marsh benefits would be the same in the Breton

Sound Basin as with any of Plans 1-5 because the Big Mar site is an identical component of all 16 plans. Details on acreages of the various marsh types which would be saved by Plan 16 are discussed in Section 6.2.1., which covers Plans 1-5.

6.2.4.4. The potential effects of ponding on marsh in the 7,425-acre overflow area warrants discussion at this point. It is difficult to concretely predict what the long-term impacts would be because of the wide array of diversion scenarios possible (see para. 6.4.4.2.). In addition, the assumption that water would be ponded over the entire area is somewhat oversimplistic. In actuality, a deltaic splay of unknown configuration would be created adjacent to the diversion outfall. The areal extent and thickness of the delta is discussed in paragraph 6.4.4.2. Portions of this delta would be populated by marsh vegetation and would offset the dramatic marsh loss presently occurring in this area. The manager of the Salvador WMA for the past 14 years has observed dramatic marsh loss in this area, as well as significant changes in species composition of the vegetation. Amercian lotus, a species of relatively little value to wildlife, has become extremely abundant in the past few years in the shallow open-water bodies which were formerly marsh. Beggarticks, which are harmful to furbearers and outcompete more desirable species, are also increasing in abundance. Overall, the change in species composition in the area has been toward less desirable species. Both the manager of the Salvador WMA and the Chief of Refuges for the Louisiana Department of Wildlife and Fisheries believe the proposed diversion would have a pronounced positive impact on the area's marshes. The Mississippi River water which would flow through the area is high in dissolved oxygen. The diversion would create a lotic situation and stagnation should not create a problem. Although it has not been determined who would be responsible for operation of the weirs at the lower end of the overflow area, it is highly probable that the Department of Wildlife and Fisheries would have

a strong voice in controlling water levels in the WMA. Personnel of the Department have indicated that the area would be managed to achieve overall marsh benefits. Even in years of design diversion, the water could be drawn down by June, allowing ample time for regeneration of many marsh species. It is possible that sedimentation could adversely affect some of the bulltongue marshes located just north of Lake Cataouatche; however, ponding of water over these areas for the durations previously described should not adversely impact these marshes.

6.3. BOTTOMLAND HARDWOOD FOREST

6.3.1. Plans 1-5

6.3.1.1. Plans 1-5 would adversely impact from 22 to 161 acres of bottomland hardwood forest due to construction of the diversion routes. The Bayou Lasseigne site would not impact this habitat type. With the Bayou Fortier site in the Barataria Basin, 32 to 53 acres would be lost to channel and 51 to 86 acres to levee/disposal areas. Twenty-two acres would be impacted by the Big Mar site. Nine acres would be lost to channel and 13 acres to levee/disposal areas.

6.3.1.2. These plans would not directly benefit bottomland hardwood forests. Therefore, acreages for this habitat type are the same for all plans in any given year over project life. Acreage of bottomland hardwoods in the study area would decline from 52,949 to 25,849 acres over project life due primarily to clearing for agricultural, industrial, and urban development. In the Barataria Basin, acreage of bottomland hardwood forest would decline from 43,470 to 21,844 acres. In the Breton Sound Basin, this habitat type would decline from 9,479 to 4,005 acres. Detailed analyses of bottomland hardwood forest acreages impacted by construction of various diversion routes can be found in

Appendix D, Section 3. The methodology used for estimating remaining acreages in the Barataria and Breton Sound Basins can be found in Appendix D, Section 4.

6.3.2. Plans 6-10

6.3.2.1. Plans 6-10 would adversely impact from 31 to 142 acres of bottomland hardwood forest due to construction of the diversion routes. With the Bayou Fortier site in the Barataria Basin, 32 to 42 acres would be lost to channel and 51 to 69 acres to levee/disposal areas. With the Oakville site 3 to 5 acres would be lost to channel and 6 to 8 acres to levee/disposal areas. The Bayou Lasseigne site would not impact any bottomland hardwoods. Impacts to bottomland hardwoods due to construction of the Big Mar site are the same as Plans 1-5.

6.3.2.2. These plans would not directly benefit bottomland hardwood forests. See the discussion presented for Plans 1-5 in 6.3.1.2.

6.3.3. Plans 11-15

6.3.3.1. Plans 11-15 would adversely impact from 38 to 149 acres of bottomland hardwood forest due to construction of the diversion routes. Impacts due to construction of the Bayou Fortier site would be the same as Plans 6-10. With the Myrtle Grove site, 7 to 9 acres would be lost to structure and channel and 9 to 11 acres to levee and disposal areas. The Bayou Lasseigne site would not impact any bottomland hardwoods. Impacts to bottomland hardwoods due to construction of the Big Mar site are the same as Plans 1-5.

6.3.3.2. These plans would not directly benefit bottomland hardwood forests. See the discussion presented for Plans 1-5 in 6.3.1.2.

6.3.4. Plan 16

6.3.4.1. Plan 16 would adversely impact 122 acres of bottomland hardwood forest due to construction of the diversion routes. The Davis Pond site would impact 100 acres of this habitat type. Twenty-two acres would be impacted by the Big Mar site.

6.3.4.2. This plan would not directly benefit bottomland hardwood forests. Refer to the discussion in Section 6.3.1.2. for details on the fate of this habitat type in the overall study area.

6.4. WOODED SWAMP

6.4.1. Plans 1-5

6.4.1.1. Plans 1-5 would adversely impact from 318 to 516 acres of wooded swamp due to construction of the diversion routes. With the Bayou Lasseigne site, 88 to 148 acres would be lost to channel and 148 to 241 acres to levee/disposal areas. With the Bayou Fortier site, 63 to 119 acres would be lost to channel and 104 to 193 acres to levee/disposal areas. The Big Mar site would impact only 6 acres of this habitat type.

6.4.1.2. No direct benefits have been quantified for this habitat type due to implementation of any of these plans. However, it is likely that freshwater diversions would help to preserve and rejuvenate existing cypress-tupelo swamps that are currently stressed or suffering mortalities due to saltwater intrusion. These benefits notwithstanding, it is projected that the acreage of wooded swamp in the study area would decline from 170,780 to 85,723 acres over project life due to drainage for alternative uses. In the Barataria Basin, acreage of wooded swamp

would decline from 169,774 to 85,298 acres. In the Breton Sound Basin, this habitat type would decline from 1,006 to only 425 acres. Detailed analyses of wooded swamp acreages impacted by construction of the various diversion routes can be found in Appendix D, Section 3. The methodology used for estimating remaining acreages in the Barataria and Breton Sound Basins can be found in Appendix D, Section 4.

6.4.2. Plans 6-10

6.4.2.1. Plans 6-10 would adversely impact from 282 to 444 acres of wooded swamp due to construction of the diversion routes. With the Bayou Lasseigne site, 88 to 128 acres would be lost to channel and 144 to 210 acres to levee/disposal areas. With the Bayou Fortier site, 63 to 93 acres would be lost to channel and 104 to 153 acres to levee/disposal areas. With the Oakville site, 17 to 24 acres would be lost to channel and 22 to 31 acres to levee/disposal areas. Impacts due to the Big Mar site are the same as Plans 1-5.

6.4.2.2. No direct benefits have been quantified for this habitat type due to implementation of any of these plans. See the discussion presented for Plans 1-5 in 6.4.1.2.

6.4.3. Plans 11-15

6.4.3.1. Plans 11-15 would adversely impact from 227 to 405 acres of wooded swamp due to construction of the diversion routes. Impacts to wooded swamp due to construction of the Bayou Lasseigne and Bayou Fortier sites would be the same as for Plans 6-10. This habitat type would not be impacted by the Myrtle Grove site. Impacts due to the Big Mar site are the same as Plans 1-5.

6.4.3.2. No direct benefits have been quantified for this habitat type due to implementation of any of these plans. See the discussion presented for Plans 1-5 in 6.4.1.2.

6.4.4. Plan 16

6.4.4.1. Plan 16 would adversely impact 118 acres of wooded swamp due to construction of the diversion routes. The Davis Pond site would impact 112 acres of this habitat type and the Big Mar site would impact 6 acres. In addition to impacts in the direct construction rights-of-way, implementation of this plan could possibly impact approximately 415 acres of wooded swamps located immediately west of the road to Willowdale subdivision (See Main Report, Plate 9). This area could be drained by operation of the pump that would be installed to restore the integrity of the drainage interrupted by project implementation. The pumping capacity of this pump, combined with the more efficient drainage ditches, could drain this wetland area. Whether or not this occurs would be dependent on those responsible for operation of the pump. Any intentional draining of this area by anyone would be subject to applicable Federal and state permitting activities.

6.4.4.2. Sedimentation and ponding could impact the wooded wetlands within the impounded overflow area. Before addressing the potential impacts, it is necessary to provide an overview of the array of diversion scenarios which could occur. The project is designed to maintain the optimal salinity regime in the Barataria Basin for the driest year which would occur in an average ten year rainfall cycle. During this year, up to 10,650 cfs would be diverted from January through May, with an average flow of 7,500 cfs. Three years out of ten, no diversion would be necessary at all, as rainfall in the area would be sufficient. During the remaining six years, an average of 4,500 cfs would be diverted into the area. It is estimated that a 4 square mile

delta ranging in depth from 1 to 4 feet would develop where the outflow channel enters the overflow area. This marsh is rapidly deteriorating into open water and delta formation would offset marsh loss. The delta would be formed by deposition of sand and heavy silts. During diversions, the predominant flow would be in a southerly direction toward Lake Cataouatche. Some of the finer sediments would be deposited in the lower end of the overflow area or pass through the weirs into Lake Cataouatche. It is not anticipated that significant sediments would be deposited in the wooded wetlands to the west of the diversion channel. These areas are of higher elevation and due to this gradient it is unlikely that sediments would accumulate. Most of the dominant tree species in the area can tolerate greater siltation depths than would occur due to project implementation without experiencing significant mortality.

6.4.4.3. During diversion, water would be ponded to an average depth of 2 feet in the overflow area, with water being deeper over the lower marsh areas and shallow or absent of the higher portions of the ridges. Duration of the ponding would vary depending on the diversion scenarios described in the preceeding paragraph. The ponding could adversely impact certain trees and shrubs, particularly some of those located on the ridges. Many of the trees and shrubs in the area, particularly those in the swamps between the ridges and on the lower portions of the rapidly subsiding ridges, would not suffer significant adverse impacts. According to Klimas et al. (1981) swamp and low-ridge species such as water hickory, pecan, buttonbush, swamp privet, green ash, water locust, deciduous holly, tupelogum, water elm, overcup oak, Nuttall oak, black willow, and baldcypress are very tolerant and can survive deep prolonged flooding for more than one year. Species which grow on low ridges such as red maple, hackberry, persimmon, and sweetgum are described as tolerant and are able to survive flooding for one growing season. Other species found an the higher ridges in the area,

such as honey locust, willow oak, live oak, and American elm are only somewhat tolerant, being able to survive flooding for about 30 consecutive days. These would be adversely impacted in certain areas.

6.4.4.4. In order to bring certain issues into proper perspective, it is necessary to point out some pertinent facts about the area. The entire area north of Lake Cataouatche is rapidly deteriorating. Subsidence is a major factor, and there is also evidence of saltwater intrusion. Observation of aerial photographs and USGS 1:24,000 quadrangle maps show dramatic increases in open water areas. Analysis of data from Wicker (1980) shows significant changes in the Lake Cataouatche area, with conversion of palustrine open water to estuarine open water and conversion of fresh marsh to intermediate marsh. In addition, large portions of the ridges which are present in the area have subsided and are flooded much of the time. The refuge manager for the Salvador Wildlife Management Area has worked in the area for 14 years and has noted the dramatic changes in the ridges and wooded areas. The trend will continue if nothing is done to ameliorate the problems. It should be also the pointed out that diversion of river water would improve dissolved oxygen levels and flushing action in certain areas. Although it is acknowledged the project implementation would cause certain adverse impacts, it is felt that benefits would far outweigh these impacts, both in the immediate overflow area, as well as the entire Barataria Basin. In light of the fact that the sole purpose of this project is environmental enhancement, these impacts must be weighed accordingly.

6.4.4.5. As with Plans 1-15, direct benefits have not been quantified for this habitat type. However, it is likely that freshwater diversions would help to preserve and rejuvenate existing cypress-tupelo swamps in

the upper basins. Plan 16 would be particularly beneficial to the wooded swamps in the Salvador WMA which is presently deteriorating at a rapid rate.

6.5 AGRICULTURAL LANDS

6.5.1. Plans 1-5

6.5.1.1. Plans 1-5 would impact a total of 82 to 123 acres of agricultural land, including both pasture and sugarcane, due to construction of the diversion routes. With the Bayou Lasseigne site, 21 to 32 acres would be lost to structure and channel and 35 to 53 acres to levee/disposal areas. The Big Mar site would not impact any agricultural lands.

6.5.1.2. These plans would impact from 68 to 106 acres of sugarcane fields. Sugarcane is classified as unique farmland. The Bayou Lasseigne site would impact from 45 to 68 acres and the Bayou Fortier site would impact from 46 to 75 acres of sugarcane. The portion of the diversion route passing through agricultural lands for the Bayou Lasseigne site passes primarily through soils classified as either the Commerce-Convent Association or the Sharkey Association. These areas are generally classified as prime farmlands. The Bayou Fortier site passes primarily through the Commerce-Convent Association and agricultural areas within its diversion route would also be classified as prime. Certain areas within the various diversion routes which are presently either bottomland hardwoods or wooded swamp are in areas with soil types classified as prime farmland. These areas were not quantified in this study.

6.5.2. Plans 6-10

6.5.2.1. Plans 6-10 would impact a total of 60 to 107 acres of agricultural land, including both pasture and sugarcane, due to construction of the diversion routes. With the Bayou Lasseigne site, 21 to 32 acres would be lost to structure and channel and 35 to 53 acres to levee/disposal areas. With the Bayou Fortier site, 19 to 31 acres would be lost to structure and channel and 32 to 51 acres to levee/disposal areas. The Oakville and Big Mar sites would not impact any agricultural lands.

6.5.2.2. These plans would impact from 50 to 91 acres of sugarcane fields. Sugarcane is classified as unique farmland. The Bayou Lasseigne site would impact from 45 to 57 acres and the Bayou Fortier site would impact from 46 to 61 acres of sugarcane. The agricultural lands within the diversion routes for the Bayou Lasseigne and Bayou Fortier sites are classified as prime farmlands. See the discussion presented for Plans 1-5 in 6.5.1.2.

6.5.3. Plans 11-15

6.5.3.1. Plans 11-15 would adversely impact 84 to 126 acres of agricultural land, including both pasture and sugarcane, due to construction of the diversion routes. Impacts to agricultural land due to construction of the Bayou Lasseigne and Bayou Fortier sites would be the same as Plans 6-10. With the Myrtle Grove site, 8 to 10 acres would be lost to structure and channel and 11 to 14 acres to levee/disposal areas. The Big Mar site would not impact any agricultural lands.

6.5.3.2. These plans would impact the same acreage of sugarcane and, therefore, the same acreage of unique farmlands as Plans 6-10. The

diversion routes for these plans would also pass through prime farmlands. See the discussion presented for Plans 1-5 in 6.5.1.2.

6.5.4. Plan 16

6.5.4.1. Plan 16 would impact a total of 36 acres of agricultural land due to construction of diversion route for the Davis Pond site. The Big Mar site would not impact any agricultural lands. Field inspection indicated that the 36 acres is probably used for pasture in some years and row crops in others. The area would be converted to levee and channel.

6.5.4.2. Due to the location and soil type of these 36 acres, they are classified as prime farmland. However, these 36 acres have been designated for industrial use by St. Charles Parish and as such are not considered prime farmland under the Farmland Protection Policy Act which became effective on August 6, 1984.

6.6. WATER BODIES

6.6.1. Plans 1-5

6.6.1.1. Plans 1-5 would impact from 72 to 187 acres of water bodies due to construction of the diversion routes. The Bayou Lasseigne site would impact only 1 to 2 acres of borrow pits. With the Bayou Fortier site, 38 to 44 acres would be converted to channel and 63 to 73 acres to levee/disposal areas. Water bodies affected include portions of two lakes, the Mississippi River, and Bayou Fortier. The Big Mar site would impact approximately 70 acres of Big Mar. Approximately 29 acres would become part of the channel and 41 acres converted to levee and disposal areas. Additional information on impacts on water bodies due to construction of the diversion routes can be found in Appendix I, Section 404(b)(1) Evaluation.

6.6.1.2. These plans would impact approximately 648,000 and 334,000 acres of receiving water bodies in the Barataria and Breton Sound Basins, respectively. The primary impacts would be alteration of salinity regimes. Inland water bodies would become fresher as the isohalines are shifted seaward. In the receiving water bodies, sedimentation in the form of a delta is expected. In Lac des Allemands, the delta could cover about 3 square miles of lake bottom 3 feet thick during the 50 year project life. This would impact about 12 percent of the lake bottom. In Big Mar, the sediment could cover the entire lake bottom to a depth of 2 1/4 feet deep during the project life. Additional discussions concerning impacts to water quality in the receiving water bodies are presented in Section 6.17. of this EIS and Appendix H, Water Quality.

6.6.2. Plans 6-10

6.6.2.1. Plans 6-10 would impact from 154 to 266 acres of water bodies due to construction of the diversion routes. Water bodies impacted by the Lasseigne site would be the same as with Plans 1-5. The Bayou Fortier site would impact from 101 to 109 acres of water bodies (38 to 41 acres converted to channel and 63 to 68 acres to levee/disposal areas). Water bodies affected are the same as with Plans 1-5. The Oakville site would impact 82 to 91 acres of water bodies (35 to 39 acres converted to channel and 47 to 52 acres to levee/disposal areas). Water bodies affected by the Oakville site include Bayou Concession and the Intracoastal Waterway. Impacts on water bodies at the Big Mar site would be the same as Plans 1-5.

6.6.2.2. These plans would impact approximately 648,000 and 334,000 acres of receiving water bodies in the Barataria and Breton Sound Basins, respectively. Impacts to these water bodies would be the same as discussed for Plans 1-5.

6.6.3. Plans 11-15

6.6.3.1. Plans 11-15 would impact from 287 to 391 acres of water bodies due to construction of the diversion routes. Impacts due to construction of the Bayou Lasseigne and Bayou Fortier sites would be the same as for Plans 6-10. The Myrtle Grove site would impact 216 acres of water bodies. Ninety-three acres would be converted to channel and 123 acres converted to levee and disposal areas. Water bodies affected by the Myrtle Grove site include Wilkinson Canal, Bayou McCutchen, and estuarine open water. Impacts on water bodies at the Big Mar site would be the same as Plans 1-5.

6.6.3.2. These plans would impact approximately the same acreage of receiving water bodies as Plans 6-10. Impacts to these water bodies would be the same as discussed for Plans 1-5.

6.6.4. Plan 16

6.6.4.1. Plan 16 would impact 285 acres of water bodies due to construction of the diversion routes. The Davis Pond site would impact 43 acres of water bodies. Water bodies impacted include portions of Bayou Verret, the borrow pits along highway 90 and adjacent to the Mississippi River and shallow open water in fresh marsh. The Big Mar site would impact approximately 70 acres of Big Mar.

6.6.4.2. This plan would impact approximately 648,000 and 334,000 acres of receiving water bodies in the Barataria and Breton Sound Basins, respectively. Impacts to these water bodies would be the same as discussed for Plans 1-5.

6.7. BARRIER ISLANDS

6.7.1. Plans 1-5

Plans 1-5 would not significantly impact the Chandeleur Islands which form the gulfward boundary of Chandeleur and Breton Sounds or the Grande Isle-Grande Terre Island complex located along the southern edge of Barataria Bay. The islands are too far removed from the diversion sites to be directly impacted.

6.7.2. Plans 6-10

Same as Plans 1-5.

6.7.3. Plans 11-15

Same as Plans 1-5.

6.7.4. Plan 16

Same as Plans 1-5.

6.8 FISHERIES

6.8.1. Plans 1-5

6.8.1.1. Plans 1-5 would impact from 72 to 187 acres of water bodies due to direct construction of the diversion routes. The impacts on these water bodies during construction would also impact fisheries. In areas where dredging is performed in existing water bodies, benthic populations would be destroyed. However, in that portion of the area that would become diversion channel, some repopulation of benthos by

adult migration and larval recruitment should occur, as the areas would not be separated from adjacent areas with similar benthic communities. The extent of repopulation would depend on the frequency and magnitude of diversions and the nature of the sediments in the channel. In that portion of existing water bodies converted to levee/disposal areas, dredged material would be deposited several feet deep. Benthic losses, especially to more sessile organisms, would be almost total. Mobile, epibenthic organisms would tend to avoid these areas. Effects of turbidity and sediment deposition adjacent to levee/disposal areas would be localized and of short duration. Suspended particles may clog gills and feeding apparatuses in some instances. Phytoplankton and aquatic plants would be displaced or destroyed at designated disposal sites. Phytoplankton production adjacent to construction areas would be temporarily affected due to decreased light penetration. Impacts to aquatic organisms due to the maintenance activities described in Section 4 would be generally similar, but would be more localized and of a lesser magnitude. Additional information on impacts due to construction can be found in Appendix I, Section 404(b)(1) Evaluation.

6.8.1.2. These plans would provide maximum benefits to fishery resources due to reductions in rates of marsh loss and saltwater intrusion, increased nutrients, and maintenance of more favorable salinity regimens. It is the general consensus of fishery experts that fishery production is related to wetland acreage. Studies point to marsh as being an ecological limiting factor and a declining marsh area is occurring within the study area. Marsh loss and saltwater intrusion have had an adverse impact on fishery resources production and seriously threaten the Louisiana fishery resource. In coastal Louisiana, the majority of commercially and recreationally important finfish and shellfish species are estuarine-dependent with juveniles using the estuaries and adjacent wetlands as nursery areas. Louisiana's commercial fishery harvest represents over 25 percent of the total

United States harvest every year. In 1980, approximately 1.4 billion pounds, valued at $178 million, were landed. In addition, estimates are that recreational fishing in Louisiana contributes $150 million annually to the state economy (Aquanotes, 1981). Historically, Louisiana's most valuable commercial fisheries have revolved around shrimp, menhaden, and oysters. These species, as well as the majority of other finfish and shellfish species of importance in Louisiana, depend heavily on estuarine ecosystems. The U.S. Environmental Protection Agency (1971) stated that "it is currently assumed that none of the major commercial species would continue to exist in commercial quantities if estuaries were not available for development." Average annual harvests have not declined in recent years, primarily because of improved technology and increased fishing effort. These factors have compensated for declines in habitat. However, in the opinion of biologists, a continuation of current trends in habitat reduction will be accompanied by a diminishing harvest (Craig et al., 1979). Shrimp and menhaden yields have been directly correlated to the area of wetlands. Turner (1977, 1979) and Zimmerman et al. (1984) have reported a correlation between the area of intertidal wetlands and shrimp production. Cavit (1979), in work conducted for the US Fish and Wildlife Service, established that yields of menhaden increase as the ratio of marsh to open water increases. Peters and Schaaf (1981) have reported a close relationship between marsh and Atlantic menhaden, a close relative of the Gulf menhaden. Harris (1973) has stated that total estuarine-dependent commercial fisheries production in coastal Louisiana has peaked and will decline in proportion to the acreage of marshland lost. Marshes produce large amounts of organic detritus. Some of the detritus is transported into adjacent water bodies. Detritus is one of the important components of the estuarine food web and is vital to maintaining the high level of fishery productivity in Louisiana. The role and importance of detritus in the estuarine food web is well documented by Darnell (1961) and Odum et al. (1973). Marshes and associated shallow water bodies are used by various life stages of many estuarine-dependent species that take

advantage of the protection from predators, warmer water temperatures, optimal salinity regimes, and the rich detrital food chain. Many important sport and commercial species depend on shallow marsh areas. They include the Atlantic croaker (Rogers, 1979), menhaden (Simoneaux, 1977), brown and white shrimp (White and Boudreaux, 1977), and blue crab (More, 1969). Conner and Truesdale (1973) demonstrated the value of shallow marsh habitat to juvenile brown and white shrimp, gulf menhaden, Atlantic croaker, sand seatrout, and southern flounder. Saltwater intrusion has narrowed the broad brackish, low salinity zones that are vital for the juvenile stage of most important commercial and sport finfish and shellfish. The rising salinities have reduced the low-salinity nursery habitat important to white shrimp and blue crab. Saltwater intrusion is particularly harmful to the American oyster. The optimal salinity range for growth and survival of oysters is 5-15 ppt (Galtsoff, 1964; St. Amant, 1964; Loosanoff, 1965). Prolonged salinities lower than 5 ppt cause osmoregulatory difficulties in oysters and reduced reproductive capabilities. However, grave problems occur when salinities exceed 15 ppt. Above this level, oysters are subject to considerable predation, parasitism, and disease. The most important enemies of oysters in higher salinities include a carnivorous conch, the southern oyster drill (Thais haemostoma) and the fungus Labyrinthomyxa marina. The black drum, Pogonia cromis, is also a serious oyster predator at certain times. Other notable enemies include boring sponges, polychaete worms, boring clams, and stone crabs. It is generally assumed and reported (Chapman, 1959) that average salinities in excess of 15 ppt favor oyster drill populations. Butler (1953) stated, "The only real barrier to snail [southern oyster drill] migration is a chemical one - lack of sufficient salt in the water. They are normally absent from those areas having a sustained salinity level of less than 15 ppt." The southern oyster drill has plagued the Louisiana oyster industry for years. St. Amant (1938) stated that oyster drills caused estimated losses in oyster production as high as 50

percent statewide. May and Bland (1969) observed that during a nine-month period, over 85 percent of the oysters in a high salinity area were killed by drills. Dugas (1977) reported that oysters remaining in high salinity areas throughout the summer generally encounter high mortalities from oyster drill predation. Based on the above discussion, the importance of maintaining salinities less than 15 ppt over oyster production areas becomes obvious.

6.8.1.3. Marsh acreages would be greater with project implementation than under the without project condition. Production of shrimp, menhaden, and other commercial species, including blue crab, red drum, seatrout, Atlantic croaker, and spot was directly correlated to marsh acreage. Oyster benefits were estimated differently. Although quantity and quality of wetland habitat are partly responsible for oyster benefits, other factors were considered. It was estimated that oyster production would increase by 100 percent due to reduction in marsh loss, increased nutrients, and increased acreage and stability of areas with favorable (5-15 ppt) salinity regimens. Additional information concerning commercial fishery benefits can be found in Appendix D, Natural Resources and Appendix F, Economics.

6.8 1.4. With any of Plans 1-5, it is estimated that total fishery harvest in the study area would amount to approximately 77.4 million pounds more in 2035 than without project (See Table 6.8.1.). This harvest would be valued at approximately $38.6 million. Harvest would be 66.9 and 10.5 million pounds greater, valued at about $28.6 and $10.0 million in the Barataria and Breton Sound Basins, respectively. Total menhaden harvest would be approximatlely 41.1 million pounds greater, valued at $2.5 million. Harvest would be 40.1 and 1.0 million pounds greater, valued at $2.4 and $0.06 million in the Barataria and Breton Sound Basins, respectively. Total shrimp harvest would be approximately 8.6 million pounds greater, valued at $9.8 million. Harvest would be 7.5 and 1.1 million pounds greater, valued at $8.6 and $1.2 million, in the Barataria and Breton Sound Basins, respectively.

