US Army Corps
of Engineers
New Orleans District

West Bank of the Mississippi River in the Vicinity of New Orleans, La. (East of the Harvey Canal)

Feasibility Report and Environmental Impact Statement

Volume 1
August 1994

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

REPLY TO
ATTENTION OF:

WEST BANK OF THE MISSISSIPPI RIVER IN THE VICINITY OF NEW ORLEANS, LOUISIANA (EAST OF THE HARVEY CANAL) HURRICANE PROTECTION STUDY

FEASIBILITY REPORT AND

ENVIRONMENTAL IMPACT STATEMENT

AUGUST 1994

CELMN-PD-FG (10-1-7a) 27 Jun 94

MEMORANDUM FOR C/Information Management Office (Library)

SUBJECT: West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana (East of the Harvey Canal), Study

A copy of the final feasibility report for the West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana (East of the Harvey Canal), study is enclosed. The Division Engineer's Public Notice was issued on 1 Sep 94. Please maintain this copy as a source for future reference.

for Robert A. Bunson x2288

R. H. SCHROEDER, JR.
Chief, Planning Division

Encl

WEST BANK OF THE MISSISSIPPI RIVER IN THE VICINITY OF NEW ORLEANS, LOUISIANA (EAST OF THE HARVEY CANAL) HURRICANE PROTECTION STUDY

FEASIBILITY REPORT

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SYLLABUS

This report presents the results of studies to determine the feasibility of providing additional hurricane surge protection for the west bank of the Mississippi River in the vicinity of New Orleans. The study area, referred to as the area east of the Harvey Canal, is bounded by the Harvey Canal to the west, the Mississippi River to the north and east, and the Hero Canal to the south. The area includes over 35,000 acres in portions of Jefferson, Orleans, and Plaquemines Parishes. The Algiers Canal physically divides the study area into two distinct areas that can be evaluated independently from an economic and environmental standpoint. These areas are referred to as the area west of Algiers Canal and the area east of Algiers Canal.

During the study, investigations identified and analyzed both non-structural and structural alternatives for providing hurricane surge protection in addition to the alternative of "no action." For the area east of the Harvey Canal, investigations showed that feasible non-structural measures were already part of without-project conditions and that structural alternatives were feasible.

The study area has a relatively low level of hurricane protection, and the surge produced by a severe hurricane could result in the catastrophic loss of life and property damage. Hurricane Juan, a category 1 hurricane, battered the Louisiana coast for several days in 1985, producing stages in the study area estimated to have a 60-year return frequency. Extensive sandbagging along the banks of the Harvey Canal was required to prevent overtopping. Hurricane Andrew, a more severe category 3 hurricane threatened the study area as it approached the Louisiana coast, but maintained a more easterly track making landfall in south-central Louisiana. Due to the low level of hurricane protection within the study area, residents were ordered to evacuate up to 36 hours prior to Andrew's projected landfall. This caused widespread confusion that resulted in very low participation rates, leaving much of the population vulnerable if Hurricane Andrew had approached on a more critical path.

The needs of the study area related to hurricane protection can be demonstrated by the fact that of the 31,650 residential structures located within the study area 12,627 (or 40%) would be flooded by the 100-year event and 26,098 (or 82%) would be flooded by the Standard Project Hurricane (SPH). Estimated damages under the without project

conditions as a result of the 100-year event are in excess of $625 million. The potential damages increase to over $2.2 billion for the SPH event. The equivalent annual damages for the without project conditions are $41,209,000 for the area west of Algiers Canal and $2,702,000 for the area east of Algiers Canal.

Plans considered in detail for the area west of Algiers Canal, include Plan 1 (floodwall along the east bank of the Harvey Canal) and Plan 3B (floodgate structure in the Harvey Canal). Either plan would fulfill the primary objective of providing improved hurricane protection for the study area. Plan 1 was evaluated for the 30-year, 70-year, 100-year, 200-year and SPH levels of protection and Plan 3B was evaluated for only the SPH level of protection. Lower levels of protection for Plan 3B would compromise the authorized level of protection for the Westwego to Harvey Canal project. For the area east of Algiers Canal, only one alignment was considered in detail. This alignment was evaluated for the 100-year, 200-year and SPH levels of protection.