TABLE 6-8-1

HARVEST AND VALUE OF COMMERCIAL FISHERIES WITH AND WITHOUT PROJECT IN BARATARIA AND BRETON SOUND BASINS

(Year 2035)

	Barataria Basin		Breton Sound Basin	
	With	Without	With	Without
Menhaden				
Harvest[1]	158.92	118.83	9.04	8.06
Value[2]	9.54	7.13	0.54	0.48
Shrimp				
Harvest	29.74	22.24	10.05	8.96
Value	33.91	25.35	11.46	10.21
Oysters				
Harvest	20.26	5.33	12.52	4.30
Value	24.78	8.32	15.28	6.70
Other[3]				
Harvest	17.42	13.02	2.19	1.95
Value	4.84	3.62	0.77	0.68
Total				
Harvest	226.34	159.42	33.80	23.27
Value	73.07	44.42	28.05	18.07

1/ Millions of pounds.
2/ Millions of 1983 dollars.
3/ Includes blue crab, red drum, seatrout, Atlantic croaker, and spot.

6.8.1.5. Recreationally important fish and shellfish species would also benefit from reductions in rates of habitat degradation. This would lead to increased sport fishing opportunities. Increases in sport fishing benefits are discussed in Section 6.13. Additional information concerning recreational values due to sport fishing can be found in Appendix G, Recreation.

6.8.1.6. Although it is the general consensus of fishery experts that overall benefits to fishery resources would outweigh the adverse impacts, a variety of potential adverse impacts could occur. Aquatic organisms could be adversely impacted by changes in salinity, temperature, levels of pollutants, and hydrologic factors. Quantification of potential impacts is not possible based on available information. More information will become available with implementation of the pre- and post-construction biological and water quality monitoring programs. The following information identifies concerns and discusses potential adverse impacts in a qualitative manner.

6.8.1.7. The primary project objective is to retard the rate of saltwater intrusion. The diversions would move existing isohalines seaward. This would result in overall positive benefits to species such as oysters, white shrimp, blue crab, menhaden, and Atlantic croaker but could exert adverse impacts on certain species, including brown shrimp, spotted seatrout, and red drum. Temperature differences between the Mississippi River and prospective receiving areas could also cause adverse impacts. Mississippi River water averages 5°C to 8°C cooler than the receiving areas from January through April, with temperature differentials of 10°C to 12°C not being uncommon. Differentials in excess of 20°C have been recorded. Additional information concerning temperature can be found in Appendix H, Water Quality. Table 6-8-2 presents pertinent information concerning key environmental parameters affecting important estuarine dependent fish and shellfish in the study

TABLE 6-8-2

KEY ENVIRONMENTAL PARAMETERS AFFECTING IMPORTANT ESTUARINE-DEPENDENT FISHES AND SHELLFISHES*

Species	Spawning Locations	Peak Spawning Period	Period of Peak Juvenile Abundance	Optimum Salinity	Critical Salinity and/or Temperature Relationships
American Oyster	On oyster grounds (sessile)	May-September 1/ peaks when temperature is 27°C 2/	May-September 1/	5-15 ppt for seed oysters; 10-25 ppt on bedding grounds; above 10 ppt for reproduction 1/	Exposure to salinity less than 5 ppt when temperature greater than 20°C causes mortality 3/. Oysters subject to heavy predation by southern oyster drill at salinities above 15 ppt 4/ 15/
Brown/Shrimp	Open gulf 3/	March-May 5/	March-May 5/	15-20 ppt best for rapid growth for juveniles 6/	Salinities below 10 ppt and temperatures below 20°C occurring after first week of April lead to decreased growth and survival of post-larvae 6/ 7/ 9/
White Shrimp	Open gulf 3/	Late spring-early summer; late fall-early winter 5/	Main influx of post-larvae in June-August; smaller influx of over-wintering sub-adults in spring 5/	0.5-10 ppt 8/	Growth of juveniles best at 20-25°C, growth negligible below 15°C 5/
Blue Crab	Copulate in low salinity waters 3/ females migrate to waters greater than 21 ppt to spawn, usually in open gulf or bays 10/	June-August 10/	January-March; June-July 11/	Peak juvenile catches below 5 ppt 3/	Inconclusive.
Menhaden	Gulf 3/	October-March 3/	Summer months 3/	Between 10 and 12 ppt 13/	Optimum catch in 25-35°C waters 12/
Atlantic Croaker	Offshore and deep Passes 3/	Fall-winter 3/	Spring-summer 3/	Peak juvenile abundance less than 5 ppt 3/	Inconclusive, greatest juvenile abundance 20-30° 3/
Spotted Seatrout	Estuaries and lagoons 3/	March-November; peaks when water temperature between 22-25°C and where salinities are 34-36 ppt 3/	Data inconclusive species in estuary entire year	5-20 ppt 3/	Abrupt decreases in salinity or temperature can cause mass movement to more saline areas 3/
Red Drum	Open ponds and along sand beaches 3/	September-January 13/	Data inconclusive; species in estuary entire year	Data limited; most larvae and juveniles occur at 9-26 ppt; bigger fish prefer higher salinities 16/	Extremes in temperature and salinity tolerated; sudden temperature drops (cold fronts) may cause mortality 14/ greatest catch of juveniles in 5-15°C range 3/

Source: Modified from US Fish and Wildlife Service (1980).

* Numbers in table refer to citations listed below.

1/ Dugas, 1977.
2/ Dugas, 1979.
3/ Lindall, et al., 1972.
4/ Perret et al., 1971.
5/ White and Gaidry, 1973.
6/ Ford and St. Amant, 1971.
7/ Ford and St. Amant, 1971
8/ Gunter et al., 1964.
9/ St. Amant et.al., 1965.
10/ Fontenot, 1970.
11/ Adkins, 1972.
12/ Copeland and Bechtel, 1974.
13/ Yokel, 1966.
14/ Simmons and Breuer, 1962.
15/ Butler, 1953.
16/ Benson, 1981.

area. Optimal salinity ranges and critical salinity temperature relationships are included in the table. Review of the information presented in the table, as well as other information available in the literature, indicates that the majority of estuarine-dependent species tolerate wide ranges of salinity and temperature. Each species has optimal ranges for these parameters. However, the ranges vary with the different life stages of each species. It is also important to note that salinity and temperature often function synergistically in their effects on organisms.

6.8.1.8. The overall benefits to oysters due to alterations of salinity regimes have been discussed previously. However, as the isohalines are moved seaward, inland areas now productive for oysters would be eliminated. It is estimated that approximately 15,000 acres of leased oystering areas would be eliminated or have significantly reduced productivity due to overfreshening. About 10,000 acres would be affected in the Barataria Basin and 5,000 affected in the Breton Sound Basin. These areas would be north of the with project 5 ppt isohaline shown on Plate 10. These areas, due to their inland position, would be considered marginal for oyster production, with significant production occurring primarily during relatively dry years. In many years, the areas are too fresh to sustain production. In addition, these areas are closer to sources of pollution. At the date of this writing, these areas in the Barataria Basin were closed to oyster harvesting due to unsuitable water quality. Lowered salinities have been directly correlated with increased oyster mortalities (Butler, 1949). Marine bivalves have reduced osmoregulatory powers when placed in dilute seawater, and must close their valves to reduce loss of salts. Prolonged exposure to low salinities results in death. Reproductive capability of oysters is reduced by low salinity. Butler (1949) showed that gametogenesis is inhibited in oysters maintained in salinities less than 6 ppt. The synergistic effects of salinity and temperature are

also an important consideration. Exposure to salinities less than 5 ppt when temperature is greater than 20° C can lead to oyster mortalities (Dugas, 1977). Salinities below 5 ppt are not as harmful when temperatures are lower. Adverse impacts of lower salinities on brown shrimp have also been documented. Survival and growth of maturing brown shrimp appear to be enhanced if salinities are in excess of 10 ppt (St. Amant et al. 1965). Venkataramaiah et al. (1974) reported the best growth and survival of young brown shrimp in salinities of 8.5 to 17.0 ppt. However, it should be pointed out that the optimum salinity range for white shrimp during periods of rapid growth on the nursery grounds is 0.5 to 10.0 ppt (Gunter et al., 1964). Temperature is also an important factor affecting brown shrimp. Venkataramaiah (1974) reported growth, survival, and food conversion efficiency was best at normal temperatures of about 26° C. Growth was depressed below 21° C. Research conducted by the Louisiana Department of Wildlife and Fisheries has shown that the total number of hours of water temperature below 20° C after the first week of April appears to be a critical factor influencing brown shrimp production, particularly at salinities below 10 ppt (Barrett and Gillespie, 1973). Although lower temperatures and salinities reduce growth rates of juvenile brown shrimp, the problem could be ameliorated by delaying the opening of brown shrimp season to compensate for the lag in juvenile shrimp growth. Spotted seatrout and red drum also prefer higher salinities. Tabb (1966) reported that salinities below 5 ppt were intolerable to larval spotted seatrout. Juveniles are usually collected in the 10 to 25 ppt salinity range and adults in the 15 to 30 ppt range. Red drum also prefer moderate to high salinities. In addition to some of the more prominent species discussed above, a variety of other estuarine-dependent organisms could be affected. Some species of polychaetes, crustaceans, fish, and other groups of organisms could be displaced from some of their range during certain times of the year.

6.8.1.9. In the Barataria Basin, problems associated with temperature/salinity relationships would be more pronounced the further downstream the diversion site is located. The upper sites would provide greater opportunity for temperature and salinity buffering, and changes in the lower areas of the prospective receiving areas would not be as abrupt as with lower sites. The Big Mar site would also adversely impact certain estuarine organisms because fresh water would be diverted directly into areas utilized by estuarine species. Most motile organisms would migrate seaward and would not experience permanent harm; however, some sessile organisms would be eliminated. Any adverse impacts resulting from changes in salinity and temperature could be reduced by gradually opening the diversion structures, allowing the organisms to become acclimated to changing conditions.

6.8.1.10. Another area of concern involves potential impacts of temperature differences between the Mississippi River and the upper Barataria Basin, particularly Lac des Allemands. Lowered temperatures could have a detrimental effect on juvenile and adult freshwater species. It is estimated that during an anticipated drought year, enough water would be diverted through Lac des Allemands to replace its total volume approximately 30 times. It is likely that lake water temperature would be somewhat lowered. It is difficult to estimate what responses aquatic organisms would incur as a result of diversion. Lowered temperatures would impact the lakes productive catfish industry, but the extent is uncertain. Temperatures in the upper Barataria Basin above the GIWW range from 18.3 to 24.3 $^{\circ}$C for two-thirds of the time in April. Catfish spawning, which starts when temperatures are consistently above 21 $^{\circ}$C, would be expected to occur in April. Diversion of river water could possibly delay spawning, even if diversion were ended in March. Additionally, food consumption and food conversion efficiency for channel catfish would also be diminished during diversion months because of lower temperatures. Lac des Allemands is also

utilized by sportfishermen. In addition to channel catfish, species commonly caught include largemouth bass, crappie, and various sunfishes. Lower temperatures might also delay spawning of these species. Again, gradual opening of the structures would lessen the adverse impacts by allowing organisms to adjust to the temperature changes, especially in the immediate vicinity of the structures.

6.8.1.11. With the diversions, water level increases and sedimentation would occur in the primary receiving water bodies. During peak diversions from the Bayou Lasseigne site, water levels in Lac des Allemands would be increased by only a few inches. Since this lake is influenced by tides and also subject to increased water levels due to sustained southeast winds, fluctuations of several inches due to the project would have no significant impact on aquatic organisms. Water level increases in Big Mar during diversions would range from several inches to several feet depending upon what measures, if any, are taken by the locals to control the flow of water out of the lake. This lake is also tidally influenced and impacted by winds, so organisms inhabitating this area are already subjected to water level fluctuations. In the event that water levels increased several feet during the diversions, most aquatic organisms would likely benefit due to increased availability of feeding and nursery habitat.

6.8.1.12. In Lac des Allemands, a delta covering about 3 square miles of lake bottom approximately 3 feet thick would develop over the 50 year project life. This represents about 12 percent of the 25 square mile lake. During years of peak diversion, it is possible that some benthic organisms would be buried by sediment deposition. In areas where the water is greater than 3 feet deep, this delta would be under water and benthic organisms would populate the area. In addition, marsh vegetation would populate certain areas of the delta where the water is shallow. Although this delta could slightly decrease fishery

populations because of an overall decrease in lake area due to the factors mentioned above, the decrease would not be directly proportional to the 12 percent figure. In Big Mar, it is estimated that all of the lake will undergo 2.4 feet of filling over project life. This is an average of about 1/2 inch per year. Obviously, deposition would be greater in years of peak diversion and less in years with less than maximum diversions. In some years, it is possible that some benthic organisms may be destroyed. However, in most years, deposition would not be enough to eliminate benthos. Species composition of benthic populations would likely be modified due to differences in the sediment transported by the river and those which naturally occur in Big Mar. Quantification of impacts to aquatic organisms due to water level fluctuations and sedimentation in both Lac des Allemand and Big Mar is not possible based on existing information and the wide range of diversion scenarios on a year to year basis.

6.8.1.13. The greatest potential adverse impacts of the proposed freshwater diversions are related to the high levels of pollutants in the Mississippi River. The river often contains high levels of plant nutrients, heavy metals, phenols, pesticides, polychlorinated biphenyls, and other alien compounds. Extensive information concerning levels of these pollutants can be found in Appendix H, Water Quality. The following discussion identifies potential impacts of these substances on fish and other aquatic organisms and identifies areas of concern.

6.8.1.14. Although plant nutrients are not generally considered to be contaminants, their excessive introduction into aquatic environments can create hypereutrophic conditions. Levels of phosphorus and nitrogen in the river are such that if the design discharge is diverted for the proposed 120-day period, about 5.5 times the estimated current phosphorus loading and 2.5 times the estimated nitrogen loading would be introduced into the upper Barataria Basin than it is presently estimated

to receive via Bayous Segnette and Verret and the GIWW. Although it is acknowledged that the design condition discharge would occur on the average of only once in 10 years, the ability of the lakes in the upper basin to process the additional nutrient load is uncertain. These lakes are already reported to be hypereutrophic. Suspended sediments in diverted water would tend to retard eutrophication processes. The large forage base, high rough-fish populations, and high density of stunted catfish in Lac des Allemands are characteristic of many eutrophic lakes. Fishery resources in Lake Salvador, which is reported by Hopkinson and Day (1980) to be in a relatively low trophic state, might benefit because of added nutrients. Bayous Verrett and Segnette, which are highly eutrophic, would be affected little, if any, by diverted river water.

6.8.1.15. Although some over-fertilization may occur in the upland areas, nutrients flushed from receiving area uplands or introduced directly into the Lower Barataria and Breton Sound Basins would help sustain and enhance productive marsh and fisheries.

6.8.1.16. The bacteriological quality of the river and its impacts to fisheries in the prospective receiving areas is also a significant concern, particularly due to the relationship between bacterial levels and shellfish harvesting. Since oyster benefits attributable to the proposed diversions are substantial, potential adverse impacts due to high levels of fecal coliform bacteria in the river must be considered. The presence of coliform organisms in water has long been regarded as an indication of fecal contamination and has served for many years as a basis for water quality criteria. The use of fecal coliform bacteria as an indicator organism has proven to be of sanitary significance and the number of fecal coliforms indicates the degree of health risk associated with a variety of activities, including shellfish harvesting.

6.8.1.17. Shellfish, particularly bivalve mollusks such as oysters, clams, and mussels, have long been recognized as vectors of typhoid, hepatitis, and other diseases. These mollusks are filter feeders and tend to concentrate and accumulate viruses and bacteria, including pathogens from the overlying water. Due to the high densities of indicator organisms in Mississippi River water, during periods of diversion, significant quantities of fresh water with high bacterial densities would be introduced into the upper basins. Natural die-off, dilution, bacterial sedimentation, predation, and the bacteriocidal effect of increased salinities in the receiving areas would reduce fecal coliform populations. Calculations of fecal coliform die-off rates were not performed for the Bayou Lasseigne site. However, based on the calculations which have been done for the Davis Pond and Big Mar sites for this revised report, it can be reasonably assumed that fecal coliforms diverted with the river water would die-off before reaching even the most inland areas which currently produce oysters. The methodology and results of fecal coliform die-off rates is presented in Appendix H. It should be noted that even if areas would have to be closed to oyster harvesting during periods of diversion, these areas could be reopened after discharges have ceased and associated coliform levels decline to acceptable levels. Increased production of oysters following fresh water inflow is expected to far more than compensate for any harvest foregone during closure of some oyster reefs.

6.8.1.18. A variety of agricultural and industrial chemicals, such as pesticides and volatile and semivolatile organic compounds occur in the Mississippi River. Only limited data on the occurrence of many of these compounds is available.

6.8.1.19. Pesticides present in the river include chlorophenoxy herbicides and organochlorine and organophosphorus insecticides. The most frequently detected of these groups are 2,4-D, dieldrin, and

diazinon, respectively. Other persistent organochlorine pesticides present include DDT and endrin. Data indicate the levels of these insecticides have decreased in recent years.

6.8.1.20. A variety of industrial compounds present in the river in the Baton Rouge to New Orleans industrial corridor are known or suspected carcinogens. Because methods have not been established to determine a threshold for carcinogenic effects, the Environmental Protection Agency (EPA) policy is that there is no scientific basis for estimating "safe" levels of carcinogens. Therefore, the recommended ambient water concentration for carcinogens for maximum protection of human health is zero.

6.8.1.21. Polychlorinated biphenyls and 13 pesticides have been detected in the prospective receiving areas. The persistant organochlorine insecticides have not been frequently detected. The most frequently detected organochlorine insecticide has been lindane. Other organochlorines detected include chlordane, DDT and its metabolites DDD and DDE, dieldrin, heptachlor, and endosulfan. Only two organophosphorus insecticides, diazinon and parathion, have been detected in the prospective freshwater receiving areas. Diazinon has been the most frequently detected of these two compounds. Three common phenoxy herbicides, 2,4-D, 2,4,5-T, and silvex, have been the most frequently detected of all the specific organic compounds for which analyses have been performed; silvex is the most frequently detected of the three. Five insecticides have been detected in the Upper Barataria Basin. Organochlorine insecticides include chlordane, DDE, dieldrin, and heptachlor. One organophosphorus insecticide, diazinon, and three phenoxy herbicides, 2,4-D, 2,4,5-T, and silvex have also been detected in this area. Four organochlorine insectidies, lindane, DDT, dieldrin, and endosulfan, have been detected in the surface water of the Barataria Basin south of the GIWW. As in the upper basin, diazinon, 2,4-D, 2,4,5-T,

and silvex have also been detected. Four organochlorine compounds, including lindane, DDT, dieldrin, endosulfan, and PCB have been detected in the surface waters investigated in the Breton Sound Estuary. Positive samples for the organochlorines range from 1 percent for PCB to about 13 percent for lindane. Two organophosphorus insecticides, parathion and diazinon, and two phenoxy herbicides, 2,4-D, and 2,4,5-T have also been detected in these waters. Unfortunately, no data regarding the occurrence of the more exotic volatile and semivolatile organic compounds in the prospective freshwater receiving areas are available.

6.8.1.22. Comparison of pesticide data for the Mississippi River and the prospective receiving areas indicates comparable detection frequencies for the organophosphorus insecticides and the phenoxy herbicides. However, the persistant organochlorine insecticides, particularly DDT, dieldrin, and endrin, have been more frequently detected in the Mississippi River than in either of the prospective receiving areas. Generally, the occurrence of these compounds in the river waters is decreasing. However, if the project is implemented, the occurrence and variety of pesticides and other organic compounds in the prospective receiving areas would probably increase. Thus, the potential for bio-concentration of such compounds in aquatic life would also increase.

6.8.1.23. Trace metals and trace inorganics enter surface waters via several routes and from several sources. Trace metals and selected trace inorganics routinely detected in the Mississippi River include arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, and zinc. Copper, zinc, iron, and mercury have occasionally been detected at relatively high levels, considering the enormous dilution capacity of the river. Data contained in the Water Quality Appendix (Appendix H) present relative concentrations of several

"priority pollutants" including trace metals and inorganics detected in surface water, fish tissue, and sediment. None of the fish tissue concentrations were above Food and Drug Administration (FDA) action levels.

6.8.1.24. In the Water Quality Appendix, concentrations of six selected trace metals in the prospective receiving areas were compared to EPA fresh- and saltwater criteria. Examination of the data indicated that concentrations of cadmium, copper, lead, mercury, nickel, and zinc do not frequently exceed the maximum fresh- or saltwater criteria except for copper. Copper levels are relatively high in both receiving areas. However, concentrations of these substances often exceed 24-hour average criteria. Cadmium, copper, lead, and mercury consistently exceeded the 24-hour average freshwater criteria in the upper Barataria Basin. Copper, zinc, and mercury concentrations in the lower Barataria Basin and Breton Sound Basin most consistently exceeded the 24-hour saltwater criteria.

6.8.1.25. Predicted cadmium and copper loadings at the Davis Pond site were very close to levels observed in Lake Salvador. Significant impacts due to these elements would not be expected.

6.8.1.26. In further efforts to elucidate potential impacts, tissue levels of various substances in 30 fish samples consisting of about 130 individual fish collected from the Mississippi River near Luling, Louisiana, were analyzed to determine levels of bioconcentration of the certain pesticides heavy metals, and PCB's. The data were collected by the US Fish and Wildlife Service from 1969-1979. These data are presented in Table 6-8-3. The data show that the average tissue concentrations did not exceed FDA action levels; however, there were instances where action levels were exceeded. In addition, an examination of heavy metals in fish tissue collected by the Louisiana

TABLE 6-8-3

TISSUE CONCENTRATIONS OF SELECTED POLLUTANTS IN FISHES TAKEN FROM MISSISSIPPI RIVER AT LULING, LOUISIANA FROM 1969-1979, 1/, 2/, 3/

Species (no. samples)	Total DDT	Toxa-phene	Total PCB's	Dieldrin	Endrin	Heptachlor epoxide	C-Chlor-dane	T-Chlor-dane	C-Non-achlor	T-Non-achlor	Lindane	Lead	Mercury
Freshwater drum (7)	0.616 (1.150)	0.850)2.200)	2.327 (5.400)	0.133 (0.200)	0.079 (0.180)	0.040 (0.060)	0.090 (0.120)	0.067 (0.090)	0.023 (0.030)	0.090 (0.110)	0.017 (0.020)	0.153 (0.170)	0.083 (0.120)
Carp (9)	0.246 (0.390)	0.567 (2.500)	0.984 (4.500)	0.053 (0.130)	0.023 (0.070)	0.055 (0.400)	0.060 (0.070)	0.065 (0.070)	0.010 (0.010)	0.000 (0.000)	0.000 (0.000)	4/ 4/	4/ 4/
Largemouth bass (1)	0.260	0.500	0.600	0.030	0.000	0.010	0.040	0.010	0.020	0.040	0.000	4/	4/
Channel catfish (5)	0.540 (0.920)	0.000 (0.000)	2.350 (6.600)	0.124 (0.260)	0.138 (0.200)	0.006 (0.030)	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/
Blue catfish (3)	0.307 (0.710)	1.533 (4.600)	0.043 (0.130)	0.113 0.230	0.000 (0.000)	0.000 (0.000)	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/
Smallmouth buffalo (2)	0.000 (0.000)	3.200 (4.100)	0.850 (1.400)	0.000 (0.000)	0.000 (0.000)	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/	4/ 4/
Striped mullet (1)	0.580	4/	1.390	0.390	4/	0.000	4/	4/	4/	4/	4/	4/	4/

Source: US Fish and Wildlife Service (1982).

1/ Concentrations in parts per million (ppm) - from whole fish samples.

2/ Upper number represents mean concentration; lower number is maximum concentration. Underlined values exceed "action levels" set by Food and Drug Administration (see footnote 3).

3/ Food and Drug Administration "action levels" (recommended maximum safe concentrations for human consumption) are: 5 ppm for PCB's, DDT, and Toxaphene; 0.3 ppm for Heptachlor Epoxide, Dieldrin, Endrin, Chlordane, and Lindane; and 1 ppm for mercury. Action level not established for lead.

4/ Analysis not performed for pollutant indicated.

Department of Health and Human Resources did not reveal significant differences in tissue levels in the river and prospective receiving areas.

6.8.1.27. Oysters are of special concern with regard to potential effects of pollutants. By virtue of their filter-feeding nature, these bivalve mollusks tend to concentrate pollutants. In addition, oysters are generally eaten in their entirety, often in raw form. All of the tissues which ordinarily concentrate pollutants as well as any waste products contained in the excretory system, are eaten as well. Thus, as with the concerns associated with fecal coliforms mentioned previously, potential adverse effects exist for other pollutants as well. Bioaccumulation factors in oysters reported in the literature are notoriously high, including 3,650 for cadmium, 16,700 for zinc, and 40,000 for the mercuric compound methylmercuric chloride. A bioaccumulation factor represents how many times the initial concentration of a parameter to which an organism has been exposed has increased and accumulated in the tissue.

6.8.1.28. Phenolic compounds have historically presented problems in the Mississippi River. The development of "off" flavors in fishes taken from the Mississippi River was a serious problem in the early 1970's. Phenolic compounds are the primary substances which cause this tainting of fish flesh. Tests conducted by the EPA in 1972 indicated that catfish in the Mississippi River below Baton Rouge, Louisiana, possessed moderate to very strong off-flavors. However, an apparent decline in this problem is revealed by records of commercial landings of catfish and bullheads, compiled by the National Marine Fisheries Service, for the Mississippi River below the Bonnet Carre' Spillway. As shown in Table 6-8-4, those records reveal that catfish and bullhead landings declined from 202,000 pounds in 1964 to 46,000 pounds in 1968, and then dramatically rose to nearly 1.4 million pounds by 1977. The last year for which landing records are available is 1978; landings declined to 573,000 pounds during that year but were more than six times the average landings for the period 1965 through 1969.

TABLE 6-8-4

COMMERCIAL HARVEST AND VALUE OF CATFISHES AND BULLHEADS FROM MISSISSIPPI RIVER BETWEEN HAHNVILLE, LOUISIANA AND THE GULF OF MEXICO[1/]

Year	lbs.	$
1964	202	46
1965	119	30
1966	72	20
1967	54	15
1968	46	13
1969	145	41
1970	180	52
1971	174	56
1972	131	39
1973	2/	2/
1974	772	231
1975	1,080	350
1976	1,163	386
1977	1,388	496
1978	573	217

Source: US Fish and Wildlife Service (1982).

1/ Data complied from National Marine Fisheries Service landing records, all values in thousands.

2/ No data.

6.8.1.29. The Council on Environmental Quality National Environmental Policy Act (40 CFR 1502.22 a and b) and ER 200-2-2 (section 26c) require that when an agency is evaluating significant adverse effects on the human environment in an EIS and there are gaps in relevant information or scientific uncertainty, the agency shall always make clear that such information is lacking or that uncertainty exists. It is further required that if information relative to adverse impacts is important to making a decision on the project and the means to obtain it are beyond the state of the art, the agency shall weigh the need for the action against the risk and severity of possible adverse impacts were the action to proceed in the face of uncertainity. If the agency proceeds, it shall include a worst case analysis and an indication of the probability or improbability of its occurrence. The following discussion addresses these requirements.

6.8.1.30. In the case of the proposed project, or any project involving diversion of Mississippi River water, impacts of the relatively poor quality of the river water are an obvious source of concern. Although considerable data is available on the quality of Mississippi River water, it certainly cannot be considered exhaustive. Costs of analyzing water for many of the compounds known to occur in the river are prohibitive. Therefore, only limited data on the occurrence of these compounds are available. Water quality data on receiving areas, such as Lakes Cataouatche and Salvador, Barataria Bay, Breton Sound, and Big Mar are even more limited.

6.8.1.31. In addition to constraints and uncertainties related to water quality data, numerous gaps exist with regard to assessing the impacts of various water quality parameters on aquatic and terrestrial organisms. For many parameters, assessing impacts with any degree of certainty is beyond the state of the art. For some parameters, complex hydrological and water quality modeling would necessary to determine the

distribution and concentration of these parameters throughout the receiving areas before better judgements could be made concerning their effects upon organisms. The studies culminating in this report are based primarily on existing information. Another consideration is that effects of many contaminants are subtle and long term and concrete information on effects of the thousands of chemical compounds in the Mississippi River may never be known.

6.8.1.32. These data gaps and uncertainties are the primary reasons for the proposed water quality and biological monitoring programs. Although the monitoring programs are needed to assess the effects of the project on the study area, the most improtnat reason for the programs is to detect any problems which might arise with respect to pollutants. The programs include tissue analysis of selected organisms to assess potential bioaccumulation problems and insure the safety of humans.

6.8.1.33. It has been determined that "worst case" impact analysis for the proposed project would involve what could occur in the event of a major discharge of a highly toxic contaminant from one of the industries along the river, or as a result of a ship or barge collision. The industries along the river manufacture or use a wide variety of toxic chemicals. In addition, ships and barges transport a wide variety of toxic chemicals. The proposed structures would be electronically operated and could be closed in a relatively short period of time (about 1 hour). Provisions for manual closure in the event of power failure woud also be incorporated. However, if a major toxic contaminant spill were to occur upriver from one of the structures, the potential for catastrophic impacts exists in the event that the spill is not immediately reported, or in the case of human failure in operation of the structure. If this should occur, some of the toxic substance would be introduced into the Barataria or Breton Sound Basin and serious environmental impacts could result.

6.8.2. Plans 6-10

6.8.2.1. Plans 6-10 would impact from 154 to 266 acres of water bodies due to construction of the diversion routes. The impacts on these waterbodies would also impact fisheries. The impacts to fisheries would be the same as discussed for Plans 1-5 in paragraph 6.8.1.1.

6.8.2.2. With any of Plans 6-10, fishery benefits would be less than Plans 1-5 or 16 because marsh savings would not be as great (see paragraph 6.2.2.2.); however, it is not possible to quantify the differences based upon available information. In addition, greater potential for adverse impacts related to temperature differences and pollution exist with these plans, because that portion of the flow diverted at Oakville enters the receiving areas more directly than that diverted at the upper sites. These potential impacts have been addressed in the discussion for Plans 1-5 in Section 6.8.1.

6.8.3. Plans 11-15

6.8.3.1. Plans 11-15 would impact from 287 to 391 acres of water bodies due to construction of the diversion routes. The impacts on these water bodies would also impact fisheries. The impacts to fisheries would be the same as discussed for Plans 1-5 in paragraph 6.8.1.1.

6.8.3.2. With any of Plans 11-15, fishery benefits would be less than with Plans 1-5, 6-10, or 16 because marsh savings would not be as great (see paragraph 6.2.3.2.); however, it is not possible to quantify the differences based on available information. Greater potential for adverse impacts related to temperature differences and pollution exists with these plans than with Plans 1-5 or 6-10, because that portion of the water diverted at Myrtle Grove sites enters directly into the lower Barataria Basin and changes in these parameters would be more abrupt. Salinity changes would also be more abrupt. Potential impacts to fisheries due to these factors have been discussed in Section 6.8.1.

6.8.4. Plan 16

6.8.4.1. Plan 16 would impact 215 acres of water bodies due to construction of the diversion routes. Impacts to these water bodies would also impact fisheries. The impacts to fisheries would be similar to those discussed for Plans 1-5 in paragraph 6.8.1.1.

6.8.4.2. With Plan 16, fishery benefits would be generally the same as with Plans 1-5 because the 15 ppt isohaline would be maintained at the same position and total marsh savings would be the same. Overall impacts to fisheries would be similar to those described for Plans 1-5 in Section 6.8.1. However, due to specific differences in the receiving water bodies and associated fisheries, as well as differences in certain features between Plans 1-5 and Plan 16, it is necessary to further discuss fisheries impacts specific to Plan 16.

6.8.4.3. The Davis Pond site incorporates a 7,425 acre overflow area above Lake Cataouatche. This area consists primarily of fresh marsh and associated shallow water bodies with some areas of wooded swamp. This overflow area has a number of distinct benefits and would reduce potential for adverse impacts to fishery resources. Diverted river water would flow over this area at a depth of 1 to 2 feet. At peak flow, water would be retained in this area for about one day. Retention time would increase with reduced flows. Flow over this area would be controlled by a system of five weirs located along the northern shore of Lake Cataouatche. Velocity in the overflow area would be at a rate of about 0.5 feet per second (fps). Average velocity in Lake Cataouatche would be about 0.1 fps, although velocities would be greater adjacent to the weirs. By the time the water reaches Lake Salvador, velocity would be only about 0.06 fps.

6.8.4.4. As the water flows into the overflow area, much of the sediment would begin to settle out. At least 60 percent of the sediment would be deposited in the overflow area. It is estimated that a 4 square mile delta varying from 1 to 4 feet thick would be formed in the area where the outflow channel enters the overflow area. This delta would be formed over the 50 year life of the project. This area is rapidly deteriorating from marsh into open water. Much of this delta would become marsh and would benefit both fish and wildlife resources. Up to 14 percent of the material would settle in Lake Cataouatche. Sediments would be deposited in areas adjacent to the weirs, but would probably be winnowed due to wind and wave action in this relatively shallow lake. The remaining sediment would remain suspended and settle out at varying distances further down the Barataria Basin.

6.8.4.5. Potential adverse impacts due to pollutants would be somewhat buffered by the overflow area. Those pollutants associated with the sediments forming the delta would fall out before reaching Lake Cataouatche. In addition, some pollutants would be filtered out by the marsh, although the retention time in the overflow area is not long enough to allow substantial marsh treatment. It is estimated that this filtering effect as water passes over the marsh would reduce the pollutant load by 5-20 percent, with treatment probably being in the lower end of this range.

6.8.4.6. Two areas of potential adverse impacts have been the subject of considerable interest. These were potential impacts of cooler river water on aquatic organisms in the immediate receiving water bodies and potential impacts of fecal coliform bacteria levels in the more inland oyster producing areas. In order to address these issues in a more definitive manner, temperature was modeled and fecal coliform die-off rates (K) were determined for the Davis Pond and Big Mar sites. Temperature was modeled using the EPA QUAL-II model to determine the

rate of warming of the river water as it travels through the upper receiving areas. The methodologies and calculations for temperature and fecal coliform determinations are presented in Appendix H, Water Quality. It was calculated that incoming river water would be warmed in the overflow area by amounts ranging from 2.5°C in April up to 4.0°C in February, with the temperature increases dependent on net heat transfer and exposure (or detention) time in the basin. Remaining temperature differences between the Davis Pond outflow waters and background waters were determined to range from 4.8°C in March down to 1.1°C in May. Additional warming of the river water during passage through Lake Cataouatche was calculated to be sufficient for equlibration to predicted normal background temperatures in the upper Barataria basin in January, February, and May. In March and April, Lake Cataouatche outflow temperatures were predicted to remain about 1.6°C and 2.1°C below background. Table H-5-6 of Appendix H shows normal monthly background temperatures of the river and receiving waters, and predicted intermediate temperatures of diverted river water in the detention basin and Lake Cataouatche under design year conditions. This analysis represents normal (average) climatic conditions in the upper Barataria Basin. Therefore, temperature changes under project design year conditions would probably not be the same as those presented even if river and basin water temperatures were at average levels. Nevertheless, radical departures from the predicted gradients would not be expected except under unusual circumstances. It should be recognized that most of the Lake Cataouatche water will have become displaced by river water within a few days after commencement of full capacity diversion structure operation. Thus, even in March and April, actual temperature gradients over short distances would not be large, as the lake will have gradually shifted to a new state of equilibrium. Initiating releases in a gradual fashion over several days at the beginning of a diversion season would give most resident organisms sufficient opportunity to adjust to somewhat cooler temperatures without significant adverse effects. Additional mixing of Lake Cataouatche

outflow waters with Lake Salvador and other water bodies would further moderate any remaining temperature differentials within reasonable times and distances. Based on the temperatures calculated for the Big Mar site, it has been determined that the flow in Big Mar proper, plus the relatively slow movements of Big Mar outflows through numerous canals and bayous within the marshes, would provide ample time for gradual warming of water temperature to acceptable levels before reaching areas in the Breton Sound Basin utilized by sensitive estuarine dependent species. As for fecal coliforms, based on the K values determined for fecal coliforms in the river water, it can be safely assumed that fecal coliform bacteria would die off before reaching any oyster harvesting areas.

6.8.4.7. In addition to concerns over temperature differences and increased levels of fecal coliforms, considerable concern has been expressed with regard to other pollutants which would be introduced with diverted Mississippi River water. Particular concern was expressed by commercial catfishermen with regard to the potential effects of substances which are known to taint the flesh of catfish and cause "off flavors". Of special interest in this regard are various phenolic compounds. In order to obtain some idea of impacts which could occur, the US Fish and Wildlife Service (USFWS) agreed to conduct some tissue analysis of catfish in the Mississippi River and Lake Cataouatche. Biologists from USFWS and the Corps went with commercial fishermen to obtain fish samples from the river and the lake in September 1982. Five catfish were collected from each of two stations in the Mississippi River and two stations in Lake Cataouatche. A total of 20 catfish 12-14" in length were collected. The fish were filleted for tissue analysis of the edible portions. The tissue from the five fish from each station was combined for analysis of heavy metals, chlorinated pesticides, phenolic compounds, and polychlorinated biphenyls. The results of the analysis are presented in Table 6-8-5. Levels of most

TABLE 6-8-5
RESULTS OF FISH TISSUE ANALYSIS FROM LAKE CATAOUATCHE AND MISSISSIPPI RIVER [1/]

Parameter	Lake Cataouatche Station		Mississippi River Station		FDA Action Level [1/]
Heavy Metals	1	2	1	2	
Arsenic	<0.05 [2/]	<0.05	<0.05	<0.05	None
Lead	0.07	0.07	0.05	0.05	None
Mercury	0.05	0.05	0.05	0.05	1.0
Nickel	<0.1	0.15	0.1	0.13	None
Copper	0.578	<0.5	<0.5	<0.5	None
Zinc	14.02	14.13	7.33	8.14	None
Chromium	0.41	0.31	0.30	<0.30	None
Cadmium	<0.4	<0.4	<0.4	<0.4	None
Chlorinated Insecticides					
DDE	0.01	ND	0.06	0.04	5.0
DDD	ND [3/]	ND	0.04	0.05	5.0
DDT	ND	ND	0.02	0.02	5.0
Dieldrin	ND	ND	0.12	0.11	0.3
Alpha-BHC	ND	ND	0.03	0.03	None
Oxychlordane	ND	ND	0.01	ND	0.3
HCB	ND	ND	0.02	0.02	None
Heptachlor epoxide	ND	ND	0.04	0.03	0.3
Alpha chlordane	ND	ND	0.03	0.04	0.3
Gamma chlordane	ND	ND	0.04	0.04	0.3
Trans-nonachlor	ND	ND	0.02	0.03	None
Cis-nonchlor	ND	ND	ND	0.01	None
Phenolic Compounds					
Meta & Para Chlorophenol	<7.5	<7.5	<7.5	<7.5	None
2 - Chlorophenol	<4.0	<4.0	<4.0	<4.0	None
2, 6 - Dichlorophenol	<0.015	<0.015	<0.015	<0.015	None
2, 3 - Dichlorophenol	<0.04	<0.04	<0.04	<0.04	None
2, 5 - Dichlorophenol	<0.04	<0.04	<0.04	<0.04	None
2, 4 - Dichlorophenol	<0.03	<0.03	<0.03	<0.03	None
2, 4, 6 - Trichlorophenol	<0.001	<0.001	<0.001	<0.001	None
2, 3, 5 - Trichlorophenol	<0.004	<0.004	<0.004	<0.004	None
Pentachlorophenol	0.002	0.002	0.015	0.016	None
PCB [4/]	ND	ND	0.22	0.18	None

Source: US Fish and Wildlife Service (unpublished data)

1/ Parts per million
2/ Less than detection limit
3/ Non-detected
4/ Polychlorinated biphenyls

parameters were at or below detection limits and in no case were FDA action levels exceeded. It should be emphasized, however, that the analysis represents a very small sample. In addition, with regard to the various phenolic compounds, it is possible that "off flavors" can occur even if the levels of these substances are below chemical detection limits.

6.8.4.8. Before assessing potential impacts to fishery resources in the upper basin receiving areas such as Lakes Cataouatche and Salvador in the Barataria Basin and Big Mar in the Breton Sound Basin, it is necessary to identify the more important fisheries in these areas. Lakes Cataouatche and Salvador are fished commercially for both channel catfish and soft-shell crabs. Recreational fishing also occurs for largemouth bass, crappie, sunfishes, and catfish, especially in the canals and bayous connected to these lakes. In many years, when saltwater has intruded into the upper basin, spotted seatrout and brown shrimp are also caught by both recreational and commercial fishermen. Oysters do not occur in the immediate receiving areas. The most northerly (inland) area where oysters occur is in the lower portion of Little Lake. Impacts to oysters will be discussed later in this section.

6.8.4.9. Catfish are harvested primarily with slat-traps, although trot lines are also used. The catfish caught in these areas are generally small and the local market has developed around these smaller fish. These fish are usually filleted and sold to both consumers and restaurants around the metropolitan New Orleans area. Harvest and value of catfish from 1963 to 1976 for the Lakes Cataouatche/Salvador area are shown in Table 6-8-6. More recent landings for these specific lakes are not available due to changes in the method by which the National Marine Fisheries Service reports harvest data. Although it appears that harvest was higher in the 1960's, caution must be used when analyzing

TABLE 6-8-6

HARVEST AND VALUE OF CATFISH FROM LAKES SALVADOR AND CATAOUATCHE[1/]

Year	Harvest[2/]	Value[3/]
1963	1,364.9	$382.2
1964	1,152.8	322.8
1965	688.6	192.8
1966	641.2	179.5
1967	508.8	142.5
1968	633.1	177.3
1969	751.9	210.5
1970	579.0	162.1
1971	346.3	97.0
1972	327.4	91.7
1973	315.4	88.0
1974	437.2	122.4
1975	392.0	109.9
1976	589.4	165.0

Source: National Marine Fisheries Service (NMFS) landings, 1963-1976.

1/ Primarily channel catfish, but landings include some bullheads and blue and flathead catfish. Harvests are for lakes Salvador and Cataouatche combined, NMFS does not report them separately.
2/ Thousands of pounds.
3/ Thousands of 1976 dollars.

harvest data. Due to the fact that many fish are sold directly to consumers and restaurants on a cash basis, much harvest is not reported.

6.8.4.10. The soft-shell crab industry in the upper Barataria Basin, including the Lakes Cataouatche and Salvador area, is somewhat unique. This fishery has been reviewed by Jaworski (1970, 1971, 1972, and 1979). According to Frost (1938), soft-shell crab production in the Barataria Estuary increased when a fisherman from Lake Cataouatche discovered that peeler crabs were attracted to fresh willow branches placed in the estuarine lakes to catch river shrimp and eels. Fishermen soon found that waxmyrtle branches were even more effective in attracting shedding crabs. The crabbers tie 6 or 7 fresh waxmyrtle bushes together at the base and attach them to a line about 15 feet apart. The bushes settle to the bottom. In the past, individual fishermen used about 200 bushes but by 1971 crabbers were using 500 to 1,000 bushes (Jaworski, 1972). The fishery occurs not only in Lakes Cataouatche and Salvador, but also in Little Lake. The primary reason that these areas are suitable for this fishery is because these lakes serve as low salinity nursery areas where a lot of juvenile crabs are maturing and shedding at frequent intervals. In addition, water movement in these areas is mostly due to subtle tidal fluctuations and velocities are not sufficient to cause the crabs to leave the security of the bushes. The crabbers harvest not only soft crabs but also those which show indications they will shed soon. These crabs are taken back to onshore shedding facilities where they are held until shedding occurs. This process in discussed in detail in Jaworski (1971). Table 6-8-7 shows the harvest and value for soft-shell crabs from the Lakes Cataouatche/Salvador area from 1963-1976. As with the catfish harvests, caution must be used when analyzing trends in the fishery, because many of the soft-shell crabs are sold directly to consumers and restaurants and are not included in the harvest data.

TABLE 6-8-7

HARVEST AND VALUE OF SOFT-SHELL CRABS FROM LAKES SALVADOR AND CATAOUATCHE[1/]

Year	Harvest[2/]	Value[3/]
1963	35.5	$58.2
1964	15.3	25.1
1965	25.3	41.5
1966	24.7	40.5
1968	69.0	113.2
1969	50.6	83.0
1970	24.1	39.5
1972	41.0	67.2
1974	57.3	94.0
1975	77.4	126.9
1976	57.0	93.5

Source: National Marine Fisheries Service (NMFS) landings, 1963-1976.

1/ Harvests are for Lakes Salvador and Cataouatche combined, NMFS does not report them separately.

2/ Thousands of pounds.

3/ Thousands of 1976 dollars.

6.8.4.11. In the Breton Sound Basin, Big Mar is the primary receiving area that would be directly affected by diversion. Big Mar does not support any unique or substantial fishery activities such as those in the upper Barataria Basin. Some commercial crabbing is done in Big Mar, primarily for hard shell blue crabs.

6.8.4.12. Based on the information presented above, it is possible to make general predictions concerning the impacts related to implementation of Plan 16. These potential impacts are described below.

6.8.4.13. The catfish fishery has been discussed in paragraph 6.8.4.9. It is unlikely that implementation of Plan 16 would cause serious overall adverse effects on catfish. The cooler Mississippi River water would warm in the outflow area (see para. 6.8.4.6.) and abrupt temperature changes would not likely occur in Lake Cataouatche. However, since the temperature in Lake Cataouatche would be slightly lowered, spawning would be slightly delayed and growth and food conversion efficiency somewhat reduced during part of the year. Since much of the sediment would settle out in the overflow area before reaching the lake, sedimentation would not impact the catfish. Flow rates would not be altered significantly in the lake, so this would not impact the catfish either. As far as pollutants are concerned, it is difficult to assess the long-term effects of the various pollutants in the river on catfish populations. The river itself supports substantial catfish populations, as indicated by commercial harvest in Table 6-8-4. It is doubtful that diversion of river water would adversely affect the catfish themselves. Further, it is unlikely that consumption of the catfish would cause any human health problems. Levels of selected pollutants in edible fish tissue from fishes collected from the Mississippi River are presented in Tables 6-8-3 and 6-8-5. Analysis of data in Table 6-8-3 shows no exceedance of US Food and Drug Administration (FDA) action levels for average concentrations of the various parameters. Table 6-8-5 reveals no exceedances as well.

Nonetheless, fishermen are concerned that some of the chemicals, particularly phenolic compounds, which occur in the river water may taint the flesh and cause "off flavors". This could make the fish less marketable. This has been previously discussed in paragraph 6.8.1.27. It should be pointed out that fish from the river have lived in the river for their entire lives and are more likely to develop "off flavors" than those in the receiving areas affected by the proposed project. With the project, maximum flow would be diverted for 5 months (Jan-May) only one in ten years. Three years out of ten, water would not be diverted at all. In the other six years of a typical ten-year cycle, intermediate flows would be introduced. In addition, studies have indicated that fish can depurate themselves of these substances in one to two weeks once water quality returns to normal. In otherwords, if tainting problems should arise, they would cause problems only during peak diversions. Even then, these problems would not be comparable to those encountered in the river proper.

6.8.4.14. With regard to the catfish and the catfish fishery in Lake Cataouatche and the entire upper Barataria Basin, it is essential to emphasize several points. Implementation of the tentatively selected plan (Plan 16) could have long-term benefits which far outweigh any potential impacts. At the rate saltwater is intruding into the upper basin, the fresh and very low salinity areas suitable for existence of catfish populations will continually be reduced in areal extent. In addition, the continued marsh loss will dramatically reduce the productivity of the area. These factors would result in serious declines in catfish populations and catfish harvest.

6.8.4.15. This discussion will describe potential impacts to the soft-shell crabs and the fishery due to project implementation. As discussed previously in this fisheries section, sedimentation and flow velocity in Lake Cataouatche would not be significantly altered. Temperature in Lake Cataouatche would be somewhat lowered, although the temperature

changes would not be abrupt (see para. 6.8.4.6.). It is possible that the cooler temperature could impact the soft-shell crab fishery during part of the year. However, as described in the following discussion, the fishery may be shifted southward due to overfreshing of Lake Cataouatche. If this occurs, temperature would not be a significant concern because it is expected to equalize by the time the water reaches the lower Lake Cataouatche/upper Lake Salvador area. Alterations in salinity and water quality would be the cause of any potential impacts. Lake Cataouatche is an area of low salinity, but not completely fresh. This project would freshen this area. This would likely shift the area preferred by maturing/molting crabs to the Lake Salvador/Little Lake area. Although this would not significantly affect overall crab populations, it may adversely affect the fishermen, particularly in Lake Salvador. Due to the lake's large size and shallow water, it is often quite rough. This would make it more difficult to maintain and fish the bush lines. Water quality impacts could also affect the crabs. According to Jaworski (1971), water masses that are oxygen deficient or contain toxic substances may kill the less mobile, shedding crabs, or may lengthen the process of ecdysis (molting). Although the river may introduce certain substances which would be detrimental to the crabs, certain beneficial effects could also be realized from the diversions. The diverted water may actually increase dissolved oxygen levels. In addition, the proposed project would maintain a more stable salinity regime in the area and reduce the liklihood of sudden salinity changes. Jaworski (1979) stated that drainage modifications, such as the Barataria Waterway, have reduced the buffering capacity of the estuary and as a result, sudden salinity changes may exceed the osmoregulatory ability of shedding crabs. The primary production period for soft-shell crabs is from April through September. Based on the 10 year diversion scenario described in paragraph 6.8.4.13., it becomes apparent that this fishery would not be adversely affected over the entire harvesting period, and some years it would not be impacted at all.

6.8.4.16. Some concern has been expressed over impacts to brown shrimp and local shrimpers in the Lake Salvador area. Salinities in the upper Barataria Basin have increased significantly over the last several decades. As a result, brown shrimp and certain other estuarine-dependent species are abundant and heavily fished in inland areas where they were not found historically. The proposed project would shift the salinity regime gulfward and restore conditions which existed historically. As a result, brown shrimp and other estuarine-dependent species would shift further seaward as well. Species abundance and diversity in the basin overall would not be significantly affected. These organisms are all euryhaline and can tolerate wide ranges of salinity variations, particularly when the changes are gradual as they would be with this project. Some local fishermen who fish some of these inland areas would have to venture further to harvest these resources, particularly during the years of peak diversion. However, it must be emphasized that production of brown shrimp and other important commercially and recreationally exploited estuarine-dependent species is closely correlated with acreage of marsh. With implementation of this proposed project, significant marsh savings would accrue, thereby improving production of these species.

6.9. WILDLIFE

6.9.1 Plans 1-5

6.9.1.1. Plans 1-5 would impact from 778 to 1,169 acres of total habitat due to direct construction, of which 610 to 859 acres are highly productive wetlands. Approximately 297 to 443 acres would become channel, while 481 to 726 acres would be converted to upland, shrub-scrub by the disposal of dredged material. Material excavated during maintenance dredging would be deposited on the levee/disposal areas adjacent to the channels and would periodically destroy some small areas of shrub-scrub habitat. A small number of the less mobile species would be lost through burial during disposal. A greater number of less mobile species would be displaced to adjacent habitats where many would suffer

mortality due to competition with residents, and/or these habitats would be degraded due to overcrowding. Those disposal areas converted to shrub-scrub would retain some wildlife value for upland species.

6.9.1.2. These plans would provide maximum benefits to wildlife resources due to reductions in rates of land loss and reduced degradation of habitat quality in the study area. Of particular benefit to wildlife species would be the greatly reduced loss of fresh/intermediate marshes. The relationship between habitat quantity and quality and productivity of wildlife resources is discussed in Appendix A, and Appendix D, Exhibit A.

6.9.1.3. Commercially important wildlife, including furbearers and alligators, are dependent upon productive marsh habitat in the coastal area. Most of these species prefer the fresher marsh areas; therefore, annual future harvests are expected to be greater with the project than they would without freshwater diversion. With implementation of any of these plans, it is projected that the study area would contain a total of 99,162 acres, or 155 square miles, more marsh in year 2035 than under the without project condition. Barataria Basin would experience a savings of 59,579 acres of fresh/intermediate marsh. The Breton Sound Basin would experience significant gains in fresh/intermediate marsh and losses in brackish and saline marsh acreages due to seaward shifts in the isohalines. There would be 63,938 acres of fresh/intermediate marsh compared to only 2,555 acres under the without project condition, a difference of 61,383 acres. The total net value of furbearers in the study area is projected to be $323 thousand greater in 2035 with than without project. The harvest values in the Barataria and Breton Sound

Basins would be $181 thousand and $142 thousand greater, respectively. The total net value of alligator harvest would be $220 thousand greater, $125 thousand, and $95 thousand in the Barataria and Breton Sound Basins, respectively. Additional information concerning commercial wildlife benefits can be found in Appendix F, Economics.

6.9.1.4. Recreationally important wildlife, including big game, small game, migratory birds, and waterfowl would also benefit from reductions in rates of habitat degradation. This would, in turn, lead to increased hunting opportunities. Increases in man-days of hunting and their attendant values are presented in Section 6.13. Additional information concerning recreational values attributed to wildlife can be found in Appendix G, Recreation.

6.9.1.5. Wildlife populations in the overall study area could be both negatively and positively affected by the project. Increased levels of pollutants could potentially affect all species; however, most of the negative impacts would surround the immediate receiving bodies. Modifications of the present isohaline lines would result in a redistribution of particular populations as would water level changes during the dry months. Changes in water temperatures near the diversion channel outfall could impact specific wildlife, particularly reptiles and amphibians. Most populations would not be harmed, and many would be helped due to the reduction in wetland loss and increased productivity.

6.9.1.6. Potential negative impacts to wildlife could be related to the introduction of pollutants from the Mississippi River, including pathogens, toxins, nutrients, and sediments. The most serious problems would occur near the outfall of the diversion channels. Enriching the receiving bodies with inorganic nutrients, especially inorganic nitrogen and phosphorus, could in some situations create additional problems in already eutrophic lakes. This could impact the prey base, especially

fish, and would be more critical during warm months. Siltation and turbidity could also impact the prey base. Aquatic plants could be smothered by silt or productivity could be retarded because of reduced light penetration. Reduced visibility due to turbidity would make feeding difficult for both prey and predators alike. The presence of toxic substances is of much greater concern and would impact a greater area than nutrients or suspended particles. The toxic materials include pesticides (DDT, dieldrin), industrial wastes (PCBs), and heavy metals (copper, cadmium, and mercury). This is because these materials are relatively persistant in the environment, travel long distances, and are biologically magnified. Most of these toxic materials would be deposited in the sediment or taken up by biological systems and those pollutants would enter the food chain through plants or unicellular organisms. Once in the food web, the materials would be magnified and would continue to do so until they reach top carnivores or man. PCBs can be concentrated in a similar manner, and at a level of 10 to 100 times per trophic level. The dramatic impact of bioaccumulation can be observed in oceanic birds which never contact any large land area, yet carry a load of over 6 ppm. Although a pollutant may not reach a lethal level in healthy animals, it can result in decreased vigor or death during periods of stress or starvation. Ducklings exposed to a dosage of 25 ppm Aroclor (a PCB) had about twice the mortality rate after exposure to duck hepatitis virus as did the normal birds (Snow, 1973).

6.9.1.7. The effect of moving the 15 ppt isohaline seaward is the major beneficial impact of the project on wildlife. As areas of Barataria Bay and Breton Sound again become fresher, the vegetational distribution, and thus the animal distribution, would change. Most wildlife species would benefit from this change; however, some saltwater species would no longer expand their range, and may undergo a contraction. Species included here would be the gulf salt marsh snake, diamond-backed terrapin, black skimmer, seaside sparrow, and some rails, sandpipers, plovers, gulls, and terns.