The recommended plan for the area west of Algiers Canal (Plan 3B - SPH protection) would provide for the construction of a navigable floodgate in the Harvey Canal constructed about 3,600 feet south of Lapalco Boulevard. A navigation bypass channel would be constructed to temporarily accommodate Harvey Canal traffic during construction of the floodgate. The bypass channel would later serve as part of the outfall canal for the Cousins Pumping Station. The capacity of the Cousins Pumping Station would be increased by 1,000 cfs and the outfall canal would be diverted to discharge below the navigable floodgate. A combination of levees and floodwalls would provide protection on the east side of the Harvey Canal from the floodgate to the Hero Pumping Station. Existing protection would be raised from the Hero Pumping Station, along the west bank of the Algiers Canal to the Algiers Lock.

The recommended plan for the area east of Algiers Canal (SPH protection) would provide for raising the existing protection along the Algiers and Hero Canals. From the Algiers Lock, the existing protection would be enlarged along the east bank of the Algiers Canal and along the north bank of the Hero Canal. The protection would wrap around the head of the Hero Canal and continue west along the south bank of the canal. A new levee constructed near Oakville would connect the enlarged Hero Canal levee with an existing Plaquemines Parish levee. The existing Plaquemines Parish levee extending back towards Hwy. 23 would also be enlarged.

Implementing the recommended plan would provide protection to those areas east of the Harvey Canal and would tie the line of protection to the authorized Westwego to

Harvey Canal project. The Westwego to Harvey Canal project was authorized by the Water Resources Development Act of 1986, and construction of the project began in early 1991. These two projects would form a continuous line of protection from Westwego, located in Jefferson Parish, to Oakville, located in Plaquemines Parish, protecting over 190,000 west bank residents.

The total project first cost of the recommended plan is $99,665,000 west of Algiers Canal and $20,016,000 east of Algiers Canal. The project first cost for the area west of Algiers Canal has been reduced by $15,052,000 to account for the floodwall feature of the Westwego to Harvey Canal project which would be eliminated with the implementation of the recommended plan. Total average annual costs are $9,779,000 west of Algiers Canal and $2,077,000 east of Algiers Canal. Annual operation, maintenance, repair, replacement, and rehabilitation costs, which are included in the previous totals, are $228,000 west of Algiers Canal and $12,000 east of Algiers Canal. The costs are based on October 1993 price levels at an interest rate of 8 percent with a project life of 100 years. The equivalent annual benefits are estimated to be $44,549,000 west of Algiers Canal and $3,220,000 east of Algiers Canal. The benefit to cost ratio (BCR) west of Algiers Canal is 4.56 to 1; east of Algiers Canal, the BCR is 1.55 to 1. Annual net benefits, the difference in equivalent annual benefits and annual costs, are $34,770,000 for the area west of Algiers Canal and $1,143,000 for the area east of Algiers Canal. The total project first costs of $119,681,000 would be apportioned $77,793,000 Federal and $41,888,000 non-Federal.

The recommended plan would adversely impact approximately 279 acres of wildlife habitat as a direct result of levee and outfall channel construction and a temporary stockpile area. These lands are predominantly bottomland hardwoods but also contain some wooded swamp. Mitigation of significant environmental losses would be accomplished by the acquisition of 312 acres of high quality wooded lands including wetlands, and implementation of measures designed primarily to improve habitat quality. The average annual cost of the mitigation plan is $51,000 west of Algiers Canal and $20,000 east of Algiers Canal. Implementing this mitigation feature would compensate, in-kind, all project-induced habitat losses to the fullest extent possible. The requirements of Section 404(r) of Public Law 92-500, as amended, have been met.

WEST BANK OF THE MISSISSIPPI RIVER IN THE VICINITY OF NEW ORLEANS, LA (EAST OF THE HARVEY CANAL) HURRICANE PROTECTION STUDY

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INTRODUCTION

This report consists of two volumes. The first volume is a presentation of the study results, including overall project formulation processes, an analysis of the environmental impacts, the study recommendations, and the Environmental Impact Statement (EIS). The second volume, a set of technical appendixes, contains technical data in support of information presented in the main report. These appendixes are included primarily as an aid to the technical reviewer.

STUDY AUTHORITY

The study was authorized by the following four resolutions: two adopted by the Committee on Public Works of the United States Senate at the request of Senator Russell B. Long and the late Senator Allen J. Ellender and two adopted by the Committee on Public Works of the United States House of Representatives at the request of the late Representative Hale Boggs.