6.9.1.8. Changes in water levels during the release of Mississippi River water could impact some species near the diversion structure. Water diverted from the Bayou Lasseigne structure would raise levels in Bayou des Allemands about 0.3 feet, and the level in Big Mar would increase about 1.5 feet. Reptile and amphibian reproduction is susceptable to water level changes. Direct impacts would generally involve the loss of eggs by drowning, and indirect impacts would include increased predation and displacement. Amphibians generally lay their eggs in shallow, nearshore waters or isolated ponds. Increased water levels would allow predators, such as aquatic insects and fish, access to these areas. Aquatic snakes and turtles lay eggs near water bodies, and these sites could be covered with water. Although alligator eggs are layed in vegetative nests on the marsh floor, the egg cavity is generally a foot above the marsh. Increased water levels could impact a few avian species. The potential effects on wading birds is discussed in Section 6.12. Mottled ducks could also be impacted because they breed along marsh edges in nests constructed on the ground or in clumps of grass several inches above the marsh floor. Other ground-nesting birds that could be impacted are the rails. Increased water levels and flows would tend to increase the productivity of wetland areas, and this would provide a larger food base for most wildlife.

6.9.2. Plans 6-10

6.9.2.1. Plans 6-10 would impact from 886 to 1,176 acres of total habitat due to direct construction of which 591 to 777 acres are highly productive wetlands. Approximately 352 to 457 acres would become channel and 534 to 719 acres would be converted to upland shrub-scrub by the disposal of dredged material. Impacts to wildlife would be similar to those described for Plans 1-5.

6.9.2.2. As discussed previously in Sections 4.3. and 6.2., benefits to habitat quantity and quality would be greatest with Plans 1-5, and less with Plans 6-10, although the differences could not actually be quantified. Since wildlife benefits are based on quantity and quality of habitat, it is estimated that benefits accrued from Plans 6-10 would be less than Plans 1-5.

6.9.2.3. Potential adverse impacts to wildlife in the receiving areas would be the same as discussed for Plans 1-5.

6.9.3. Plans 11-15

6.9.3.1. Plans 11-15 would impact from 1,126 to 1,464 acres of total habitat due to direct construction, of which 669 to 894 acres are highly productive wetlands. Approximately 452 to 529 acres would become channel, while 674 to 885 acres would be converted to upland shrub-scrub by the disposal of dredged material. Impacts to wildlife would be similar to those described for Plans 1-5.

6.9.3.2. Wildlife benefits with Plans 11-15 would be less than Plans 1-5 or 6-10. See rationale presented for Plans 6-10.

6.9.3.3. Potential impacts to wildlife in the receiving areas would be the same as discussed for Plans 1-5.

6.9.4. Plan 16.

6.9.4.1. Plan 16 would impact 685 acres of total habitat due to direct construction, of which 349 acres are productive wetlands. These areas would be converted to channel and levees. Impacts to wildlife would be generally the same as described for Plans 1-5. However, due to the

overflow area which is part of Plan 16, certain wildlife impacts would occur which are somewhat different. During the diversion period, the overflow area would be covered with one to two feet of water. Some wildlife in the area would be displaced to higher ground and would be more susceptible to predation and competition. Later on in project life, wildlife would be able to migrate to portions of the four square mile delta which would be created over the life of the project.

6.9.4.2. Overall wildlife benefits with Plan 16 would be similar to Plans 1-5 because benefits to habitat quantity and quality would be the same.

6.9.4.3. Construction of the proposed project is not expected to contribute to vector-borne disease or nuisance problems. If future studies indicate that vector-related problems could arise, appropriate measures would be taken to minimize the impacts to the maximum extent practicable. Coordination will be maintained with local health authorities concerning this matter.

6.10. ENDANGERED AND THREATENED SPECIES

6.10.1. Plans 1-5

6.10.1.1. Plans 1-5 would not impact any endangered or threatened species due to direct construction of the diversion routes.

6.10.1.2. With the possible exception of the bald eagle, no significant impacts on any threatened or endangered species are expected. Most of these species could be exposed to increased pollutant levels; however, most of the toxic materials should be trapped or detoxified before reaching the basins, and the possibility of significant toxic loads is

slight. Because of biomagnification, the final pollution levels cannot be predicted. Water level or salinity changes are not expected to significantly impact any endangered species.

6.10.1.3. The brown pelican is of concern because it is an opportunistic top carnivore which has a known sensitivity to pollutants. Pelican nesting failures have been related to high levels of DDE, dieldrin, endrin, and mercury. Eggs of Florida birds transplanted to Louisiana from 1970 to 1973 showed a steady decline in shell thickness, and half the eggs had dieldrin levels considered potentially detrimental to reproductive success (Blus et al., 1975). About 40 percent of the transplanted birds died of endrin poisoning in 1975 (National Fish and Wildlife Service, 1980). Fortunately, the pelican populations and pollution levels in the birds and eggs have been monitored since 1971, and levels of DDT and endrin in the environment have been declining. A monitoring program of water and tissue analysis of lower tropic level organisms is a part of the project design, and should detect any potential for problems.

6.10.1.4. Three bald eagle territories are located near the Lac des Allemands to Lake Salvador diversion route. Because the eagle is a top carnivore, they are highly susceptable to environmental contaminants which have accumulated through the food chain. The primary cause of lowered bald eagle production in the United States has been linked to chlorinated hydrocarbon pesticides, especially DDT and its metabolites. In most instances, the pesticides have not been lethal, but have resulted in eggshell thinning and/or reduced reproduction. Sampling and analysis of eagle eggs have shown a linear relationship between the reproduction rate and amount of DDE and dieldrin present. The pesticide level in an adult which would result in eggshell thinning is unknown; however, eggs collected from nonproductive nests in Maine averaged 21.8 ppm of DDE and 1.4 ppm of dieldrin. It appears that 4 ppm

of dieldrin and 30 ppm of DDT + DDD in the brain is a lethal level. Eagles fed 160 ppm died; however, 10 ppm did not result in death. Although the effects of PCBs on bald eagles are unknown, it probably is similar to DDE. The toxicity of dieldrin and DDT is enhanced beyond an additive effect by the addition of PCBs (Snow, 1973). Dugoni (1980) found the bald eagle population in Louisiana is stable and has the potential to increase; however, subnormal clutch size and poor egg hatchability are inhibiting population growth. There is a hint of recovery in the Louisiana population and it might be due to a decline in DDT in the environment. PCBs remain a serious problem.

6.10.1.5. Turbidity could result in a reduced capture rate of prey. However, the receiving water bodies are generally shallow, thoroughly mixed, and often somewhat turbid already. A study by Dugoni (1980) found Louisiana bald eagles fed primarily upon fish (42 percent), birds (42 percent), and mammals (16 percent). About 42 percent of all prey were freshwater catfish (22 percent) and coots (20 percent). Because of the diverse foraging behavior of the eagle and alternative food resources available, prey availability is not expected to affect the population. The freshwater catfish is an exceptionally hardy species, and the project is expected to only minimally impact its availability to the eagle.

6.10.2 Plans 6-10

Same as Plans 1-5.

6.10.3. Plans 11-15

Same as Plans 1-5, except greater potential exists for adverse impacts to the brown pelican due to the shorter distance between the Myrtle Grove site and the brown pelican colony on Queen Bess Island.

6.10.4. Plan 16

6.10.4.1. Impacts to endangered species would be similar to Plans 1-5. The plan would not impact any endangered or threatened species due to direct construction of the diversion route.

6.10.4.2. A bald eagle nest is located in the lower southwest corner of the overflow area. The presence of this nest made it necessary to initiate consultation with the USFWS and prepare two amendments to the Biological Assessment of Threatened and Endangered Species. Details concerning potential impacts to the bald eagles is presented in the assessments which can be found in Appendix D, Section 2.

6.10.4.3. Based on the assessments, it has been determined that the proposed project could possibly exert impacts on the bald eagles. The primary area of concern would be the presence of toxic materials in the diverted water. However, extensive water qualtiy monitoring will be conducted to assure that the project would not adversely affect the continued existence of the bald eagles and their territory. On September 12, 1984 the USFWS transmitted their Biological Opinion stating that the project is not likely to jeopardize the continued existence of the bald eagle or result in destruction or adverse modification of critical habitat (See Appendix D, Section 2).

6.11. BLUE LIST SPECIES

6.11.1. Plans 1-5

Plans 1-5 would have minimal impacts on Blue List Species due to the direct construction of the diversion routes. Increased pollutant levels in the receiving areas would have the potential to

impact certain Blue List Species. Increased levels of nutrients, decreased salinities, and water level changes would benefit some birds and be deterimental to others. However, improvements in the quantity and quality of habitats in the study area would ultimately benefit most Blue List Species. Additional information concerning impacts on birds and other wildlife species can be found in Section 6.9 and 6.10.

6.11.2. Plans 6-10

Same as Plans 1-5.

6.11.3. Plans 11-15

Same as Plans 1-5.

6.11.4. Plan 16

Same as Plans 1-5.

6.12. NESTING COLONIES

6.12.1. Plans 1-5

6.12.1.1. Plans 1-5 would not impact any nesting colonies due to direct construction of the diversion routes.

6.12.1.2. There are 43 colonially-breeding nesting coloines with the study area. Most of the 43 nesting colonies are considerable distances from the diversion structures and are not expected to be affected by sedimentation, pollution, or turbidity. Most of the sediments should have fallen out, or have been detoxified, before reaching the colonies. Increased water levels would reduce prey availability near

the receiving bodies, but the impacts would be reduced as the distance from the diversion structure increases. It does not appear that construction of the Big Mar site would significantly impact any colonies. The project would not result in an alteration of nesting substrate.

6.12.1.3. Of concern, are five wading bird colonies near Lac des Allemands (numbers 602019, 602020, 602022, 602023, and 602027 of Portnoy, 1977). These heronries represent about 37,000 birds, and include the little blue heron (15,400), Louisiana heron (600), snowy egret (2,200), cattle egret (19,300), great egret (50), dark ibis (15), and yellow-crowned night heron (10). These colonies, except for the cattle egret, could be impacted. Increased turbidity could reduce prey visibility. Those fish captured could have higher levels of toxic materials and these would reduce fertility, promote egg shell thinning, or result in increased adult mortality. Modified water level regimes during the normally drier months could impact prey concentrations in some areas. Wading birds are dependent on declining water levels to concentrate prey to levels sufficient to induce breeding and support the young; however, the change necessary to adequately support nesting birds in Louisiana is unknown. Although prey concentrations may be reduced, increased production of fish and crayfish could offset the loss.

6.12.1.4. Those colonies near the receiving area might not be the only heronries affected by toxic materials because these materials might be biologically magnified through the plant, invertebrate, fish, and heron food chain. A shift, or establishment, of wading bird colony sites to the southeast could be expected as the isohaline line moves. The project would result in a savings of 82,690 and 16,472 acres of marsh in the Barataria and Breton Sound Basins over project life. This would increase availability of potential nesting locations and increase prey production. A monitoring program of nesting colonies would be desirable.

6.12.2. Plans 6-10

Same as Plans 1-5.

6.12.3. Plans 11-15

Same as Plans 1-5.

6.12.4. Plan 16

Same as Plans 1-5.

6.13. RECREATIONAL RESOURCES

6.13.1. Plans 1-5

6.13.1.1. Plans 1-5 would result in total annual losses of 597 to 846 man-days of sporthunting, valued at $4,189 to $5,871, due to direct construction of the diversion routes. Fishing losses could not be quantified, but are estimated to be insignificant.

6.13.1.2. With these plans, claimable benefits in 2035 are $1,386,149 per year, $1,010,600 in the Barataria Basin and $386,896 in the Breton Sound Basin. Of the total amount, $405,034 are attributable to fishing and $992,462 attributable to hunting. Fishing benefits would be $360,045 and $44,989 and hunting benefits $650,555 and $341,907 in the Barataria and Breton Sound Basins, respectively. Benefits are based on 1984 values provided by Principles and Guidelines as discussed in Appendix G.

6.13.1.3. Fishing benefits are limited by access. Therefore, mandays of fishing with and without project are the same. Fishing benefits are

based on increasing the quality of the experience due to higher productivity of fishery resources in the area under with project conditions. The rationale for determination of fishing benefits is discussed further in Appendix G, Recreation.

6.13.1.4. Hunting values accrue from 92,613 more man-days available in 2035. The man-days of individual hunting activities preserved and their associated values are:

	Net Days 2035	Net Values 2035
Big Game	3,507	$ 52,254
Small Game	17,666	72,431
Migratory Birds	18,211	74,665
Waterfowl	53,229	793,112
	92,613	$992,462

6.13.1.5. There are additional impacts that would occur as a result of the implementation of any freshwater diversion plan alternative. The alteration of salinity patterns would transfer or redistribute freshwater and saltwater sport fishing potential to those areas where the respective fishery resources have been displaced during times of diversion. Areas that formerly supported saltwater fishing would be altered to support an expanded freshwater fishery; however, recreation potential, when transferred, would not be destroyed. Salinity patterns may affect certain huntable waterfowl species in a similar manner, increasing their concentrations in expanded freshened marshlands. The preservation of marshes and swamplands as unique and esthetic habitats providing opportunities for non-consumptive wildlife-oriented recreation, such as wildlife observation and photography, would also be considered intangible project-induced benefits.

6.13.2. Plans 6-10

6.13.2.1. Plans 6-10 would result in total annual losses of 578 to 761 man-days of hunting, valued at $4,067 to $5,358, due to direct construction of the diversion routes. Fishing losses could not be quantified, but are estimated to be insignificant.

6.13.2.2. As discussed previously in Sections 4.3 and 6.2, benefits to habitat quantity and quality would be greatest with Plans 1-5, and less with Plans 6-10, although the differences could not actually be quantified. Since recreational benefits are based on quantity and quality of habitat, it is assumed that recreation benefits accrued from Plans 6-10 would be less than Plans 1-5.

6.13.3. Plans 11-15

6.13.3.1. Plans 11-15 would result in total annual losses of 598 to 731 man-days of hunting, valued at $4,454 to $5,108. Fishing losses could not be quantified, but are estimated to be insignificant.

6.13.3.2. Recreational benefits with Plans 11-15 would be less than Plans 1-5 or 6-10. See rationale presented for Plans 6-10.

6.13.4. Plan 16

6.13.4.1. Plan 16 would result in a total annual loss of 338 man-days of hunting, valued at $2,400. Fishing losses could not be quantified, but are estimated to be insignificant.

6.13.4.2. Recreational benefits with Plan 16 would be the same as with Plans 1-5. See discussion presented in paragraph 6.13.1.2.

6.14. STATE WILDLIFE MANAGEMENT AREAS AND NATIONAL PARKS

6.14.1. Plans 1-5

Plans 1-5 would not adversely impact any state wildlife management areas or national parks due to direct construction of the diversion routes. The Bohemia, Salvador, and Wisner Wildlife Management Areas and Jean Lafitte National Park would be beneficially impacted due to reductions in the rates of habitat loss and degradation in these areas. Recreational opportunities would be benefitted in these areas due to improvement of habitats.

6.14.2. Plans 6-10

Same as Plans 1-5.

6.14.3. Plans 11-15

Same as Plans 1-5.

6.14.4. Plan 16

6.14.4.1. Plan 16 would impact the Bohemia and Wisner Wildlife Management Areas and Jean Lafitte National Park similar to Plans 1-5. However, impacts to the Salvador Wildlife Management Area would be more direct and significant with Plan 16.

6.14.4.2. With Plan 16, water would be diverted just above the Salvador Wildlife Management Area and would directly impact the entire area. The area has experienced serious land loss due to both subsidence and saltwater intrusion. Between 1956 and 1978, approximately 11,000 acres of fresh marsh has been converted to open water and intermediate marsh. In addition, wooded swamp in the area has been deteriorating,

probably due to saltwater intrusion. The proposed project would prevent continued saltwater intrusion into the area. In addition, the sediments which would settle out in the overflow area would form a delta and offset creation of open water in the area. In addition, the weirs to be constructed on the north shore of Lake Cataouatche would allow control of water levels in the upper portion of the management area.

6.15. MINERALS

6.15.1. Plans 1-5

Plans 1-5 would have minimal impacts on mineral resources. Impacts would be associated with relocation of five to seven oil and gas pipelines. The Bayou Lasseigne site would require relocation of 520 to 920 feet of one 10-inch and one 20-inch natural gas pipeline. The Bayou Fortier site would require relocation of 585 to 1,045 feet of one 8-inch and one 20-inch natural gas pipeline. Construction of the Big Mar site would require relocation of 70 feet of one 10-inch oil pipeline and one 12-inch and one 16-inch natural gas pipeline. Additional information concerning these pipelines can be found in Appendix C, Engineering Investigations.

6.15.2. Plans 6-10

Plans 6-10 would impact from six to eight oil and gas pipelines. The Bayou Lasseigne site would require relocation of 520 to 775 feet of one 10-inch and one 20-inch natural gas pipeline. The Bayou Fortier site would require relocation of 585 to 825 feet of one 8-inch and one 20-inch natural gas pipeline. The Oakville site would impact from 260 to 360 feet of one 12-inch natural gas pipeline. Impacts due to construction of the Big Mar site would be the same as Plans 1-5.

6.15.3. Plans 11-15

Plans 11-15 would impact from six to eight oil and gas pipelines. Impacts due to the Bayou Lasseigne, Bayou Fortier, and Big Mar sites would be the same as Plans 6-10. The Myrtle Grove site would require relocation of 260 to 360 feet of one 20-inch oil pipeline.

6.15.4. Plan 16

Plan 16 would impact nine oil and natural gas pipelines. Construction of the Davis Pond site would require relocation of 550 feet of one 8-inch, 670 feet of one 20-inch, and 150 feet of one 22-inch natural gas pipeline and 670 feet of one 8-inch, one 10-inch and one 20-inch oil pipeline. Construction of the Big Mar site would require relocation of 70 feet of one 10-inch pipeline and one 12-inch and one 16-inch natural gas pipeline.

6.16. MISSISSIPPI RIVER

6.16.1. Plans 1-5

Plans 1-5 would have minimal impacts on the Mississippi River. The maximum flow into the study area would be 17,250 cfs, assuming that 10,650 cfs were diverted at the Bayou Lasseigne site and 6,600 cfs were diverted at the Big Mar site simultaneously. This represents only about 5 percent of the average river flow. In most years, the magnitude of the diversions would be about one-half of design in an average year. Since diversion would vary with local runoff and would occur from January through April, average annual diversion would be about 2 percent of the flow. No problems associated with water supply are anticipated. Impacts to navigation would be negligible and limited to the immediate vicinity of the structure during peak flow periods.

6.16.2. Plans 6-10

Same as Plans 1-5.

6.16.3. Plans 11-15

Same as Plans 1-5.

6.16.4. Plan 16

Same as Plans 1-5.

6.17. WATER QUALITY

6.17.1. Plans 1-5

6.17.1.1. Suspended particulates resulting from dredging and disposal operations would consist of disturbed organic and inorganic debris and sediment placed in suspension. Both suspended particulate and turbidity levels would increase substantially in the surface waters adjacent to the construction sites during dredging. Suspended particulate levels would decline rapidly after completion of construction. Light penetration, and thus, the depth of the photic zone would be adversely decreased as a result of increased suspended particulates and turbidity during dredging operations. This effect would not remain after construction has ceased. Dissolved oxygen levels in shallow water near the construction sites could be temporarily depressed or depleted by oxygen demands associated with suspended organic sediments.

6.17.1.2. These plans involve diverting freshwater at one or more sites above the city of New Orleans and one site below New Orleans. Minor degradation in the overall quality of the Mississippi River occurs with movement downstream through this segment of the Baton Rouge-New

Orleans industrial corridor. Consequently, the potential water quality impacts of freshwater diversion would be essentially the same in both of the prospective receiving areas. Diverting fresh water at the proposed sites would likely result in increased mean concentrations of cadmium, mercury, nickel, selenium, zinc, nitrogen, phosphorus, and hydrocarbons in the Barataria and Breton Sound Basins. The severity of impacts related to the potential long-term increase in mean trace metals and hydrocarbons concentrations cannot be definitely quantified at present, but possible consequences include bioaccumulation in aquatic food webs and sublethal toxicity to aquatic life. Definite degradation of the sanitary quality of the primary receiving areas would result upon implementation of freshwater diversion. The primary contact recreational use designation of some surface waters in the Barataria Basin may be jeopardized. The impacts associated with increasing bacterial densities in the receiving areas could be most pronounced at the Big Mar freshwater diversion site. However, the characteristic die-off rates of fecal coliforms in Mississippi River water indicate that bacterial densities would probably reduce to safe levels before reaching shellfish harvesting area. Increasingly brackish estuarine waters would further accelerate bacteriocidal effects in receiving areas. Moderate temperature gradients may occur in upper receiving areas with attendant minor adverse thermal effects to juvenile organisms.

6.17.1.3. Additional impacts of diverting fresh water from the river to the receiving areas would consist of altering the existing hydraulic regimes, sedimentation patterns, turbidity, longitudinal concentration gradients, and perhaps, accelerating the aging (eutrophication) process in the shallow upland lakes.

6.17.1.4. The extent of water quality impact would be greatest in both prospective receiving areas in years when the maximum or near maximum design discharge is diverted, and most localized in the vicinity of a

diversion structure in years when only small quantities of freshwater are required. It should be emphasized that a water quality monitoring program would be an integral part of the proposed project and data collected would provide valuable information concerning potential water quality impacts. The proposed monitoring program and additional information can be found in Appendix K.

6.17.2. Plans 6-10

6.17.2.1. Plans 6-10 would impact from 155 to 266 acres of water bodies due to construction of the diversion routes for the Bayou Lasseigne, Bayou Fortier, Oakville, and Big Mar sites. Water quality impacts related to construction activities would be the same as for Plans 1-5.

6.17.2.2. Based on available information, it was not possible to determine substantive site-specific differences in the overall quality of the river within the reach investigated in this study except for higher bacterial levels below New Orleans. Consequently, the potential for water quality impacts cited for Plans 1-5 is essentially the same irrespective of diversion structure location except for thermal shock effects, which would be more likely in primary receiving areas for the Oakville site.

6.17.3. Plans 11-15

6.17.3.1. Plans 11-15 would impact from 287 to 391 acres of water bodies due to construction of the diversion routes for the Bayou Lasseigne, Bayou Fortier, Myrtle Grove, and Big Mar sites. Water quality impacts related to construction activities would be the same as for Plans 1-5.

6.17.3.2. The potential for water quality impacts cited for Plans 6-10 is essentially the same irrespective of diversion structure location except that thermal shock effects would be even more likely in primary receiving areas for the Myrtle Grove site.

6.17.4. Plan 16

6.17.4.1. Plan 16 would impact 285 acres of water bodies due to direct project construction. Of this, 175 acres of open water would be converted to marsh at the Davis Pond site using dredged material excavated during channel construction.

6.17.4.2. The Davis Pond overflow area (7,425 acres) would ameliorate water quality impacts, particularly those associated with water temperature and fecal coliform bacteria. Water temperatures of project design year flows should become equilibrated to background levels within Lake Cataouatche except for the months of March and April when slightly cooler (about 2°C) temperatures would prevail in outflows to Lake Salvador and other adjacent water bodies. Additional moderation by dilution and mixing with these waters would further moderate differences with little effect on most resident organisms. Significant fractions of the fecal coliform bacteria in diverted river water should die within the overflow area, with nearly all of the remainder expiring within Lake Cataouatche. Tendencies toward accelerated eutrophication as a result of nutrient influxes to water bodies should be moderated by improved circulation and heightened turbidity during diversion periods. Nutrients would be come widely distributed in the Barataria estuary. Most of the incoming suspended sediment load should be deposited within the overflow area, which would trap from about 5 to 20 percent of most toxic substances with the sediments. Considerable diffusion and dispersion potential in the other receiving bodies should insure that large downstream concentration changes and localized bottom sediment

accumulations should not occur. Water quality impacts at Big Mar have been previously discussed in Section 6.8.4. and 6.17.1.

6.18. LOUISIANA NATURAL AND SCENIC STREAMS SYSTEM

6.18.1. Plans 1-5

Plans 1-5 would involve diversion of 10,650 cfs of Mississippi River water into Lac des Allemands. The majority of this water would exit Lac des Allemands via Bayou des Allemands. This bayou, located between Lac des Allemands and Lake Salvador, is part of the Louisiana Natural and Scenic Streams System. Based on available information, it is not known if dredging would be required in the bayou; however, this will not be known for certain until advanced engineering and design studies are completed. During periods of diversion, an increase in water level of 0.3 to 0.5 feet is anticipated, as well as increased flow velocities and alteration of water quality. Coordination with the State of Louisiana concerning this matter has been initiated.

6.18.2. Plans 6-10

Plans 6-10 would involve diversion of 3,550 to 7,100 cfs of Mississippi River water into Lac des Allemands. See discussion presented for Plans 1-5.

6.18.3. Plans 11-15

Same as Plans 6-10.

6.18.4. Plan 16

Plan 16 would not impact any natural or scenic streams.

6.19. NATIONAL REGISTER PROPERTIES

6.19.1. Plans 1-5

6.19.1.1. Plans 1-5 would not impact any of the cultural resources currently listed in, determined eligible for, or pending nomination to the National Register of Historic Places. Most of the National Register properties in the study area are located on the Mississippi River natural levee and none of these are located near the proposed diversion sites. The two National Register properties located off the Mississippi River natural levee and in the Barataria Basin, Fort Livingston and the Bayou Des Coquilles Archeological site (16Je37), would not be affected by Plans 1-5.

6.19.1.2. However, the full impacts of these plans on resources eligible for inclusion in the National Register cannot be addressed without benefit of an intensive cultural resources survey of all alternative impact areas. Such a survey will be conducted for the selected plan during the next stage of project planning to identify any significant cultural resources in the potential impact area of the project.

6.19.2. Plans 6-10

Same as Plans 1-5.

6.19.3. Plans 11-15

Same as Plans 1-5.

6.19.4. Plan 16

Same as Plans 1-5.

6.20. ARCHEOLOGICAL RESOURCES

6.20.1. Plans 1-5

6.20.1.1. The Big Mar and Bayou Lasseigne sites both have a relatively low probability for impacting archeological resources in the construction right-of-way, while the Bayou Fortier site has a relatively high potential for impacting cultural remains. In addition to possible construction impacts, Plans 1-5 would possibly affect the seven archeological resources recorded on Bayou des Allemands due to the increased erosional forces of an additional 10,650 cfs flow.

6.20.1.2. Because they include the Bayou Fortier site, Plans 1-4 have a high probability for impacting cultural remains. Plan 5 consists of the two diversion sites with the lowest relative potential for impacting cultural remains, Big Mar and Bayou Lasseigne, and therefore, it is the preferred alternative from a cultural resources viewpoint. However, as stated above, erosional impacts on Bayou des Allemands' archeological sites are possible.

6.20.1.3. The beneficial impact of Plans 1-5 would be the preservation of archeological resources located on the 155 square miles of marsh which is projected to be preserved over project life over the future without project conditions.

6.20.2. Plans 6-10

6.20.2.1. The Big Mar and Bayou Lasseigne sites both have a relatively low probability for impacting cultural remains in the construction right-of-way, while the Bayou Fortier and Oakville sites have a relatively high probability.

6.20.2.2. Because all the plans include the Oakville site and one or both of the upper Barataria Basin sites, the potential of Plans 6-10 for impacting cultural remains is high. These possible impacts include construction impacts on the numerous archeological sites located on the banks of Bayous des Allemands and Barataria.

6.20.2.3. The beneficial impacts of Plans 6-10 are the same as stated for Plans 1-5.

6.20.3. Plans 11-15

6.20.3.1. The Big Mar and Bayou Lasseigne sites both have a relatively low probability of impacting cultural remains in the construction right-of-way. The Bayou Fortier site has a relatively high probability of such impacts and the Myrtle Grove site has a very high probability of impacting cultural remains. One recorded archeological site, the Wilkinson Canal site (16PL17), is located in the construction right-of-way of the Myrtle Grove site.

6.20.3.2. Since all the plans include the Myrtle Grove site and one or both of the upper Barataria Basin sites, the potential of Plans 11-15 for impacting cultural remains is very high. This includes direct construction impacts on site 16PL17 and possibly other presently unrecorded archeological sites as well as possible erosional impacts on Bayou des Allemands' archeological sites.

6.20.3.3. The beneficial impacts of Plans 11-15 are the same as stated above for Plans 1-5.

6.20.4. Plan 16

6.20.4.1. The Big Mar site has a relatively low probability for impacting cultural remains in the construction right-of-way. However, the Davis Pond site has a high probability of adversely impacting cultural remains. Additional information is contained in Appendix E.

6.20.4.2. Since this plan includes the Davis Pond site, the potential for impacting archeological resources is high.

6.20.4.3. The beneficial effects of this plan are the same as stated for Plans 1-5.

TABLE 7. LIST OF PREPARERS

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

NAME	DISCIPLINE/ EXPERTISE	EXPERIENCE	ROLE IN PREPARING EIS
Mr. Dennis L. Chew	Fisheries Biology/ Management	4 years, Marine Biologist, Gulf Coast Research Laboratory, Ocean Springs, MS: 2 years, Assistant to the Director, Mississippi Marine Conservation Commission, Biloxi, MS; 3 1/2 years EIS Studies, Corps of Engineers, New Orleans District	EIS Coordinator, Effects on Fisheries and Wildlife
Mr. Peter Hawxhurst	Engineer/Civil Engineer	11 years, Planner, Corps of Engineers, New Orleans District	Study Manager, Engineering
Mr. E. Scott Clark	Wildlife Biologist/ Ornithology	2 years, EIS Studies, Corps of Engineers, New Orleans District	Effects on Wildlife, Endangered Species
Mr. Marvin Drake	Engineer/Environmental	13 years, Hydraulic and Environmental Engineer, Corps of Engineers, New Orleans District	Effects on Water Quality
Mr. Howard R. Bush	Recreation Planning/ Resource Development	5 years, State of Arkansas, 4 years, Corps of Engineers, New Orleans District	Effects on Recreational Resources

TABLE 7. LIST OF PREPARERS (Continued)

NAME	DISCIPLINE/ EXPERTISE	EXPERIENCE	ROLE IN PREPARING EIS
Mr. Theodore G. Hokkanen	Outdoor Recreation Planning/Recreation Resource Management	5 1/2 years, Pennsylvania Bureau of State Parks; 4 years, Chief Park Ranger, Vicksburg District; 4 years, Outdoor Recreation Planner, New Orleans District	Effects on Recreational Resources
Mr. Michael Stout	Archeology/Cultural Resource Management	6 years, Corps of Engineers, New Orleans District	Effects on Cultural Resources
Mr. Nicholas G. Constan	Regional Economist	14 years, Corps of Engineers, New Orleans District	Plan Economics, Social Impacts
Mr. Peter C. Womack	Economist	4 1/2 years, Corps of Engineers, New Orleans District	Plan Economics, Social Impacts
Mrs. Suzanne Hawes	Botany/Fisheries/ Marsh Ecology	1 year, Lab Associate, LSU Medical School; 11 years, Environmental Studies, New Orleans District	Review and Technical Assistance
Mr. Henry P. Glaviano	English/Technical Writing and Editing	4 years, Technical Writer/Editor, The Boeing Company; 11 years, Technical Writer/Editor, Corps of Engineers, New Orleans District	Review and Editorial Assistance

8. PUBLIC INVOLVEMENT

8.1. PUBLIC INVOLVEMENT PROGRAM

8.1.1. Initial public meetings on this overall study were held on 9 November, 23 December, and 17 December 1968 at Jennings, Houma, and New Orleans, Louisiana, respectively. Principal concerns of local interests were improvements for controlling beach erosion, saltwater intrusion, silting, flood control, access for recreation, and freshwater introduction for improving fish and wildlife production.

8.1.2. A public meeting on a related study, Mississippi and Louisiana Estuarine Areas, which is concerned with diverting freshwater to improve the productivity of fish and wildlife was held in New Orleans in February 1978. Elected officials and members of the public that reside in the current study area presented their views and support for freshwater diversion to the study area.

8.1.3. Several informal meetings have been held with local interests during the conduct of the investigation. Meetings were held with representatives of local agencies and elected officials to discuss freshwater diversion investigations under the current study, the related Mississippi and Louisiana Estuarine areas study, and the authorized Mississippi Delta Region project on 14 June 1978, 27 March 1979, 9 April 1979, 13 August 1979, and 12 December 1980. Due to widespread interest in freshwater diversion, a meeting was held on 23 April 1980 with elected officials and representatives of Federal and non-Federal agencies to discuss the status and future direction of the freshwater diversion studies and on 26 January 1981 to discuss study progress. In September 1980, personnel of the New Orleans District (NOD) presented papers on freshwater diversion at the National Symposium on Freshwater Inflow to Estuaries held in San Antonio, Texas. A briefing on the

status and options being considered in the diversion studies was presented to the Louisiana State Senate House Committees on Natural Resources joint hearings held 25 August 1981, and to discuss possible courses of action on 21 January 1982. A presentation on the diversion studies was made at a symposium on coastal erosion and wetlands modification conducted by the Louisiana University Marine Consortium on 5 and 6 October 1981. The NOD was represented on a panel concerned with limitation and mitigaton of dredging, and freshwater diversion. Recreation, fish and wildlife, and environmental studies have been coordinated with the US Fish and Wildlife Service, National Marine Fisheries Service, and the Louisiana Department of Wildlife and Fisheries. In addition, this study has been closely coordinated with the Louisiana Department of Natural Resources, Coastal Management Section. An interagency meeting was held on 2 December 1981 at the NOD to discuss operation and monitoring procedures for the proposed diversion structures.

8.1.4. The Draft Interim Report and EIS on Freshwater Diversion to Barataria and Breton Sound Basins was released to the public in May 1982. Since that time, numerous public meetings, as well as meetings with state and local officials have been held. Information concerning these meetings is presented in Table 8-1. On 1 June 1982, the New Orleans District held a meeting at the Rivergate in New Orleans, Louisiana, to present the TSP to the public for comment and discussion. Approximately 140 people attended the June public meeting and 43 people made statements. The majority of the people commenting on the plan favored the concept of freshwater diversion but about half opposed the TSP. Most of the opposition was directed against the west bank diversion site at Bayou Lasseigne and came from residents of St. Charles, St. John the Baptist, St. James, and Lafource parishes. These four parishes would be the most directly affected by the diversion. The comments were primarily concerned with the perceived possibility of

flooding and poor water quality that would result from the introduction of Mississippi River water into Lac Des Allemands and with the acquisition of the lands necessary for the diversion. Several parish officials asked in their statements that the Corps hold additional meetings in their parishes to give local people a better opportunity to express their views. In response to the requests for parish-level meetings, the New Orleans District participated in three additional parish sponsored meetings in June. The dates and location of these meetings are presented in Table 8.1.

8.1.5. The people attending these meetings represented a broad spectrum of the parish population--local residents, businessmen, fishermen, landowners, and elected officials. The majority of the people voiced strong opposition to the proposed diversion plan at Bayou Lasseigne. Major concerns included flooding and possible effects on local drainage, and water quality of the Mississippi River water. Other concerns in Lac Des Allemands included possible adverse effects of diversion on fish and wildlife and on jobs related to the associated fishing, hunting, and trapping industries. Concern was also expressed over the effects of siltation in Lac Des Allemands.

8.1.6. In the 30-day comment period that followed the 1 June 1982 public meeting, the New Orleans District (NOD) received written statements regarding the TSP. The comment period remained open for 30 days following the public meeting to allow people to submit oral or written statements for the record. These additional comments followed a trend similar to those presented at the public meetings. Most people favored the concept of freshwater diversion, but most local officials and residents were opposed to the Bayou Lasseigne site. Due to this opposition to the Bayou Lasseigne site, NOD elected to analyze alternate sites.

TABLE 8-1

MEETINGS

LOUISIANA COASTAL AREA STUDY

LOCATION	DATE	PRIMARY ATTENDEES/PARTICIPANTS
Rivergate, New Orleans, LA	1 June 1982	Federal, state, local officials, and general public
St. James Parish Courthouse Vacherie, LA	9 June 82	Parish council and parish residents
St. Charles Parish, St. Gertrude, Church Hall, Des Allemands, LA	17 June 82	Parish council and parish residents
St. John the Baptist Parish Courthouse, Edgard, LA	21 June 82	Police jury and parish residents
Louisiana Department of Natural Resources, Baton Rouge	10 Aug 82	Governor's Coastal Protection Task Force
Louisiana Department of Natural Resources, Baton Rouge, LA	18 Aug 82	Coastal Protection Task Force Technical Subcommittee
Louisiana Department of Wildlife and Fisheries Baton Rouge, LA	28 Oct 82	Coastal Protection and Task Force Technical Subcommittee
Louisiana Department of Natural Resources, Baton Rouge, LA	29 Nov 82	Coastal Protection Task Force and Technical Subcommittee
Bollinger Shipyard, Lockport, LA	6 Dec 82	Chairman, Coastal Protection Task Force; President, St. Charles Parish

TABLE 8-1 (CONTINUED)

LOCATION	DATE	PRIMARY ATTENDEES/PARTICIPANTS
St. Charles Parish Courthouse, Hahnville, LA	9 Dec 82	Chairman, Coastal Protection Task Force, St. Charles Parish Council
St. Charles Parish Courthouse, Hahnville, LA	6 Jan 83	Parish Coastal Zone Management Advisory Committee
Bollinger Shipyard, Lockport, LA	18 Jan 83	Chairman, Coastal Protection Task Force; Representatives of Orleans, Jefferson, St. Charles, St. John the Baptist Parishes
St. Charles Parish, Lakewood Jr. High School	20 Jan 83	Federal, state, local officials, and general public
St. Charles Parish Courthouse	11 July 1983	St. Charles Parish Council; Federal, state, local officials, and general public
Ormond Country CLub Destrehan, LA	17 May 1984	St. Charles Parish Council and CZM Advisory Board, state officials
St. Charles Parish	4 June 1984	St. Charles Parish Council; Federal, state, and local officials, and general public
Jefferson Parish Courthouse Gretna, LA	31 July 1984	Federal, state, local officials, and general public

8.1.7. When the opposition became apparent, NOD personnel held a series of meetings with the Governor's Coastal Protection Task Force and Technical Subcommittee thereof to review alternative plans for diversion of fresh water into the Barataria Basin. Through this series of meetings, support for the Davis Pond site evolved, and NOD was asked to further investigate and develop information concerning the feasibility of this site. The purpose of the revised draft EIS was to present this information.

8.2. REQUIRED COORDINATION

A revised draft Environmental Impact Statement (EIS) was furnished to Federal agencies, state agencies, and other interested parties for their review in June 1984. Circulation of this final report will accomplish the remaining required coordination with the National Park Service (NPS) and State Historic Preservation Officer (SHPO) as provided under the National Historic Preservation Act; and the NPS as provided under the Federal Water Project Recreation Act.

8.3. STATEMENT RECIPIENTS

All US senators and congressmen, Federal, and state agencies listed below have received copies of the Main Report and accompanying Revised Draft EIS (Volume I) and Report Appendixes (Volumes II and III). All others listed below have received at least copies of Volume I or a Notice of Availability. For those interested in reviewing Volumes I, II, and III, copies have been furnished the libraries listed below. Distribution of the final volumes will be the same as that of the draft volumes except that the Public Views and Responses Appendix (Volume 4) will be added.

Honorable J. Bennett Johnston
Honorable Russell B. Long
Honorable Lindy (Mrs. Hale) Boggs
Honorable John B. Breaux

Honorable Jerry Huckaby

Honorable Robert L. Livingston

Honorable Gillis W. Long

Honorable W. Henson Moore

Honorable William "Billy" Tauzin

Honorable Buddy Roemer

FEDERAL AGENCIES

Department of the Interior, Office of Environmental Project Review

US Department of Interior, Special Assistant to Secretary, Atlanta, GA

US Department of Interior, Director, Water Resource Policy Coordinator

US Department of Interior, Heritage Conservation and Recreation Service, South Central Region Office

US Department of the Interior, Fish and Wildlife Service, Field Supervisor, Lafayette, LA

US Geological Survey, Regional Hydrologist, Lakewood, CO

US Geological Survey, District Chief, WRD, Baton Rouge, LA

National Park Service, Director, Southwest Region

US Environmental Protection Agency, Regional EIS Coordinator, Region VI

US Environmental Protection Agency, the Administrator

US Department of Commerce, Joyce M. Wood, Director, Office of Ecology and Conservation

US Department of Commerce, National Oceanic & Atmospheric Administration National Marine Fisheries Service, Southeast Region

National Marine Fisheries Service, Mr. Donald Moore, Environmental Assessment Branch

US Departmental of Commerce, Executive Director, Gulf of Mexico Fishery Management Council

US Department of Commerce, Natural Resource Economics Division, Economics, Statistics and Cooperative Service, Little Rock, AR

US Department of Commerce, Secretarial Represenative, Dallas, TX

US Department of Commerce, Regional Economic Analysis Division, Bureau of Environmental Analysis

US Department of Commerce, Water Resource Coordinator, Office of Regulatory Policy

US Department of Commerce, Director, Economic Development Administration, Regional Office

US Department of Commerce, Director, Office of Habitat Protection, National Marine Fisheries Service

US Department of Commerce, National Weather Service, Regional Hydrologist, Southern Region

US Department of Commerce, Interagency Coordinator, Office of Coastal Zone Management

US Department of Agriculture, Area Director, Forest Service

US Department of Agriculture, State Director, Farmers Home Administration

US Department of Agriculture, Washington, D.C.

US Department of Agriculture, Southern Region, Regional Forester, Forest Service

US Department of Transportation, Administrator, Federal Highway Administration, Washington, D.C.

US Department of Transportation, Administrator, Federal Railroad Administration

US Department of Health, Education, and Welfare, Food and Drug Administration, Regional Shellfish Consultant

US Department of Energy, Director, Environmental Compliance, Washington, D.C.

Federal Emergency Management Administration, Washington, D.C.

Soil Conservation Service, Harry S. Rucker, State Conservationist

US Department of Transportation, Deputy Director for Environmental and Policy Review

Federal Highway Administration, Division Administrator, Region VI

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

US Department of Health and Human Services, Dr. Stephen Margolis, Chief, Environmental Affairs Group, CDC, Atlanta, GA

US Department of Housing and Urban Development, Regional Administrator, Region VI

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

Advisory Council on Historic Preservation, Golden, CO

STATE AGENCIES

Louisiana Department of Natural Resources, Coastal Resource Analyst, Division of State Land's, P. O. Box 44396

Louisiana Department of Natural Resources, Coastal Resources Program, Consistency Coordinator, P. O. Box 44396

Louisiana Department of Health and Human Resources, Office of Health Services and Environmental Quality

Louisiana Department of Transportation and Development, Office of Public Works, Assistant Secretary

Louisiana Department of Highways, Mr. Vincent Pizzolato, Public Hearings and Environmental Impact Engineer

Louisiana Forestry Commission, Baton Rouge, LA

Louisiana Department of Wildlife & Fisheries, Mr. Maurice B. Watson Ecological Studies Section

Louisiana Department of Wildlife & Fisheries, Secretary

Louisiana Department of Natural Resources, Office of Environmental Affairs, Water Pollution Control Division

Louisiana Department of Natural Resources, Title and Records Section, Division of State Lands, P.O. Box 44124

Louisiana Department of Commerce, Research Division, Mrs. Nancy P. Jensen

Louisiana Department of Culture, Recreation, and Tourism, State Historic Preservation Officer

Louisiana Department of Culture, Recreation, and Tourism, Office of State Parks

Louisiana Department of Natural Resources, Office of Environmental Affairs, P. O. Box 44066

Louisiana Department of Natural Resources, Office of Forestry

Louisiana State Planning Office, Ms. Joy Bartholomew, Policy Planner

Louisiana State University, Center for Wetland Resources, Dr. Jack R. Van Lopik

Louisiana State University, Department of Geography and Anthropology, Curator of Anthropology

Louisiana State University, Coastal Studies Institute, Library

Governors Coastal Protection Task Force

Association of Levee Boards of Louisiana, Executive Director, Baton Rouge, LA

Water Resources Research Institute, Director, Louisiana State University

Office of Intergovernmental Relations, Office of the Governor, Baton Rouge, LA

ENVIRONMENTAL

Mr. Oliver Houck

Ecology Center of Louisiana, Inc., J. Vincent, President

Orleans Audubon Society, Mr. Barry Kohl

Environmental Defense Fund

Clio Sportman's League

Westbank Sportsman and Conservation Club

Barataria Bassmasters of Marrero, Inc.

Jefferson Rod & Gun Club

Greater New Orleans Tarpon Club

Sierra Club, Delta Chapter, New Orleans

Orleans Audubon Society, c/o Clifford Danby

Regional Representative, National Audubon Society, Southwestern Regional Office.

Field Research Director, National Audubon Society

Director of Audubon Sanctuaries, National Audubon Society, Miles Wildlife Sanctuary

National Sierra Club, San Francisco, CA

Thibodaux-Houma Sierra Club, c/o Bob Blair

Mr. Michael Halle

Chappepeela Group Sierra (Florida Parishes), c/o Hulin Robert

National Wildlife Federation, Washington, DC

Randy P. Lanctot, Executive Director, Louisiana Wildlife Federation

Wildlife Management Institute, South Central Representative, Mr. Murray T. Walton

The Conservation Foundation, Washington, DC

James W. Keeton, Trout Unlimited, San Antonio, TX

Robert F. Philip, Trout Limited

Natural Resources Defense Council Inc.

Environmental Information Center

League of Women Voters of the US

Slidell Sportmen's League

Mr. Donald Landry, President, South Louisiana Environmental Council

Mr. Sidney Rosenthal, Jr., Field Agent, The Fund for Animals, Inc.

Environmental Impact Officer, Jefferson Parish, Louisiana

Captain O. T. Melvin, LaRose, Louisiana

OTHERS

Southwest Federal Region Council

President, Ascension Parish Police Jury

President, Assumption Parish Police Jury

President, Lafourche Parish Police Jury

President, Jefferson Parish Council

President, St. Bernard Parish Police Jury

President, St. Charles Parish Council

President, St. James Council

President, St. John the Baptist Parish Police Jury

President, Plaquemines Parish Commission Council

Teche Regional Clearinghouse, Thibodeaux, Louisiana

Capital Regional Planning Division, Baton Rouge, LA

Regional Planning Commission for Jefferson, Orleans and St. Bernard Parishes, New Orleans, Louisiana

Metropolitan Regional Clearinghouse, New Orleans, Louisiana

Plaquemines Parish Mosquito Control Commission

Mayor, City of New Orleans

Louisiana Farm Bureau Federation, Inc., Director of Natural Resources

Terrebonne Parish Policy Jury, Waterways and Permit Committee

Gulf States Marine Fisheries Commission

Louisiana Shipbuilders and Repair Association

Mrs. Roberta A. Scull, Government Documents Department, Library, LSU

Government Documents Division, Earl K. Long Library, UNO

Sea Grant Legal Program

Chairman, Environmental Committee, Bonnet Carre' Rod and Gun Club

Lake Pontchartrain Sanitary District

Lafayette Natural History Museum and Planetarium

Mr. J. H. Jones, Professor, Department of Economics and Finance, College of Administration and Business, Louisiana Tech University

Mr. C.C. Lockwood, Wildlife Photographer, Cactus Clyde Productions

Mr. Charles W. Mallory, Vice-President, Hittman Associates, Inc.

Mr. R. W. Collins

Mr. Freddy Trosclair, Jr.

Mr. Joel D. Patterson, Manager, Environmental Affairs Section, Middle South Services, Inc.

Mr. Ronnie W. Duke, T. Baker Smith & Son, Inc.

Mr. Warren Mermilliod, Marine Advisory Agent, Louisiana Cooperative Extension Service, US Department of Agricultural, LSU

Mr. George Pivach, Jr.

Mr. Anatoly Hochstein

LIBRARIES

US Department of Defense, US Army Corps of Engineers, New Orleans District Library

New Orleans Public Library, Main Library

Plaquemines Parish Public Library

Louisiana State University Library

Earl K. Long Library, University of New Orleans, Lakefront

St. Charles Parish Public Library, Westbank

West Bank Regional Library

Jefferson Parish Public Library

Lafourche Parish Public Library

St. John the Baptist Parish Public Library

St. James Parish Public Library

St. Bernard Parish Public Library

Nicholls State University Library

Tulane University Library

8.4. STATEMENT COMMENTATORS

FEDERAL AGENCIES

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

United States Department of Agriculture,
Soil Conservation Service, Alexandria, LA

United States Department of Commerce,
Gulf of Mexico Fishery Management Council, Tampa, FL

United States Department of Commerce,
National Marine Fisheries Service, St. Petersburg, FL

United States Department of Commerce,
National Ocean Service, Washington, D.C.

United States Department of Health and
Human Services, Food and Drug Administration, Dallas, TX

United States Department of Housing and Urban Development,
Fort Worth, TX
United States Department of the Interior
Office of Environmental Project Review, Albuquerque, NM
United States Department of Transportation
United States Coast Guard, New Orleans, LA
United States Environmental Protection Agency
Dallas, TX

STATE AGENCIES

Louisiana Department of Culture, Recreation, and
Tourism, Office of Cultural Development, Baton Rouge, LA
Louisiana Department of Environmental Quality, Baton Rouge, LA
Louisiana Department of Natural Resources, Baton Rouge, LA
Louisiana Department of Transportation and
Development, Baton Rouge, LA
Louisiana Department of Wildlife and Fisheries, Baton Rouge, LA

ORGANIZATIONS AND INDIVIDUALS

Acadia Plantation, Thibodaux, LA
Barataria Civic Improvement Association, Marrero, LA
Coastal Environments, Inc., Baton Rouge, LA
Delacroix Corporation, New Orleans, LA
Fromherz Engineers, Inc., New Orleans, LA
Greater LaFourche Port Commission, Galliano, LA
Michael Halle, New Orleans, LA
Ralph Pausina, Pausina Oyster Corporation, New Orleans, LA
Rathborne Land Company Inc., Harvey, LA
St. Charles Parish Waterwork, District No. 2, Luling, LA
Tenneco LaTerre Company, Houma, LA
Tulane Law School, Oliver A. Houck, New Orleans, LA

8.5. PUBLIC VIEWS AND RESPONSES

Public views expressed to this agency concerning saltwater intrusion, land loss, and concomitant declines in fish and wildlife productivity resulted in preparation of the draft, revised draft, and final reports on freshwater diversion under the authority of the Louisiana Coastal Area Study. The planning objectives established for this study were in response to concerns and views of the public. As discussed in Section 1 of this final EIS, several controversial issues exist which will require resolution prior to project implementation. These issues have been brought forth at public meetings and in written comments on the report. Public views and responses are presented in Volume 4, Appendix L.

TABLE 9. INDEX

(LOUISIANA COASTAL AREA STUDY INTERIM REPORT ON FRESHWATER DIVERSION TO BARATARIA AND BRETON SOUND BASINS)

Subject	Environmental Impact Statement	Main Report (References Incorporated)	Report Appendixes (References Incorporated)
Affected Environment	pp. EIS-44-60	pp. 9-18	App. A, pp. A-13-54; App. C, pp. C-2-28; App. E, pp. E-16-17; App. G, pp. G-2-18; App. H, pp. H-68-76, 89-93, 105-113, 116-122, 136-137, 145-148
Alternatives	pp. EIS-11-23	pp. 35-45	App. B, pp. B-19-62; App. C, pp. 120-128; App. E. pp. E-18-25; App. F, pp. F-39-41; App. G, pp. G-48-49
Areas of Controversy	p. EIS-3	—	—
Coastal Zone Management	pp. EIS-3,5	—	App. J
Comparative Impacts of Alternatives	pp. EIS-24-43	pp. 45-65	App. B, pp. B-30-41; App. E, pp. E-18-22; App. F, pp. F-39-41; App. G, pp. G-48-49.
Economics	pp. EIS-21-23, 43	pp. 15-17; 22-25 67-68, 73-74	App. A, pp. A-13-22; App. B, pp. B-26, 30-41 App. C, pp. C-81-118; App. G, pp. G-2-18
Environmental Conditions	pp. EIS-44-45	pp. 8-17	App. A, pp. A-13-54; App. E, pp. E-16-17; App. G, pp. G-2-18
Environmental Effects	pp. EIS-24-43, 61-140	pp. 46-66	App. B, pp. B-11-13; App. C, pp. C-62-72; App. E, pp. E-18-25; App. G, pp. G-48-49; App. H, pp. H-80-88, 96-104, 114-115, 132-135, 142-143, 148-150
Fish and Wildlife Coordination Act Report	—	—	App. D, p. D-111
404(b)(1) Evaluation	pp. EIS-2, 79	—	App. I
Habitat Projections	pp. EIS-11, 61-70	pp. 18-24	App. D, pp. D-84-107
Implementation Responsibilities	pp. EIS-21-23	pp. 56, 59, 62, 65, 76-78	App. B, pp. B-32, 38, 41
List of Preparers	pp. EIS-141-142	—	—
Literature Cited	pp. EIS-161	—	App. A, pp. A-95-100; App. C, pp. C-73-74; App. D, pp. D-5,35,60-61,107 App. H, pp. H-158-159

(LOUISIANA COASTAL AREA STUDY INTERIM REPORT ON FRESHWATER DIVERSION TO BARATARIA AND BRETON SOUND BASINS)
(Continued)

Subject	Environmental Impact Statement	Main Report (References Incorporated)	Report Appendixes (References Incorporated)
Major Conclusions and Findings	pp. EIS-1-3	pp. 73-75, 82-83	App. B, pp. B-74-76; App. C, pp. C-130-131; App. H, pp. H-151-152; App. I, pp. I-23-24
Monitoring	pp. EIS-84, 121, 133	pp. 72-73	App. C, pp. C-119-121; App. H, pp. H-153-157; App. K, pp. K-6-12
Need for and Objectives of Action	pp. EIS-7-10	pp. 3-5, 28-31	App. A, pp. A-2-3
Operation Criteria	p. EIS-88	pp. 70-72	App. K, pp. K-2-5
Planning Objectives	p. EIS-10	pp. 31-32	App. A, pp. A-93-94; App. B, p. B-2
Plans Considered in Detail	pp. EIS-13-19	pp. 35-65	App. B, pp. B-19-62; App. C, pp. C-12-129; App. E, pp. E-18-25; App. F, pp. F-39-41
Plans Eliminated from Further Study	p. EIS-11	pp. 35-45	App. B, pp. B-2-18
Public Concerns	p. EIS-9	PP. 78-81	APP. L
Public Involvement Program	pp. EIS-143-147	pp. 78-81	APP. L
Public Views and Responses	p. EIS-156	pp. 78-81	APP. L
Relationship of Plans to Environmental Requirements	p. EIS-5	—	App. E, p. E-27
Required Coordination	p. EIS-148	—	—
Significant Resources	pp. EIS-24-43, 44-60	—	—
Agricultural Lands	pp. EIS-27,48, 73-75	pp. 12, 13, 17, 54, 57, 60, 63	App. A, pp. A-18-19; App. B, pp. B-11-13, 31, 34, 37, 40, 71
Archeological Resources	pp. EIS-42, 60, 138-140	pp. 15, 20, 22, 75	App. A, pp. A-51-54, 66, 90; App. B, pp. B-30, 33, 36, 39; App. E, pp. E-14-15, 17. App. I, p. I-21; App. J, p. J-11
Barrier Islands	pp. EIS-29, 48-49, 78	—	App. A, p. A-24
Blue List Species	pp. EIS-33, 52, 123-124	—	App. A, p. A-45