The Senate Committee resolutions adopted November 10, 1965, and May 6, 1966, respectively, read as follows:

"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 report of the Chief of Engineers, on the Mississippi River Delta at and below New Orleans, Louisiana, published as House Document Numbered Five-Fifty, Eighty Seventh Congress, and other pertinent reports, with a view to determining if the existing project should be modified in any way at this time with particular reference to improvements for hurricane protection, flood control, and related purposes in that part of Jefferson Parish, Louisiana, between the Mississippi River and Bayou Barataria and Lake Salvador."

"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 report of the Chief of Engineers on the Mississippi River Delta at and below New Orleans, Louisiana, published as House Document Numbered 550, Eighty-seventh Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to improvements for hurricane protection, flood control, and related purposes in the area on the West Bank of the Mississippi River at and in the vicinity of New Orleans, Louisiana."

The House Committee resolutions adopted on May 5, 1966, and October 5, 1966, respectively, read as follows:

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports on the Mississippi River Delta at and below New Orleans, Louisiana, to determine if the existing project should be modified at this time with respect to improvements for hurricane protection, flood control, and related purposes in that part of Jefferson Parish, Louisiana, between the Mississippi River and Bayou Barataria and Lake Salvador."

"RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on the Mississippi River Delta at and below New Orleans, Louisiana, published as House Document Number 550, Eighty-seventh Congress, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to improvement for hurricane protection, flood control, and related purposes in the area on the West Bank of the Mississippi River in the vicinity of New Orleans, Louisiana, including Plaquemines, Orleans, Jefferson, and St. Charles Parishes."

STUDY PURPOSE AND SCOPE

The purpose of this report is to present the results of studies to determine the feasibility of providing hurricane surge protection to the portion of the west bank of metropolitan New Orleans from the Harvey Canal eastward to the Mississippi River. Improved hurricane protection for the Lafitte-Barataria area was determined infeasible and

therefore this report focuses on results of studies for the east of the Harvey Canal area.

REPORT AND STUDY PROCESS

This report, which includes the feasibility report and Environmental Impact Statement (EIS) and appendixes, is in partial response to the above referenced study resolutions. The report addresses the feasibility of providing additional hurricane surge protection for that area on the west bank of the Mississippi River generally bounded by the Harvey Canal on the west, the Mississippi River to the north and east, and the Hero Canal to the south.

The draft report and draft EIS were furnished to Federal, state, and local agencies and other interested entities for review the week of June 6, 1994. On July 21, 1994, following the circulation of these documents, a public meeting was held to discuss the tentatively selected plan. Following the public meeting and receipt of comments on the draft report, the final report and EIS were prepared.

The final report will be submitted to the Lower Mississippi Valley Division Engineer in Vicksburg, Mississippi, for review. Following review, the Lower Mississippi Valley Division Engineer will issue a public notice of availability of the report and forward the report, with his recommendations, to the Washington Level Review Center (WLRC). Preconstruction Engineering and Design (PED) will then begin. The WLRC will review the report, authorize the filing of the final EIS with EPA, and coordinate the report with other Federal and state agencies and with the Governor of Louisiana. Upon receipt of comments from the Federal and state agencies, the WLRC will complete its final assessment which will be forwarded to the Office of the Chief of Engineers. The Office of the Chief of Engineers will then submit its report to the Office of the Secretary of the Army.

The Secretary of the Army will obtain the comments of the President's Office of Management and Budget, sign the Record of Decision, and transmit the report with his recommendation to congress for action.

STUDIES CONDUCTED UNDER THIS AUTHORITY

This is the second of three studies conducted under this authority. The other two studies are described below.

• A feasibility report entitled "West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana," was published by the U.S. Army Corps of Engineers in December 1986. The report investigated the feasibility of providing hurricane surge protection to that portion of the west bank of the Mississippi River in Jefferson Parish between the Harvey Canal and Westwego and down to the vicinity of Crown Point, Louisiana. The report recommended implementing a plan that would provide hurricane protection to an area on the west bank between Westwego and the Harvey Canal north of Crown Point (see Plate 1). The project was authorized by the Water Resources Development Act of 1986 (Public Law 99-662). The West Jefferson Levee District is the non-Federal sponsor for the project. Construction was initiated in early 1991.

• A reconnaissance study entitled "West Bank Hurricane Protection, Lake Cataouatche, Louisiana," was completed by the U. S. Army Corps of Engineers in February 1992. The study investigated the feasibility of providing hurricane surge protection to that portion of the west bank of the Mississippi River in Jefferson Parish between Bayou Segnette and the St. Charles Parish line (see Plate 1). A 100-year level of protection was found to be economically justified based on constructing a combination steel sheet pile wall/earthen levee along the alignment of the existing Lake Cataouatche levee. The West Jefferson Levee District, by a letter dated March 9, 1992, indicated their intent to serve as the non-Federal sponsor for additional studies leading to the authorization of a Federal project. The study is proceeding as a post authorization change to the Westwego to Harvey Canal project.