(LOUISIANA COASTAL AREA STUDY INTERIM REPORT ON FRESHWATER DIVERSION TO BARATARIA AND BRETON SOUND BASINS)
(Continued)

Subject	Environmental Impact Statement	Main Report (References Incorporated)	Report Appendixes (References Incorporated)
Bottomland Hardwood Forest	pp. EIS-25, 47, 66-67	pp. 13, 20-21	App. A, p. A-40; App. B, pp. B-30, 33, 36, 39; App. D, pp. D-85-86, 91-93
Endangered Species	pp. EIS 2, 5, 32, 51, 120-120	pp. 14, 54, 57, 60, 63	App. A, p. A-45; App. B, pp. B-30, 33, 36, 37, 68-69; App. D, pp. D-6-74; App. I, pp. I-18, 21; App. J, p. J-12
Fisheries	pp. EIS-30, 49-50, 78-113	pp. 14-16, 22-24, 26-27, 54, 57, 60, 63	App. A, pp. A-45-49; App. B, pp. B-30, 33, 36, 39, 69; App. I, pp. I-16-17
Marshes	pp. EIS-24, 46-47, 61-66	pp. 13, 20-21, 54, 57, 60, 63	App. A, pp. a-38-39; App. B, pp. B-30, 33, 36 39, 67; App. D, pp. D-84-107
Minerals	pp. EIS-37, 55-56, 130-131	pp. 16	App. A. pp. A-19-21
Mississippi River	pp. EIS-38, 56, 131-132	pp. 10-11	App. A, pp. A-28-29; App H, pp. H-68, 89 105, 116, 137, 145
National Register Properties	pp. EIS-41, 59-60, 137-138	pp. 15, 54, 57, 60, 63	App. A, p. A-53; App. B, pp. B-30, 33, 36, 39, 69; App. E, pp. E-14-16
Natural and Scenic Streams Systems	pp. EIS-5, 40, 57-58, 131-132	—	
Nesting Colonies	pp. EIS-34, 53, 124-126	—	App. A, p. A-43
Recreation	pp. EIS-35, 53-54, 126-128	pp. 15, 22	App. A, pp. A-49-50, 65, 88-89; App. B, pp. B-31, 34, 37, 40; App. F, pp. F-5, 29-37; App. G; App. I, pp. I-19-21; App. J, p. J-12
Section 122 Resources	p. EIS-45	pp. 54-55, 57-58, 60-61 63-64	App. B, pp. B-30-41; App. E, pp. E-6-8

(LOUISIANA COASTAL AREA STUDY INTERIM REPORT ON FRESHWATER DIVERSION TO BARATARIA AND BRETON SOUND BASINS)
(Continued)

Subject	Environmental Impact Statement	Main Report (References Incorporated)	Report Appendixes (References Incorporated)
State Wildlife Management Areas	pp. EIS-36, 54-55, 124-125	p. 14	App. A, p. A-62; App. G, pp. G-6, 9-15 App. I, p. I-18
Water Bodies	pp. EIS-28, 48, 75-77	pp. 10,-12, 18-19, 54, 57, 60, 63	App. A, pp. A-30-31, 84; App. B, pp. B-30, 33, 36, 39, 67
Water Quality	pp. EIS-39, 56-58, 132-135	pp. 11-12, 19, 54, 57, 59, 62	App. A, pp. A-33-41; App. B, pp. B-30, 33, 36, 39, 67-68; App. H; App. I, pp. I-8-18; App. J, pp. J-5-11, 22-24
Wildlife	pp. EIS-31, 50-51, 114-119	pp. 13-14, 17, 54, 57, 59, 62	App. A, pp.A-44-56, 72-76, 88-89; App.B, B-30, 33, 36, 39, 69; App. F, pp. F-8-9, 25, 27-29; App. I, p. I-18
Wooded Swamp	pp. EIS-26, 47-48, 68-72	pp. 13, 20	App. A, pp. A-43, 73-75, 83, 97; App. B, pp. B-30, 33, 36, 39; App. D, pp. D-85-86, 91-93
Statement Recipients	pp. EIS-148-155	—	—
Study Authority	pp. EIS-7-8	pp. 2-3	App. I, p. I-3
Table of Contents	p. EIS-6	p. i	Appendixes A-K, p. i
Unresolved Issues	p. EIS-4	—	—
Without Condition (No Action)	pp. EIS-11-12	pp. 18-24	App. A, pp. A-66-67; App. B, pp. B-30-41; App. D, pp. D-84-88, 91-94

10. LITERATURE CITED

Adkins, G. 1972. A study of the blue crab fishery in Louisiana. Louisiana Wildlife and Fisheries Commission, Oysters, Water Bottoms, and Seafoods Division, Technical Bulletin 3.

Aquanotes. 1981. Land loss; coastal zone crisis. Louisiana State University Sea Grant College Program. Vol. 10, Issue 3.

Barrett, B.B, and M.C. Gillespie. 1973. Primary factors which influence commercial shrimp production in coastal Louisiana. Louisiana Wildlife and Fisheries Commission, Oysters, Water Bottoms, and Seafoods Division, Technical Bulletin 9.

Beavers, Richard C. 1977. The Archeological Significance of the Barataria Basin, Southeastern Louisiana. On file at Jean Lafitte NHP.

Benson, N.G., Editor. 1981. Life history requirements of selected finfish and shellfish in Mississippi Sound and adjacent areas. US Fish and Wildlife Service, Biological Services Program, Washington, DC GWS/OBS-81/51.

Blus, L.J., Ted Joanen, Andre A. Belisle, and R.M. Prouty. 1975. The brown pelican and certain environmental pollutants in Louisiana. Bulletin of Environmental Contamination and Toxicology. Vol. 13, No. 6, New York.

Butler, P.A. 1949. Gametogenesis in the oyster under conditions of depressed salinity. Biological Bulletin, Vol. 96, No. 3., pp. 263-269.

Butler, P.A. 1953. The Southern Oyster Drill. Proc. Nat. Shellfish Assoc., 44:67-75.

Cavit, M.H. 1979. Dependence of menhaden catch on wetland habitats: a statistical analysis. Unpublished report submitted to US Fish and Wildlife Service, Ecological Services Field Office, Lafayette, Louisiana. US Fish and Wildlife Service, Office of Biological Services, National Coastal Ecosystems Team. 12pp.

Chapman, C.R. 1959. Oyster drill (Thais haemostama) predation in Mississippi Sound. 1958. Proc. Nat. Shellfish Assoc., 49:87-97.

Conner, J.V. and F.M. Truesdale. 1973. Ecological implications of a freshwater impoundment in a low salinity marsh. Pages 259-276 in P.H. Chabreck, ed. Prceedings of the coastal marsh and estuary management symposium. Louisiana State University, Baton Rouge.

Copeland, B.J., and T.J. Bechtel. 1974. Some environmental limits of six Gulf Coast organisms. Contributions in Marine Science 18: 169-204.

Craig, N.J., R.E. Turner, and J.W. Day, Jr. 1979. Land loss in Coastal Louisiana. Pages 227-254 in: J.W. Day, Jr., D.D. Culley, Jr., R.E. Turner, and A.J. Mumphrey, Jr. eds. Proc. Third Coastal Marsh and Estuary Management Symposium. Louisiana State University, Baton Rouge.

Darnell, R.M. 1961. Trophic spectrum of an estuarine community based on studies of Lake Pontchartrain, Louisiana. Ecology 42:553-568

Dugas, R.J. 1977. Oyster distribution and density on the productive portion of state seed grounds in southeastern Louisiana. Louisiana Department of Wildlife and Fisheries, Seafoods Division, Technical Bulletin 23.

Dugas, R.J. (personal communication, 26 September 1979)

Dugoni, J.A. 1980. Habitat utilization, food habits, and productivity of resting southern bald eagles in Louisiana. M.S. Thesis Louisiana State University, Baton Rouge. 151 pp.

Fontenot, B.J., Jr. 1970. Blue crab, pp. 57-58 in Louisiana Wildlife and Fisheries Commission, 13th biennial report 1968-1969. New Orleans.

Ford, T.B., and L.S. St. Amant. 1971. Management guidelines for predicting brown shrimp, Penaeus aztecus, production in Louisiana. Proceedings of the Gulf and Caribbean Fisheries Institute 23: 149-161.

Frost, M.O. 1938. Always original. Jefferson Parish (Louisiana) Yearly Review 0(0): 53-74.

Galstoff, P.S. 1964. The Amercian oyster, Crassostrea virginica (Gmelin). US Department of the Interior, Fish and Wildlife Service, Fish. Vol. 64.

Gunter, G., J.Y. Christmas, and R. Killebrew. 1964. Some relations of salinity to population distributions of motile estuarine organisms with special reference to Penaeid shrimp. Ecology 45:181-185.

Harris, A.H. 1973. Louisiana estuarine-dependent commercial fishery production and values (regional summary and WRPA analysis of production and habitat requirements). Unpublished report prepared for US Department of Commerce, National Marine Fisheries Service, Water Resources Division., St. Petersburg, Florida.

Hopkinson, Charles S. and John W. Day. 1980. Aquatic productivity and water quality at the upland-estuary interface in Barataria Basin, Louisiana. Louisiana State University.

Jaworski, Eugene. 1970. Biogeography of the blue crab fishery, Barataria estuary, Louisiana. Unpublished PhD. Disseration. Louisiana State University, Baton Rouge, LA.

Jaworski, Eugene. 1971. Decline of the soft-shell blue crab fishery in Louisiana. Environmental Quality Note 4. Texas A&M University, College Station, TX 33 pp.

Jaworski, Eugene. 1972. The Blue Crab Fishery, Barataria Estuary, Center for Wetland Resources, Louisiana State University, Baton Rouge, LA. 112pp.

Jaworski, Eugene. 1979. History and status of Louisiana's soft-shell blue crab fishery. Proceedings of the blue crab colloquim. Oct. 18-19, 1979, 153-157.

Klimas, C.V., Martin, C. O., and Teaford, J.W. 1981. "Impacts of Flooding Regime Modification on Wildlife Habitats of Bottomland Hardwood Forests in the Lower Mississippi Valley," Technical Report EL-81-13, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Lindall, W,M,, J.R. Hall, J.E. Sykes, and E.L. Arnold, Jr. 1972. Louisiana coastal zone: analyses of resources and resource development needs in connection with estuarine ecology. Sections 10 and 13 - fishery resources and their needs. Prepared by National Marine Fisheries Service Biological Laboratory, St. Petersburg, Florida, for Department of the Army, New Orleans District, Corps of Engineers.

Loosanoff, Victor L. 1965. The Amercian or eastern oyster. US Fish Wildl. Serv., Bur. Com. Fish Circ. No. 205. 36 pp.

May, E.B. and D.G. Bland. 1969. Survival of young oysters in areas of different salinity in Mobile Bay. Proc. 23rd Annual Conf. Southeastern Assoc. of Game and Fish Comm. 519-521pp.

Montz, G.N. 1975a. Master List of Herbs, Ferns and Fern Allies and Vine of the New Orleans District. US Army Corps of Engineers, New Orleans District, Mimeograph Report. 72 p.

Montz, G.N. 1975b. Master List of Trees and Shrubs of the New Orleans District. US Army Corps of Engineers, New Orleans District, Mimeograph Report. 30 p.

More, W.R. 1969. A contribution to the biology of the blue crab (Callinectes sapidus, Rathbum) in Texas, with a description of the fishery. Texas Parks and Wildlife Department. Technical Series No. 1. 31pp.

National Fish and Wildlife Laboratory. 1980. Selected vertebrate endangered species of the seacoast of the United States: Brown Pelican. US Fish and Wildlife Service, Biological Services Program; FWS/OBS/90/01.40; March 1980. 16pp.

National Marine Fisheries Service landings data, 1963-1976.

National Park Service. 1981. Draft General Management Plan: Development Concent Plan and Environmental Assessment of Jean Lafitte National Historical Park, Louisiana.

Odum, W.E., J.C. Zieman, and E.J. Heald. 1973. The importance of vascular plant detritus to estuaries. Pages 91-114 in R.H. Chabreck ed. Proceedings of the coastal marsh and estuary management symposium. Louisiana State University, Baton Rouge, LA.

Peters, D.S. and W.E. Schaaf. 1981. Food requirements and sources for juvenile menhaden. Trans. Am. Fish. Soc. 110: 317-324.

Portnoy, J.W. 1977. Nesting colonies of seabirds and wading birds - coastal Louisiana, Mississippi, and Alabama. US Fish and Wildlife Service, Biological Services Program. FWS/OBS-77/07. 126pp.

Rogers, B.D. 1979. The spatial and temporal distribution of Atlantic croaker, Micropogon undulatus, and spot, Leiostomus xanthurus, in the upper drainage basin of Barataria Bay, Louisiana. M.S. Thesis, Louisiana State University, Baton Rouge. 96 pp.

Simoneaux, L.F. 1979. The distribution of menhaden, genus Brevortia, with respect to salinity, in the uper drainage basin of Barataria Bay, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 96p.

Simmons, E.G., and J.P. Breuer. 1962. A study of redfish, Scianops ocellata Linnaeus and black drum, Pogonias cromis Linnaeus. Publications of the Institute of Marine Science, University of Texas 8:184-211.

Snow, C. 1973. Habitat management series for endangered species. Rep. 5. Southern bald eagle and northern bald eagle. U.S.D.I., Bur. Land Manage., Portland, Ore. 58 pp.

St. Amant, L. 1938. Studies on the distribution of the Louisiana oyster drill. Thais floridana Haysae Clench. Master's Thesis. Louisiana State University, Baton Rouge.

St. Amant, L. 1964. Louisiana leads in oyster production. Louisiana Department of Wildlife and Fisheries, Wild. Educ. Bull. 84. 11pp.

St. Amant, L.S., J.G. Broom, and T.B. Ford. 1965. Studies of the brown shrimp, Penaceus aztecus, in Barataria Bay, Louisiana, 1962-1965. Bulletin of Marine Science of the Gulf and Carribbean Fisheries Institute 181:-16.

Tabb, D.C. 1966. The estuary as a habitat for spotted seatrout, Cynoscion nebulosus. Am. Fish. Soc. Spec. Publ. 3:59-67.

Turner, R.E. 1977. Intertidal vegetation and commercial yields of penaeid shrimp. Trans. Am. Soc. 106(5): 411-416.

Turner, R.E. 1979. Louisiana's coastal fisheries and changing environmental conditions. Pages 363-370 in J.W. Day, Jr., D.R. Culley, Jr., R.E. Turner, and A.J. Mumphrey, Jr. eds. Proceedings of the third coastal marsh and estuary management symposium. Louisiana State University, Baton Rouge.

US Environmental Protection Agency. 1971. The economic and social importance of estuaries. Estuarine Poll. Study Serc., US Government Printing Office, Washington, D.C.

US Fish and Wildlife Service. 1980. A planning aid report on the Mississippi and Louisiana Estuarine Areas Study. Lafayette, Louisiana. 86 pp.

US Fish and Wildlife Service. 1982. Draft fish and wildlife Coordination Act Report for Louisiana Coastal Area Study, Lafayette, Louisiana. 85 pp.

Venkataramiah, A., G.J. Lakshmi, and G. Gunter. 1974. Studies on the effects of salinity and temperature on the commercial shrimp, Penaeus aztecus Ives, with special regard to survival limits, growth, oxygen consumption and ionic regulation. US Army Engineers Waterways Experiment Station, Vicksburg, MS, Contract Report H-74-2, 134 pp.

White, C.J. and C.J. Boudreaux. 1977. Development of an aerial management concept for gulf Penaeid shrimp. Louisiana Wildlife and Fisheries Commission, Oysters, Water Bottoms, and Seafoods Division, Technical Bulletin 22, 77 pp.

White, C.J. and W.J. Gaidry, III. 1973. Investigations of commercially important Penaeid shrimp in Louisiana estuaries. Louisiana Wildlife and Fisheries Commission. Oysters, Water Bottoms, Seafoods Division, and Technical Bulletin 8.

Wicker, K.M. 1980. Mississippi Deltaic Plain Region ecological characterization: a habitat mapping study. US Fish and Wildlife Service, Office of Biological Services. FWS/OBS-79107.

Yokel, B.J. 1966. A contribution to the biology and distribution of the red drum, Sciaenops ocellata. M.S. Thesis, University of Miami, Coral Gables, Florida.

Zimmerman, R.J., T.J. Minello and G. Zamora, Jr. 1984. Selection by Penaeus aztecus for Spartina alterniflora habitat in a Galveston Bay marsh. U.S. Dept. Comm. NOAA Fish. Bull. 82(2) 12 p. in press.

RECOMMENDATION

I find that the recommended plan of improvement, as developed in this report, is based on a thorough analysis and evaluation of all practicable alternative courses of action. The plan produces net benefits in excess of cost and has a favorable benefit-to-cost ratio. It involves more disruption of existing facilities than other alternative plans considered, but causes the fewest adverse environmental impacts. Where the proposed action has an adverse effect, this effect is either minimized or substantially outweighed by beneficial social, economic and environmental effects. The plan has been endorsed by non-Federal interests. On balance, the total public interest could best be served by implementing the plan.

I also find that the recommended plan is identical in purpose with the Mississippi Delta Region project authorized by the Flood Control Act of 1965, Public Law 89-298, (House Document Number 308, 88th Congress, 2d Session). The authorized project provides for salinity control structures on the east bank and on the west bank of the river to introduce freshwater into the delta region for fish and wildlife enhancement. The recommended plan reconfirms, with minor changes, the viability of the authorized project plan for a freshwater diversion structure on the east bank of the river in the vicinity of Caernarvon, Louisiana. The west bank site of the recommended plan is a different site from that in the authorized project plan. The modification represented by the west bank site is within the discretionary authority of the Chief of Engineers.

I, therefore, recommend the plan to divert Mississippi River water into the Barataria and Breton Sound Basins, Louisiana, in order to retard saltwater intrusion and enhance fish and wildlife resources be implemented under the authorized Mississippi Delta Region project, as a

modification under the Chief of Engineers discretionary authority; at a first cost to the United States presently estimated at $35,600,000, Provided that, the exact amount of non-Federal contributions shall be determined by the Chief of Engineers prior to project implementation, in accordance with the following requirements of the Flood Control Act of 1965, as amended by the Water Resources Development Act of 1974, Public Law 93-251 to which non-Federal interests must agree prior to implementation:

a. Provide, without cost to the United States, all land, easements, and rights-of-way necessary for construction and operation of the works;

b. Hold and save the United States free from damages due to the construction works except where such damages are due to the fault or negligence of the United States or its contractor;

c. Operate and maintain the works after completion;

d. Contribute 25 percent of the project costs associated with fish and wildlife enhancement; and

e. Assure adequate public access to the project area.

This report serves as a general reevaluation of the east bank (Caernarvon/Big Mar) structure in the preconstruction planning effort and as a technical supporting document to accompany a postauthorization change report for the west bank (Davis Pond) structure. Preconstruction planning and engineering for the Caernarvon/Big Mar site is underway. Preconstruction planning and engineering for the Davis Pond site will follow approval of a postauthorization change report.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for implementation funding.

Eugene S. Witherspoon
Colonel, CE
Commanding

American Shrimp Canners and Processors Association

P.O. Box 50774 • New Orleans, Louisiana 70150

January 14, 1983

Colonel Robert C. Lee
U. S. Army, Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160

Dear Colonel Lee:

This letter is in regard to our Association supporting the proposed freshwater introduction into the estuarine areas of coastal Louisiana.

The American Shrimp Canners and Processors Association is a trade association currently comprised of members of the processing and marketing segments of the shrimp industry from the states of Alabama, Mississippi, and Louisiana, most of which are in Louisiana. Our member companies process nearly 75 percent of all shrimp landed in Louisiana as well as all oysters that are dedicated to canning.

It is our sincere and strong opinion that the benefits derived from this diversion of fresh water will far outweigh any possible negative impacts of any water quality problems of the Mississippi River.

The benefits of reducing an estimated 100,000 acres in the marsh loss rate (caused by saltwater intrusion) over the next 50 years is of substantial consequence for the future of the Louisiana seafood industry.

As you may know, Louisiana holds the position as the number one producing state for shrimp (in volume). But this ranking could be threatened by the continued loss of the marshlands, the nursery area for the shrimp crop.

Regarding oysters: an estimated 100 percent increase in the commercial oyster harvest in the project area, which represents a 20 percent increase in the nation's oyster harvest, is obviously very beneficial not only to the fishing, processing, and marketing segments of our industry, but also to the consumers of Louisiana.

The experience of spillway openings in recent years has taught us much about the effects of freshwater diversion and introduction into the fishery area. In most instances the heavy volume of uncontrolled entrance of riverwater had caused an immediate adverse impact to the fishery during that year, but was always followed by years of much improved harvests of various fishery products.

EXHIBIT 1

Though we are confident it has been considered in the project's plans, we, of course, would recommend monitoring and control of this project so that a limited flow would be maintained and the monitoring would include maintaining favorable levels of salinity. This would give us the beneficial aspects without the above mentioned adverse impacts.

In conclusion, we strongly recommend this proposed project and urge that it be implemented as soon as possible.

This letter can be considered a resolution as it was approved unanimously by our board of directors on this day at our quarterly board of directors meeting which was held in Mobile, Alabama.

Thank you,
AMERICAN SHRIMP CANNERS
AND PROCESSORS ASSOCIATION

Jeffery J. Scott, President

William D. Chauvin
Executive Director

EXHIBIT 1

State of Louisiana

DEPARTMENT OF WILDLIFE AND FISHERIES

JESSE J. GUIDRY
SECRETARY

400 ROYAL STREET
NEW ORLEANS 70130

DAVID C. TREEN
GOVERNOR

(504) 342-9473
January 28, 1983

Colonel Robert C. Lee, District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

On July 2, 1982 the Department of Wildlife and Fisheries provided comments relative to the interim report on proposed freshwater diversions to Barataria and Breton Sound Basins. The comments contained herein are intended to supplement the Department's initial review of the report, and to further develop some of the conceptual aspects of the proposal.

Louisiana's coastal wetlands support the nation's largest commercial fishery, alligator and wild fur harvests as well as significant recreational economies based upon sport fishing and hunting for waterfowl and game animals. It is now well documented, however, that Louisiana's coastal regions are subsiding and eroding, and some researchers have estimated a coastwide land loss rate as high as 49 square miles a year (Bauman, personal communication).

At the time when the Mississippi and Atchafalaya River systems were leveed off, the effects of severely restricting the processes of overbank flooding and distributary flow were not well known. Today it is generally understood that the discharge of nutrient and sediment-rich freshwater from the Atchafalaya and Mississippi Rivers, in concert with man-induced processes, has played a major part in controlling the rate of marshland gains or losses in Louisiana coastal areas.

The coastal marshes and estuaries provide habitat and nursery areas for a variety of fish and shellfish species. Marsh vegetation provides a source of organic material which is an important component of the detrital based food web. Recent studies tend to substantiate the view, held by most investigators, that the production of commercial and recreational fisheries is linked not only to the quality of marsh habitat but to the quantity of habitat as well. For example Turner (1977) reported that Louisiana commercial shrimp catches are directly proportional to the area of intertidal wetlands. The National Marine Fisheries

Service has stated that the total estuarine dependent commercial fisheries production of coastal Louisiana, including menhaden, shrimp, oysters, crabs, and some industrial bottomfish, has probably reached a peak and will decline in proportion to the acreages of marshland lost. Wildlife biologists would likewise agree that the production of furbearers, alligators, waterfowl, and game animals is linked in a similar way to the wetlands.

The Department has long recognized the value of freshwater introduction to the production of fish and wildlife resources. In the early 1950's and 1970's, in cooperation with the Plaquemines Parish Council, the Department contributed monies and technical assistance for the development of two sites, Bayou Lamoque (as a demonstrational project) and Bohemia on the lower Mississippi River, for the controlled introduction of freshwater into estuarine areas of Plaquemines Parish. These projects also involved monitoring and enforcement by closing contaminated areas to oyster harvests by the Louisiana Department of Health and Human Resources. Since that time the successful operation of these two freshwater diversion structures has been based upon a schedule of carefully controlled discharges and monitoring with excellent cooperation between the parish council, and the Departments of Health and Human Resources and Wildlife and Fisheries. Our assessment of these projects is that any adverse effects that may result from periodic introductions of lower quality Mississippi River water are greatly outweighed by the benefits of increased productivity. Ron Dugas (oyster biologist with the Department) indicated that oyster production has often doubled in these areas after large influxes of freshwater and that may be attributable, in large part, to more favorable salinity regimes which reduced predation and disease. The decreased salinities and subsequent increased oyster production in Breton Sound in 1974-76 were likely due to the openings of the Bonnet Carre spillway in 1973 and 1975. After conducting a preliminary analysis of data collected in Lake Pontchartrain before and after the Bonnet Carre openings, Johnny Tarver (Department biologist) observed significant increases in many populations of estuarine dependent species following the influx of large volumes of freshwater to the system.

The New Orleans Corps of Engineers in cooperation with this agency, NMFS, and the U. S. Fish and Wildlife Service, is now investigating the feasibility of enhancing habitat conditions and improving productivity of fish and wildlife resources by the introduction of freshwater into two estuaries, Barataria Bay and Breton Sound, and adjacent wetlands. These areas now support extensive commercial and sport fisheries, and contain important hunting and trapping areas, and like much of coastal Louisiana, have experienced the adverse effects of saltwater intrusion and land loss in recent years as indicated by the reduction of fresh and intermediate marsh, the concomitant expansion of saline and brackish marsh, and the conversion of large acreages of marsh to open water. Two diversion sites are now being evaluated. One for the Barataria Basin would be located near Davis Pond (river mile 118) below the community of Lone Star at which Mississippi River water would be routed into the Department owned Salvador Wildlife Management Area. The other would be located at Big Mar and would provide for a diversion of water to the Breton Sound Basin.

It becomes very evident if one looks in depth at the oyster production records for the Barataria unit, that the prime oyster seed and culturing grounds have shifted significantly northward through the bay (Van Sickle, 1981). During periods of low rainfall, low river stages and decreased freshwater influx, as was experienced during the latter part of 1981 and early 1982, very limited oyster production takes place in Barataria Bay proper because salinity levels are too high for successful production to occur. This bay, particularly the lower end, was historically a prime area for the production of oysters and has extensive areas with suitable bottoms. With proper control of the diversion structure and the introduction of freshwater adequate to maintain the average position of the 15 ppt isohaline in an area in the lower end of the bay (commonly referred to as the "Ford Line"), conditions would be suitable for increasing oyster production many fold. An increase of 100% in oyster production or more under these conditions could then be a reasonable expectation, particularly when one visualizes that such conditions would bring into a biologically productive zone the vast acreages of suitable oyster culturing bottoms which were developed in previous years of intensive culturing at the lower end of the bay.

In addition, the location of a diversion structure near the Davis Pond site would provide direct benefits to the Salvador Wildlife Management Area in the reduction of land loss rates in the area, enhancement of fish and wildlife production, and increased public hunting and fishing opportunities, while still accomplishing the overall benefits to Barataria Basin.

In Breton Sound the Department maintains an oyster seed ground reservation of some 600,000 acres. As in Barataria Bay, only a small portion of the area has been consistently productive in the past 20 years due to increasing salinity levels. If the proposed diversion structure at Big Mar is of sufficient size and functions as planned, Department biologists estimate that a considerable portion of the reservation could be restored to oyster production which could easily double present levels of production. In addition, the introduction of freshwater to the Breton Sound Basin would prove beneficial for other commercially important forms.

The Department is in agreement with the estimates for reduction of rates of marsh loss for various marsh types developed jointly by biologists for the Corps and Fish and Wildlife Services and that are cited in the report. While the Department recognizes the fact that the proposal under consideration would not completely reverse the trends of marsh loss, the diversions would reduce the rates of loss in the study area, and would aid significantly in maintaining a salinity regime more favorable to fish and wildlife production.

Based upon its experience and decades of study and observation, this Department reiterates its support for the concept of controlled freshwater introduction primarily for the enhancement of fish and wildlife habitat and resources, and is

interested and willing to cooperate in developing a program for the operation and monitoring of the diversion structures.

Sincerely,

Jesse J. Guidry

Jesse J. Guidry
Secretary

JJG/CJK/fs

EXHIBIT 2

DAVID C. TREEN
GOVERNOR

State of Louisiana
EXECUTIVE DEPARTMENT
Baton Rouge

January 21, 1982

Colonel Robert C. Lee
Commander and District Engineer
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Lee:

The State of Louisiana has within its boundaries one of the most productive and environmentally sensitive areas of the United States in its coastal zone. This tremendously valuable asset is being lost at an alarming rate. We must take whatever actions to maintain and preserve this area that are deemed to be technically and economically feasible.

Of particular concern is the marshland adjacent to the Mississippi River delta below Donaldsonville and in particular the areas downstream from New Orleans in St. Bernard and Plaquemines Parishes. Our Coastal Zone Management Commission and Legislature have been actively pursuing and developing a coastal zone program that can be timely activated to resolve problems associated with coastal erosion, salt water intrusion, land subsidence and land losses. As a result of this concerted effort Act 41 of the First Extra Session of 1981 provides a vehicle to carry out the program. The sum of Thirty-Five Million ($35,000,000) Dollars has been appropriated out of the Louisiana Investment Fund for Enhancement to the Coastal Environment Protection Trust Fund for this program.

One of the vital and high priority features of this program is a fresh water diversion structure at Caernarvon, Plaquemines Parish, Louisiana. This structure has the potential of reducing salt water intrusion and providing valuable nutrients to this once highly productive marshland area.

Your office is currently completing a study that will also indicate the value of this region. This study in conjunction with the already authorized project (Mississippi Delta Region, Louisiana; Public Law 89-298, 89th Congress) provides an immediate vehicle to proceed with planning for this project.

EXHIBIT 3

I am pleased to advise you that the State of Louisiana, as authorized by Act 41 of the 1981 Extra Session, will provide Louisiana's share of the necessary funding and at the appropriate time will provide the assurances normally required for this type project. This letter, therefore, states our intention to cooperate with the Federal government to the extent required by law in the implementation of the project, as well as our intention to provide, or to arrange for an appropriate public body of the State of Louisiana to provide, the local cooperation required by the law authorizing the project.

It is requested that you proceed with acquisition of funds necessary to develop plans to construct this facility at the earliest possible date. We will provide coordination for the project through the Office of Public Works in cooperation with Coastal Zone Management Section of the Department of Natural Resources and other appropriate entities in order to develop this site. In the interim I am asking the Office of Public Works to work with you in the consideration of the use of advance local funding, if required, to expedite the design and construction of this project.

Sincerely,

David C. Treen

DCT:nem

cc: Senator Samuel B. Nunez, Jr.
Representative Frank J. Patti
Representative Manuel A. Fernandez
Office of Public Works
Department of Natural Resources
Division of Administration
Mr. William A. Nungesser

EXHIBIT 3

Department of Transportation and Development
OFFICE OF PUBLIC WORKS
P.O. BOX 44155 CAPITOL STATION
BATON ROUGE, LA. 70804

PAUL J. HARDY
SECRETARY

DARRELL WILLIAMSON
ASSISTANT SECRETARY
342-7535

DAVID C. TREEN
GOVERNOR

March 11, 1983

Colonel Robert C. Lee
Commander and District Engineer
U.S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

RE: Davis Pond Site, St. Charles Parish
Freshwater Diversion Project

Dear Colonel Lee:

The State of Louisiana continues to maintain its vigilance in regard to management of our coastal zone resources. This valuable asset is being lost at an alarming rate. We must take the necessary steps to halt and alleviate this condition. Projects such as this freshwater diversion will be of great value in accomplishing this type of program.

We are particularly concerned with the loss of marshland adjacent to the Mississippi River system below Donaldsonville and the area on the west bank of the river that will be affected by this project. The Louisiana Legislature has been actively pursuing and developing a coastal zone program that can be utilized to help resolve problems associated with coastal erosion, salt water intrusion, land subsidence and land loss. As you are already aware Act 41 of the First Extra Session of 1981 provides a vehicle to fund this program.

One of the high priority areas for a freshwater diversion structure is at the Davis Pond site in St. Charles Parish as defined by your current studies. This structure has the potential of reducing salt water intrusion land loss, and will provide valuable nutrients to this highly productive marshland area. This project study is in conjunction with the already authorized project Mississippi Delta Region, Louisiana: Public Law 89-298, 89th Congress and provides an immediate vehicle to proceed with planning for this project.

I am pleased to advise you that the State of Louisiana, as authorized by Act 41 of the 1981 Extra Session will provide Louisiana's share of the necessary funding and at the appropriate time will provide the assurances normally required for this type project. This letter, therefore, states our intention to cooperate with the Federal Government to the extent required by law in the implementation of the project, as well as our intention to provide the local cooperation required by law authorizing this project.

EXHIBIT 4

It is requested that you proceed with acquisition of funds necessary to develop plans to construct this facility at the earliest possible date. The Office of Public Works will provide coordination for this project with the appropriate State agencies and other entities in order to develop this site.

With kindest regards,

Darrell Williamson

DARRELL WILLIAMSON
ASSISTANT SECRETARY
DW:sl

xc: Honorable David C. Treen
Department of Natural Resources
Senator Ron R. Landry
Representative Ralph Miller
Senate Committee on Natural Resources
House Committee on Natural Resources

EXHIBIT 4

State of Louisiana

DEPARTMENT OF WILDLIFE AND FISHERIES
POST OFFICE BOX 15570
BATON ROUGE, LA. 70895

J. BURTON ANGELLE, SR
SECRETARY
(504) 925-3617

EDWIN W. EDWARDS
GOVERNOR

September 10, 1984

Colonel Eugene S. Witherspoon
District Engineer
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160-0267

Dear Sir:

On July 2, 1982 the Department of Wildlife and Fisheries provided comments relative to the interim report on proposed freshwater diversions to Barataria and Breton Sound Basins. The comments contained herein are intended to address the proposal in general, and more specifically, to evaluate revisions to the original report which concern a new tentatively selected plan for Barataria Basin.

Because of its extensive coastal wetlands, Louisiana is the nation's leader in commercial fisheries production, and alligator and wild fur harvests; Louisiana also supports significant recreational economies based upon sport fishing and hunting for waterfowl and game animals.

However, it is now well documented that Louisiana's coastal areas are subsiding and eroding and some investigators have estimated a coastwide land loss rate from all causes as high as 45 square miles a year.

The state's coastal marshes and estuaries provide habitats and nursery areas for a wide variety of fish and shellfish species and marsh vegetation provides a source of organic material which is an important component of the detrital based food web. Recent scientific studies tend to substantiate the view that the production of commercial and recreational fisheries is linked not only to the quality of marsh habitat but to the quantity of habitat as well. For example, some researchers have reported that Louisiana commercial shrimp catches are directly proportional to the area of intertidal wetlands. The National Marine Fisheries Service has stated that the total estuarine-dependent commercial fisheries production of coastal Louisiana, including menhaden, shrimp, oysters, crabs, and some industrial bottomfish, has probably reached a peak and will decline in proportion to the acreages of marshland lost. Wildlife biologists would likewise agree that the production of furbearers, alligators, waterfowl, and game animals is linked in a similar way to the wetlands.

EXHIBIT 5

The Department has long recognized the value of freshwater introduction to the production of fish and wildlife resources. By the early '50's the Department and Plaquemines Parish were cooperating in the development of a site on the lower Mississippi River for the controlled introduction of freshwater into estuarine areas in the Parish. Since that time the successful operation of this freshwater diversion structure has been based upon a schedule of carefully controlled discharges and monitoring; excellent cooperation has existed between the Plaquemine Parish Council, the Louisiana Department of Health and Human Resources and the Louisiana Department of Wildlife and Fisheries. Our assessment of this project is that any adverse effects that may result from periodic introductions of Mississippi River water are greatly outweighed by the benefits of increased oyster production. Department biologists have indicated that oyster production has often doubled in these areas after large influxes of freshwater and such increases may be attributable, in large part, to more favorable salinity regimes which reduced predation and disease. The decreased salinities and subsequent increased oyster production in Breton Sound in 1974-76 were attributed to the openings of the Bonnet Carre Spillway in 1973 and 1975. After conducting a preliminary analysis of data collected in Lake Pontchartrain before and after the Bonnet Carre openings, Department biologists observed significant increases in many populations of estuarine-dependent species following the influx of large volumes of freshwater to the system.

The New Orleans Corps of Engineers in cooperation with various federal, state and local agencies, is now investigating the feasibility of enhancing habitat conditions and improving productivity of fish and wildlife resources by the introduction of freshwater into two estuaries, Barataria Bay and Breton Sound, and adjacent wetlands. These areas now support extensive commercial and sport fisheries, and are important hunting and trapping areas, and like much of coastal Louisiana, have experienced the adverse effects of saltwater intrusion and land loss in recent years. This is indicated by the reduction of fresh and intermediate marsh, the concomitant expansion of saline and brackish marsh, and the conversion of large acreages of marsh to open water. Two diversion sites are now being evaluated. One for the Barataria Basin would be located near Davis Pond (river mile 118) below the community of Lone Star at which Mississippi River water would be routed into the Department owned Salvador Wildlife Management Area. The other would be located at Big Mar and would provide for a diversion of water to the Breton Sound Basin.

It becomes very evident when oyster production records for the Barataria unit are examined, that the prime oyster seed and culturing grounds have shifted significantly northward through the bay. During periods of low rainfall, low river stages and decreased freshwater influx, as was experienced during the latter part of 1981 and early 1982, very limited oyster production takes place in Barataria Bay proper because salinity levels are too high for successful production to occur. This bay, particularly the lower end, was historically a prime area for the production of oysters and has extensive areas with suitable bottoms. With proper control of the diversion structure and the introduction of controlled amounts of freshwater adequate to maintain the average position of the

15 ppt isohaline in an area in the lower end of the bay (commonly referred to as the "Ford Line"), conditions would be suitable for increasing oyster production many fold. An increase of 100% in oyster production or more under these conditions could then be a reasonable expectation, because such conditions would bring into a biologically productive zone the vast acreages of suitable oyster culturing bottoms which were developed in previous years of intensive culturing at the lower end of the bay. Additionally, the location of a diversion structure near the Davis Pond site would provide direct benefits to the Salvador Wildlife Management Area in the reduction of land loss rates in the area, enhancement of fish and wildlife production, and increased public hunting and fishing opportunities, while still accomplishing the overall benefits to Barataria Basin.

In Breton Sound the Department maintains an area for public seed grounds of some 600,000 acres. As in Barataria Bay, only a small portion of the area has been consistently productive in the past 20 years due to increasing salinity levels. If the proposed diversion structure at Big Mar is of sufficient size and functions as planned, Department biologists estimate that a considerable portion of the seed grounds could be restored to oyster production which could conceivably double present levels of production. In addition, the introduction of freshwater to the Breton Sound Basin would prove beneficial for other important species.

We anticipate that the diversion projects would provide overall benefits to fish and wildlife resources in Barataria and Breton Sound Basins as isohalines are moved seaward by freshwater introductions. However, in areas lying landward of the 5 ppt project isohaline, there would be some losses to oyster production. This would affect approximately 10,000 acres of leased waterbottoms in Barataria Basin and some 5,000 acres in the Breton Sound Basin. While the loss of potential production in these areas is a matter of great concern to the Department, we believe that with a lifting of the existing moratorium on new lease applications, lease holders who might be adversely affected would be provided opportunities to establish productive leases in other areas.

Another matter of concern is the impact of freshwater introduction during the spring months, especially during high river years, into areas utilized as brown shrimp nursery grounds. Introductions during this critical period could adversely affect the survival and growth of maturing brown shrimp in affected areas. Evaluations should be made to determine all feasible means by which such potential impacts to both oyster and shrimp production could be offset.

The Department is in agreement with the estimates for reduction of rates of marsh loss for various marsh types developed jointly by biologists for the Corps and Fish and Wildlife Service and that are cited in the report. While the Department recognizes the fact that the proposal under consideration would not completely reverse the trends of marsh loss, the diversions would reduce the rates of loss in the study area, and would aid significantly in maintaining a salinity regime more favorable to fish and wildlife production.

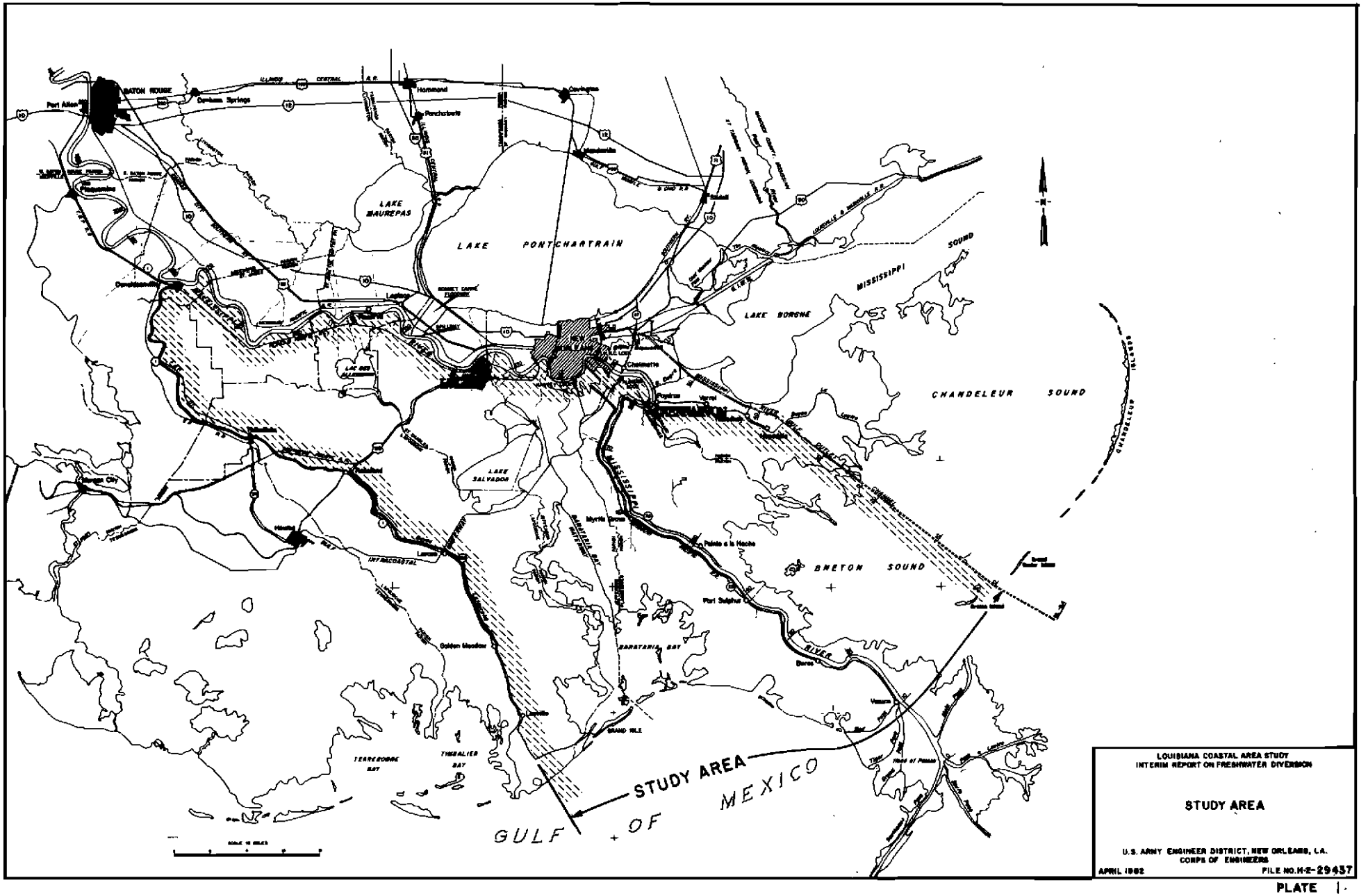
Based upon its experience and decades of study and observation, this Department reiterates its support for the concept of controlled freshwater introduction primarily for the enhancement of fish and wildlife habitat and resources, and is interested and willing to cooperate in developing a program for the operation and monitoring of the diversion structures.

Sincerely yours,

J. Burton Angelle

J. Burton Angelle
Secretary

JBA/CJK/fsb



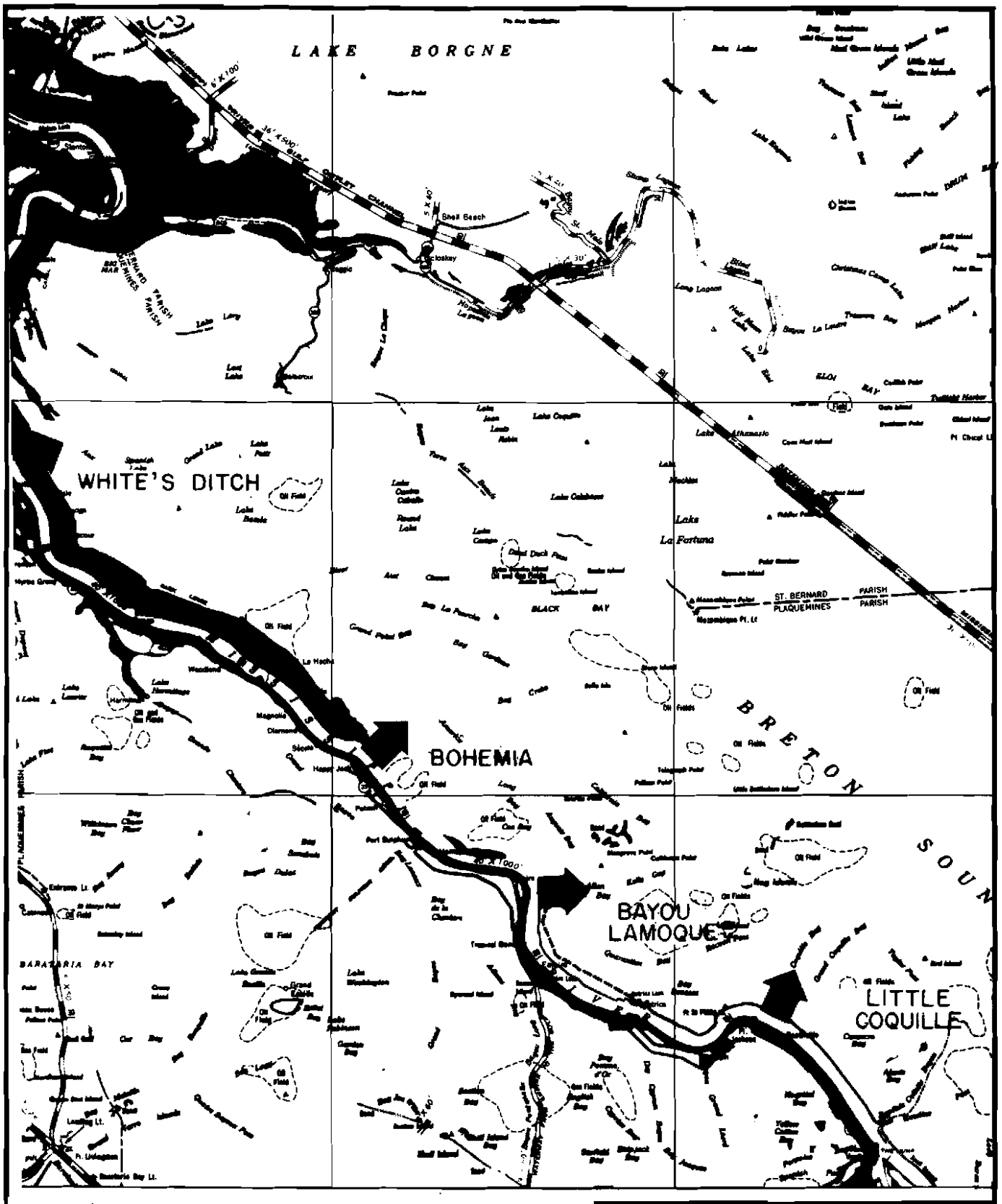
LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

STUDY AREA

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

APRIL 1982 FILE NO. H-2-29437

PLATE 1



LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

STATE CONSTRUCTED FRESHWATER DIVERSION STRUCTURES

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

FILE NO.

PLATE 2

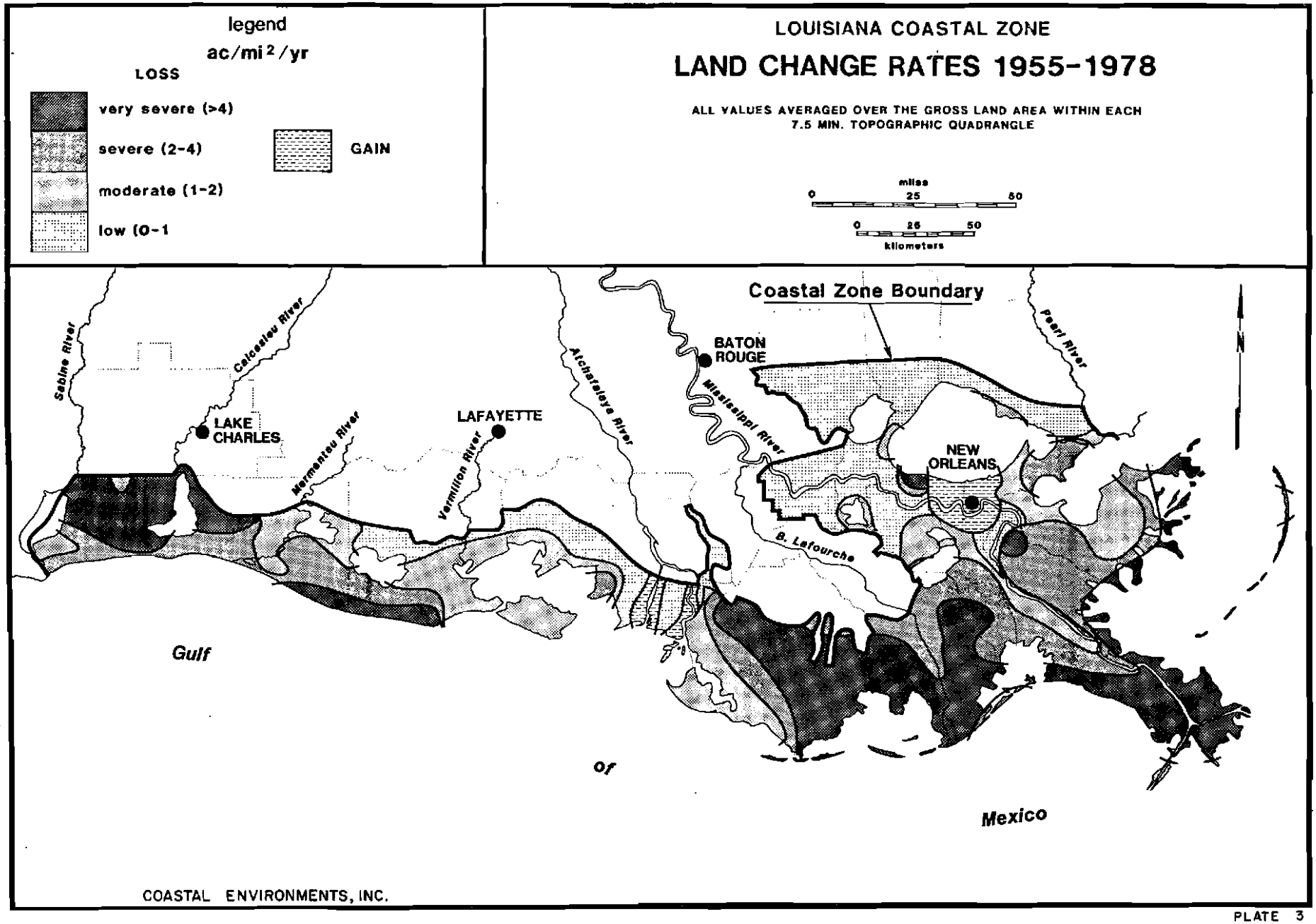
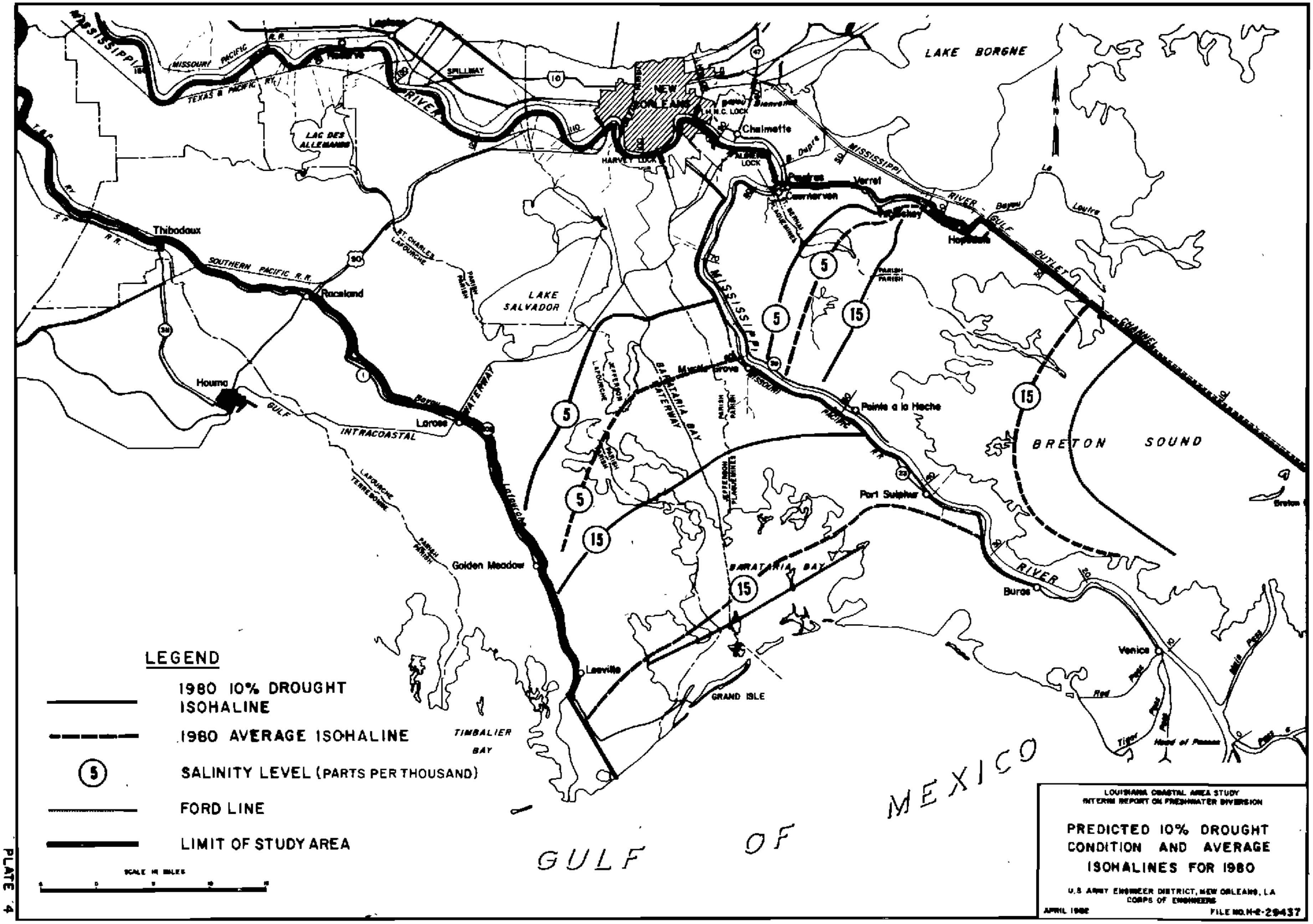

legend
ac/mi²/yr
LOSS
very severe (>4)
severe (2-4)
moderate (1-2)
low (0-1
GAIN
LOUISIANA COASTAL ZONE
LAND CHANGE RATES 1955-1978
ALL VALUES AVERAGED OVER THE GROSS LAND AREA WITHIN EACH 7.5 MIN. TOPOGRAPHIC QUADRANGLE
miles
0 25 50
0 25 50
kilometers
Coastal Zone Boundary
Sabine River
Calcasieu River
LAKE CHARLES
Mermentau River
LAFAYETTE
Vermilion River
Atchafalaya River
BATON ROUGE
Mississippi River
Pearl River
NEW ORLEANS
B. Lafourche
Gulf
of
Mexico
COASTAL ENVIRONMENTS, INC.