PRIOR STUDIES AND REPORTS

A number of studies and reports on water resources development in the vicinity of the study area have been prepared by the U.S. Army Corps of Engineers, other Federal, state, and local agencies, research institutes, and individuals. Previous Federal and non-Federal studies have established an extensive data base for this report. The more relevant studies, reports, and projects are described in the following paragraphs.

• A report entitled "Flood Control, Mississippi River and Tributaries," published as House Document No. 90, 70th Congress, 1st Session, submitted December 8, 1927, resulted in authorization of a project by the Flood Control Act of May 15, 1928. The project provides comprehensive flood control for the lower Mississippi Valley below Cairo, Illinois, and has had a significant impact on water and land resources in the study area. Features of the project pertinent to the study area are:

(a) The Mississippi River levees extend from Baton Rouge, Louisiana, to Bohemia, Louisiana, on the east bank and from above the study area to Venice, Louisiana, on the west bank. They provide protection from the standard project flood (SPF) on the Mississippi River and Tributaries system. The levees are essentially complete in the study area except in locations where additional work is required to bring them up to project grade.

(b) The Bonnet Carre Spillway is located upstream of New Orleans, Louisiana, on the east bank of the Mississippi River in the vicinity of Norco, Louisiana. The purpose of the spillway is to divert Mississippi River flows into Lake Pontchartrain to lower flood stages on the Mississippi River in the New Orleans area. The spillway was completed in 1932.

(c) Revetments and foreshore protection have been constructed along the Mississippi River to prevent erosion. Revetments are constructed where levees or development is threatened by bank caving or where unsatisfactory alignment and channel conditions are developing. Construction of this feature is continuing as needed.

• The U.S. Army Corps of Engineers prepared a final feasibility report, "Louisiana Coastal Area, Freshwater Diversion to Barataria and Breton Sound Basins" in September 1984. The report recommends diverting Mississippi River water near Caernarvon into the Breton Sound and near Davis Pond into the Barataria Basin to enhance habitat conditions and improve fish and wildlife resources. The report also recommends that the plan be implemented under the authorized Mississippi Delta Region Project, which is identical in purpose. The diversions would reduce land loss and save about 99,200 acres of marsh. Construction of the Caernarvon structure was completed in early 1991. Advanced engineering and design studies on the Davis Pond feature are underway.

• The Louisiana Department of Natural Resources published a report entitled "Recommendations for Freshwater Diversion to Louisiana Estuaries East of the Mississippi River" in June 1982. The report recommends that Mississippi River water be diverted to the Lake Pontchartrain Basin and the Breton Sound Basin to improve production of fish and wildlife resources. The report parallels and confirms studies conducted by the U.S.

Army Corps of Engineers under the Louisiana Coastal Area and Mississippi and Louisiana Estuarine Area studies.

• The "Louisiana Coastal Wetlands Restoration Plan," a comprehensive plan for restoring and conserving the coastal wetlands of Louisiana, was mandated by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). The final report was submitted to higher authority in December 1993, and the Record of Decision on the Programmatic Environmental Impact Statement was signed in March 1994. The report details the process by which wetlands restoration plans were developed for the nine hydrologic basins in the coastal zone. The projects presented in the report far exceed the CWPPRA's funding capacity (approximately $40 million per year from 1991 to 1997, including 25 percent cost sharing by the state of Louisiana). The task force established by CWPPRA is initiating feasibility studies with a view toward securing authorization and funding for a number of large-scale projects.

• The U.S. Army Corps of Engineers completed a reconnaissance report, "Jefferson and Orleans Parishes, Louisiana Urban Flood Control and Water Quality Management," in July 1992. The study was authorized by Senate and House resolutions to investigate rainfall flooding and water quality problems associated with storm water runoff in Jefferson and Orleans Parishes. A total of nine urban flood control plans, five in Jefferson and four in Orleans Parish, were determined to be economically feasible. A number of proposed improvements were identified within the area west of the Algiers Canal. The Jefferson Parish Council signed a feasibility cost sharing agreement in January 1994 to participate in a four year urban flood control feasibility study. The Sewerage and Water Board of New Orleans, the local sponsor for the Orleans Parish study, signed their feasibility cost sharing agreement in June 1994.