PLATE 3



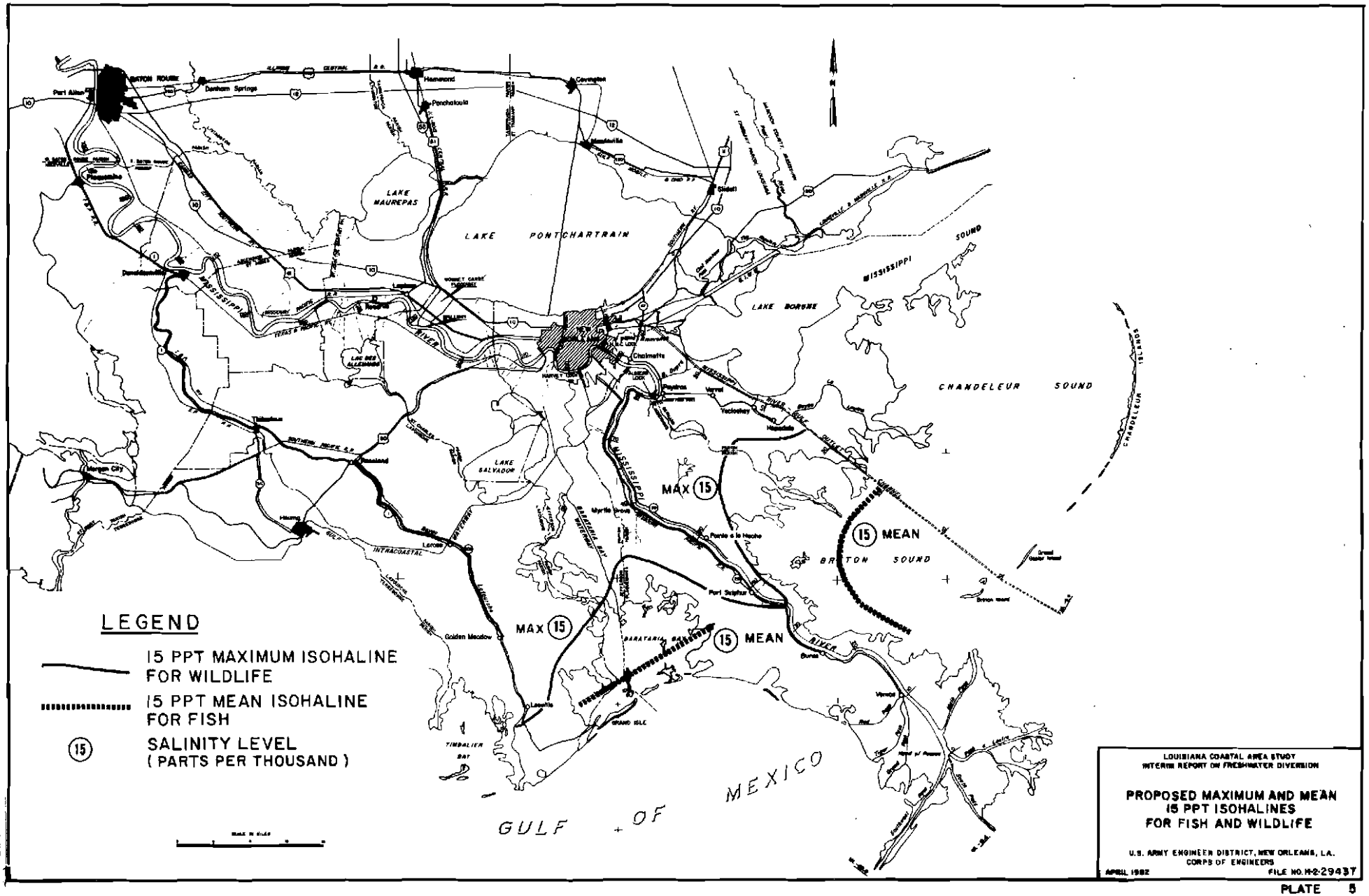
LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

PREDICTED 10% DROUGHT CONDITION AND AVERAGE ISOHALINES FOR 1980

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

APRIL 1982 FILE NO. H-2-29437

PLATE 4



LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

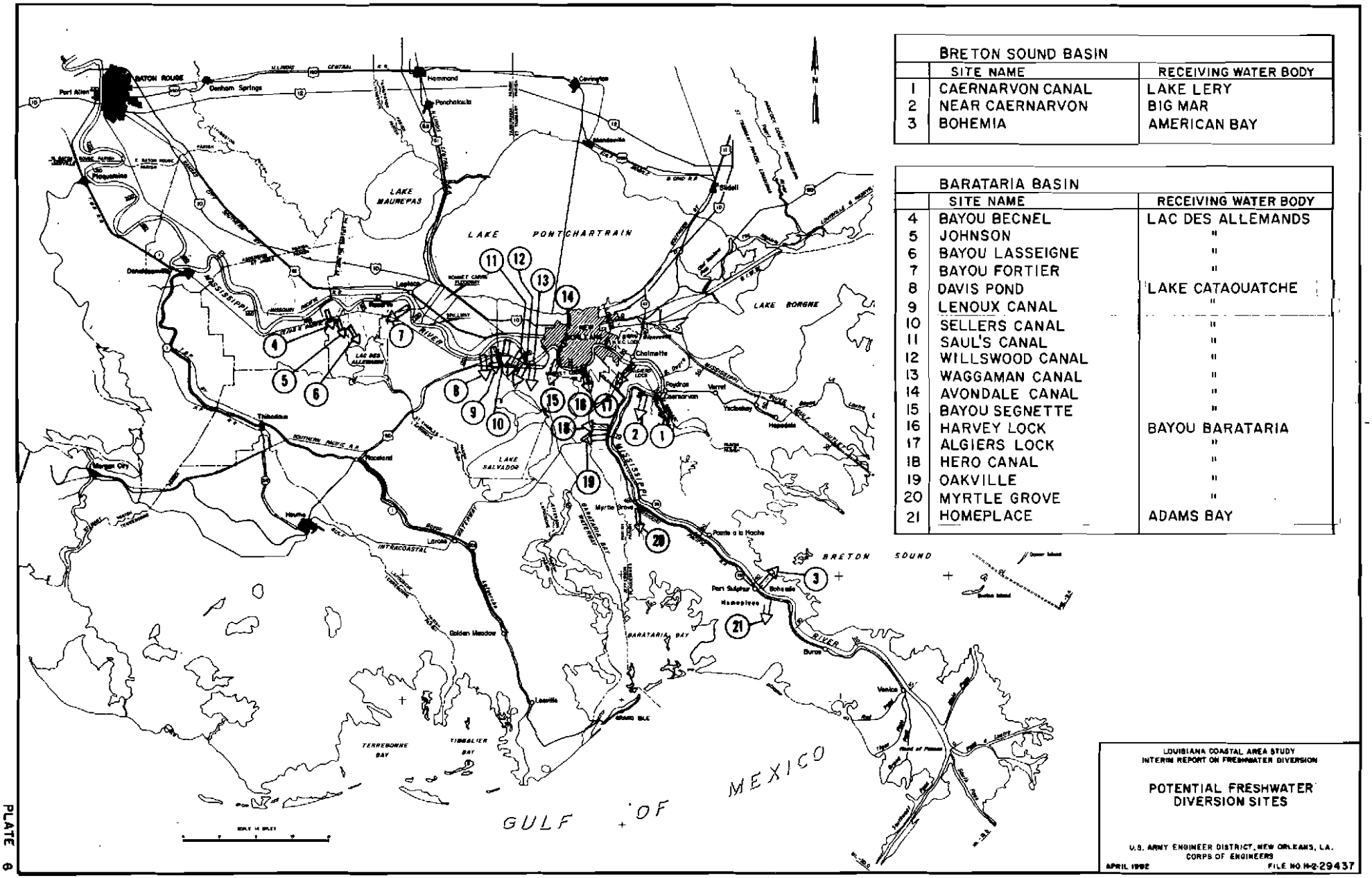
PROPOSED MAXIMUM AND MEAN 15 PPT ISOHALINES FOR FISH AND WILDLIFE

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

APRIL 1982 FILE NO. H-2-29437

PLATE 5

PLATE 5



BRETON SOUND BASIN		
	SITE NAME	RECEIVING WATER BODY
1	CAERNARVON CANAL	LAKE LERY
2	NEAR CAERNARVON	BIG MAR
3	BOHEMIA	AMERICAN BAY

BARATARIA BASIN		
	SITE NAME	RECEIVING WATER BODY
4	BAYOU BECNEL	LAC DES ALLEMANDS
5	JOHNSON	"
6	BAYOU LASSEIGNE	"
7	BAYOU FORTIER	"
8	DAVIS POND	LAKE CATAOUATCHE
9	LENOUX CANAL	"
10	SELLERS CANAL	"
11	SAUL'S CANAL	"
12	WILLSWOOD CANAL	"
13	WAGGAMAN CANAL	"
14	AVONDALE CANAL	"
15	BAYOU SEGNETTE	"
16	HARVEY LOCK	BAYOU BARATARIA
17	ALGIERS LOCK	"
18	HERO CANAL	"
19	OAKVILLE	"
20	MYRTLE GROVE	"
21	HOMEPLACE	ADAMS BAY

LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

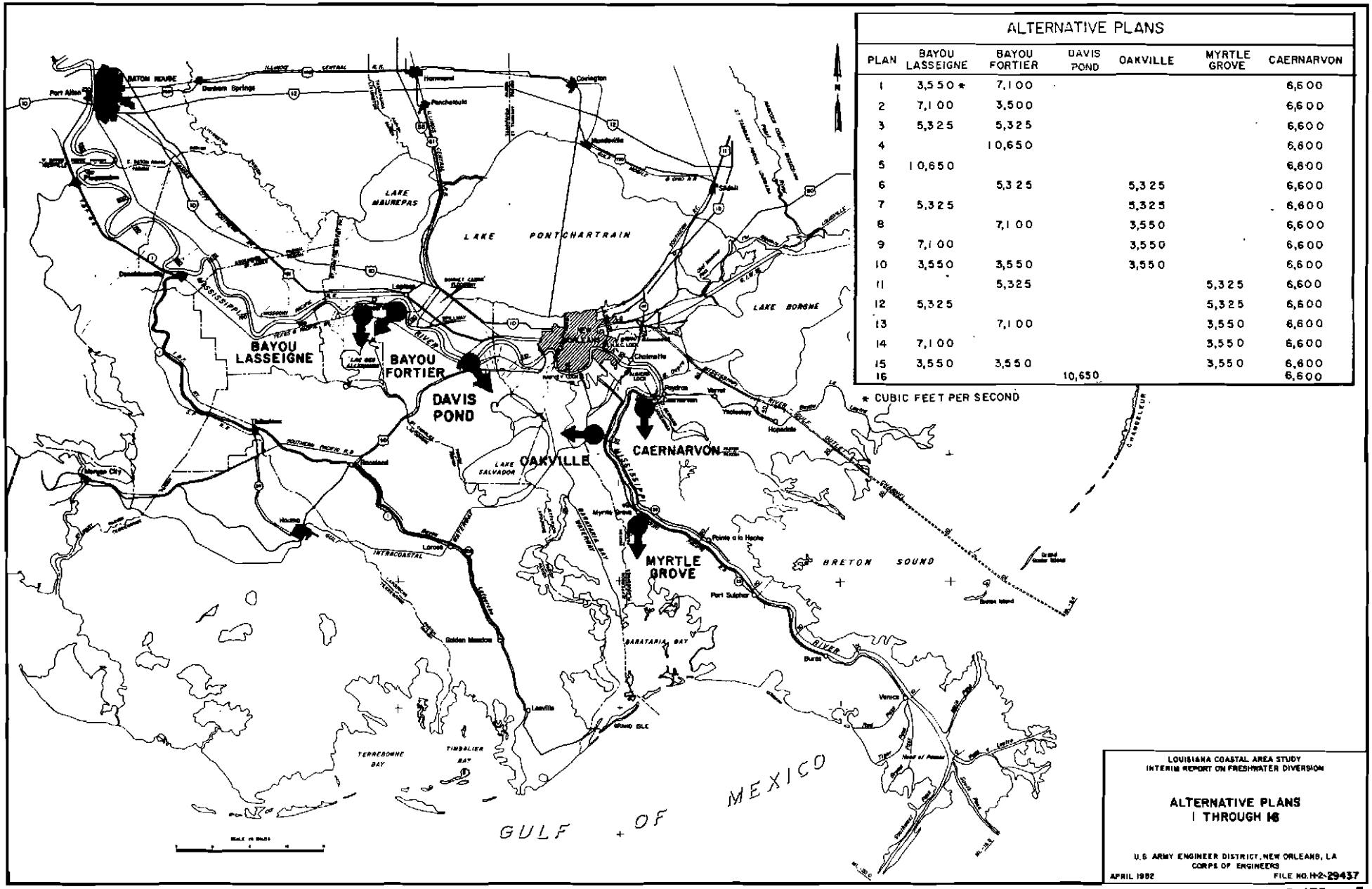
POTENTIAL FRESHWATER DIVERSION SITES

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

APRIL 1982 FILE NO. H-2-29437

PLATE 6

PLATE 6



ALTERNATIVE PLANS

PLAN	BAYOU LASSEIGNE	BAYOU FORTIER	DAVIS POND	OAKVILLE	MYRTLE GROVE	CAERNARVON
1	3,550 *	7,100				6,600
2	7,100	3,500				6,600
3	5,325	5,325				6,600
4		10,650				6,600
5	10,650					6,600
6		5,325		5,325		6,600
7	5,325			5,325		6,600
8		7,100		3,550		6,600
9	7,100			3,550		6,600
10	3,550	3,550		3,550		6,600
11		5,325			5,325	6,600
12	5,325				5,325	6,600
13		7,100			3,550	6,600
14	7,100				3,550	6,600
15	3,550	3,550			3,550	6,600
16			10,650			6,600

* CUBIC FEET PER SECOND

LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

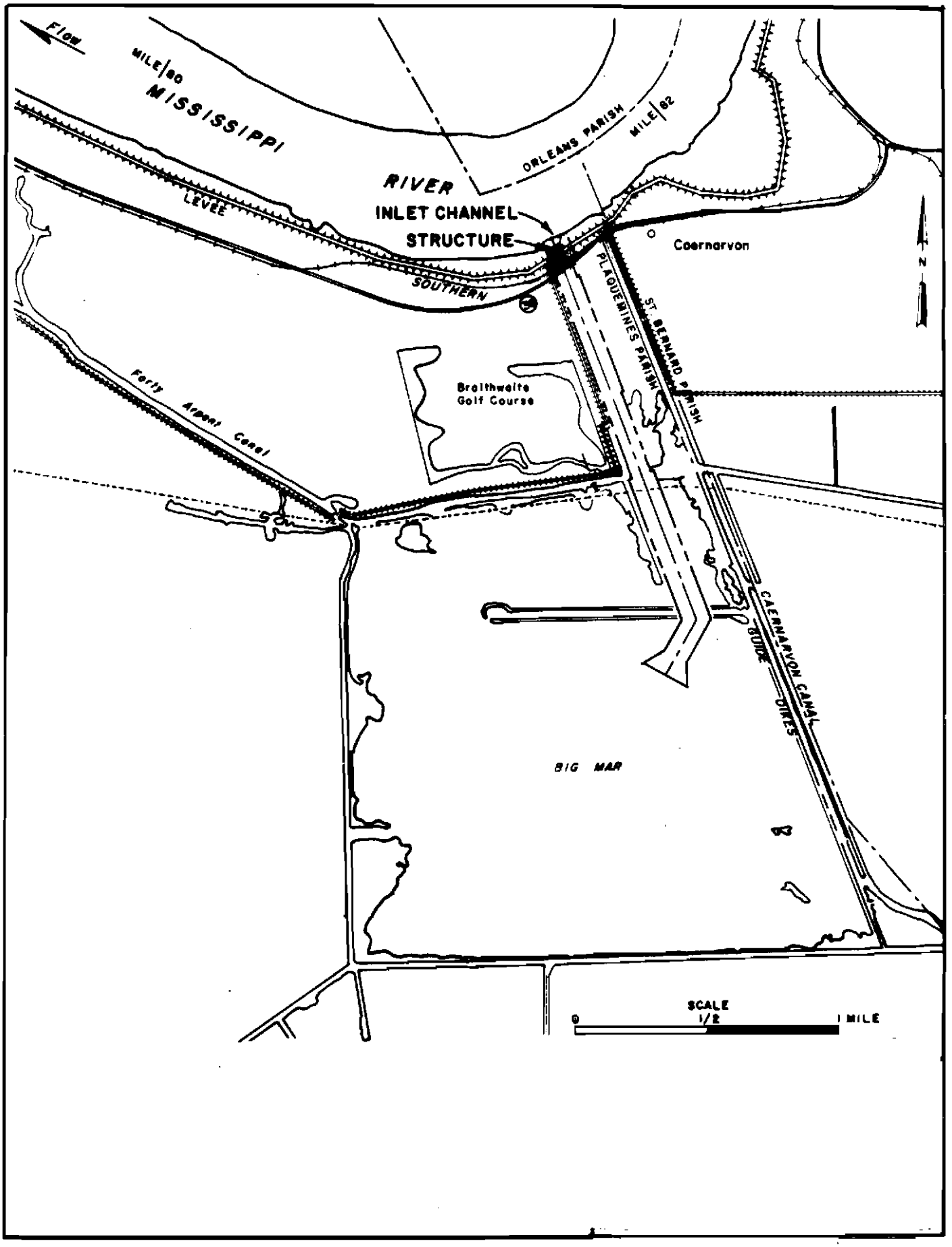
**ALTERNATIVE PLANS
1 THROUGH 16**

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

APRIL 1982 FILE NO. H-2-29437

PLATE 7

PLATE 7


Flow
MILE 80
MISSISSIPPI
RIVER
ORLEANS PARISH
MILE 82
LEVEE
INLET CHANNEL
STRUCTURE
SOUTHERN
Caernarvon
N
PLAQUEMINES PARISH
ST. BERNARD PARISH
Braithwaite
Golf Course
Ferry Airport Canal
CAERNARVON CANAL
BUDE
DIKES
BIG MAR
SCALE
0
1/2
1 MILE

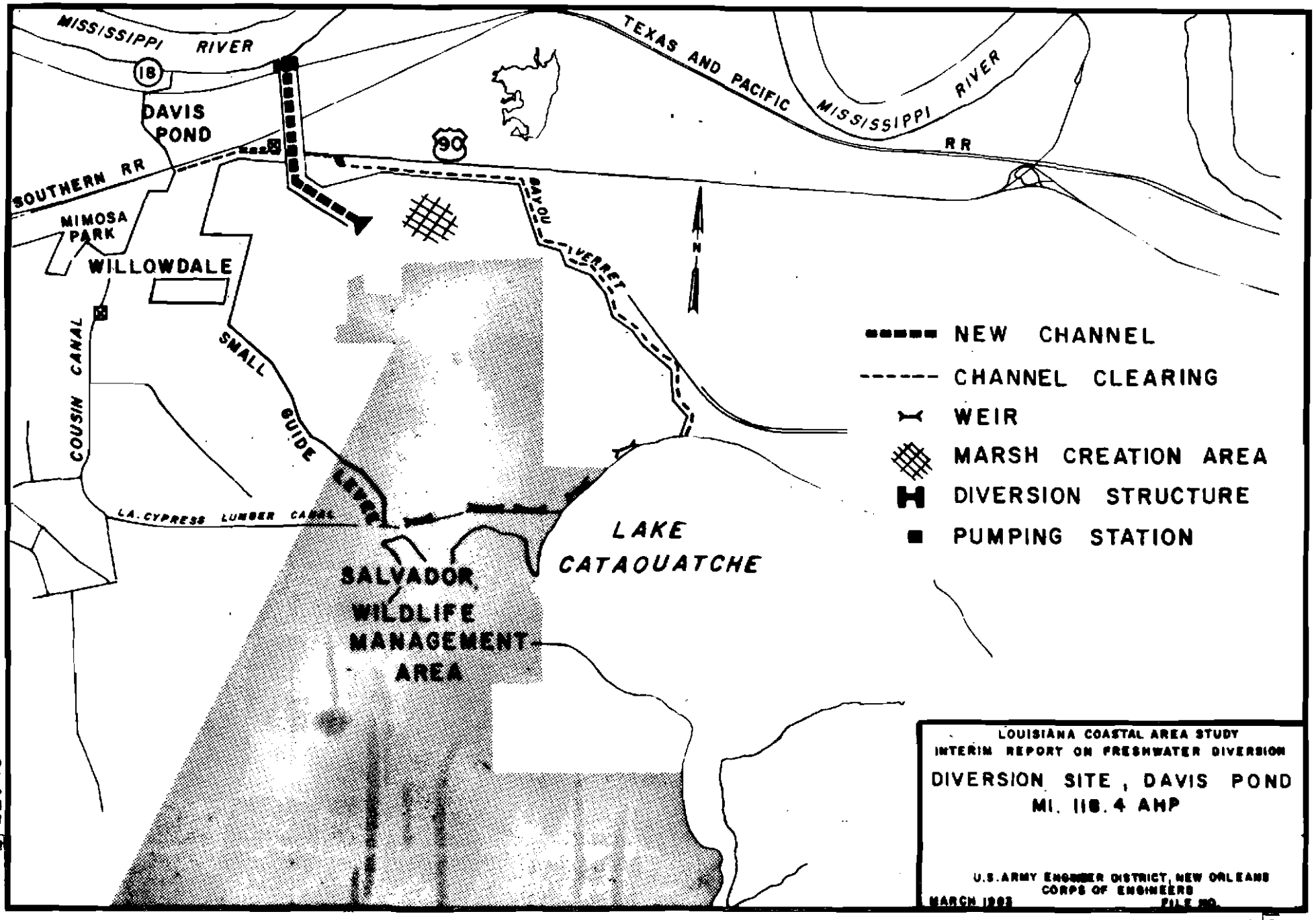
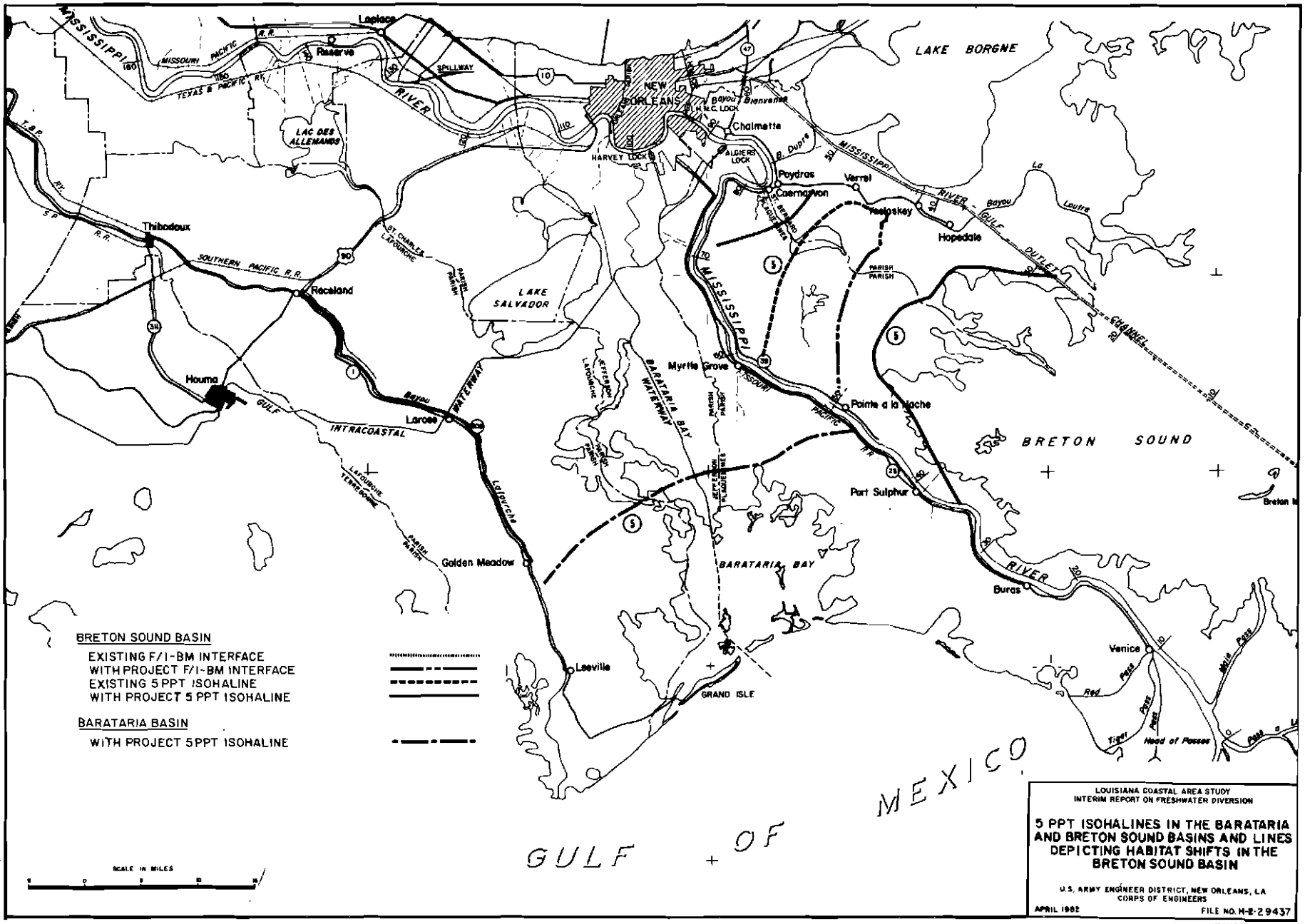


PLATE 9

PLATE 9



LOUISIANA COASTAL AREA STUDY
INTERIM REPORT ON FRESHWATER DIVERSION

5 PPT ISOHALINES IN THE BARATARIA AND BRETON SOUND BASINS AND LINES DEPICTING HABITAT SHIFTS IN THE BRETON SOUND BASIN

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

APRIL 1982 FILE NO. H-E-29437

PLATE 10

PLATE 10