• The "Lake Pontchartrain, Louisiana, and Vicinity" project was authorized by the Flood Control Act of 1965 and by the Water Resources Development Act of 1974. The authorized project provided for a standard project hurricane level of protection for the developed areas on the east bank of the Mississippi River in Jefferson, Orleans, St. Bernard, and St. Charles Parishes. The plan provided for the construction of a system of levees and a hurricane surge barrier across the tidal inlets to Lake Pontchartrain. The hurricane surge barrier allowed levees along Lake Pontchartrain to be lower in elevation. In December 1977, a Federal court injunction stopped construction of portions of the authorized project until a new Environmental Impact Statement could be prepared. A reevaluation study, dated July 1984 recommended construction of the Lake Pontchartrain

High Level Plan and the Chalmette Area Plan. The plans consist of raising existing levees and constructing new levees, with no barriers at the entrance to Lake Pontchartrain. Construction of the revised project is continuing.

• A report entitled "Louisiana-Texas Intracoastal Waterway, New Orleans, Louisiana to Corpus Christi, Texas," was published as House Document No. 230, 76th Congress, 1st Session. The project provides for an inland channel, 12 feet deep and 125 feet wide from the mouth of the Rigolettes to the Sabine River and includes eight primary navigation locks and 384 miles of channel. The Harvey Lock, connecting the inland channel to the Mississippi River, was completed in 1935. The main stem of the waterway was completed to the 12-foot project depth in 1948. The Algiers Canal alternate route and the Algiers Lock were completed in 1956. The Gulf Intracoastal Waterway project was modified by the River and Harbor Act of October 1962 to provide for a channel 16 feet deep and 150 feet wide between the Mississippi River and the Atchafalaya River via the Algiers Canal alternate route and a channel 16 feet deep by 200 feet wide between the Atchafalaya River and the Sabine River. This enlargement has not been constructed.

• A report entitled "New Orleans to Venice, Louisiana, Hurricane Protection," was published as House Document No. 550, 87th Congress, 2nd Session. The project provides hurricane protection to developed areas in Plaquemines Parish along the Mississippi River. The locally constructed back levee on the west bank of the Mississippi River from City Price to Venice would be enlarged and the existing levee from Phoenix to Bohemia on the east bank of the Mississippi River would be brought up to grade. Work on these features is underway. The General Design Memorandum Supplement No. 5, dated October 1983, provides for the creation of 297 acres of marsh in the Delta-Breton National Wildlife Refuse as mitigation for marsh loss caused by the levees.

• The U. S. Army Corps of Engineers published the "Grand Isle and Vicinity (Larose to Vicinity of Golden Meadow), General Design Memorandum," in May 1972. The Larose to Golden Meadow Hurricane Protection Project was authorized by Public Law 298, 89th Congress, 1st Session, approved October 27, 1965. This project will provide protection against hurricane surge flooding with a levee loop approximately 43 miles in length along both banks of Bayou Lafourche from Golden Meadow to Larose. The project includes floodgates in Bayou Lafourche at Larose and Golden Meadow. Construction of the project is continuing.

• The U.S. Army Corps of Engineers published the "Grand Isle and Vicinity

Louisiana, Phase II General Design Memorandum," in June 1980. The report contains detailed studies of a combined beach erosion and hurricane protection plan for the shore of Grand Isle. Design features include beach fill, vegetated dunes, and a jetty. Construction of these features is completed.

• A study of drainage and hurricane protection along the Harvey Canal and Bayou Barataria between the Roussel Pumping Station and Crown Point was authorized by resolutions adopted September 11, 1961, and May 10, 1962, by the U.S. Senate and House Committees. The study was completed and approved for construction on January 22, 1964. Construction of the Harvey Canal-Bayou Barataria levee was initiated under the authority of Section 205 of the Flood Control Act of 1948 (Public Law 87-874). The project has not been completed.

• The Louisiana Department of Natural Resources published a report entitled "Louisiana's Eroding Coastline: Recommendations for Protection" in June 1982. The report recognizes that future losses of coastal wetlands is unavoidable and will require either retreat of development from the coastal zone or increasingly greater levels of protection. Areas with initial erosion problems were identified and ranked according to severity. The report recommends development and implementation of a shoreline protection plan and proposes a number of pilot projects using water and sediment diversions, dredged material placement, and planting vegetation as a means to reduce erosion. A study to determine future coastal conditions, including changes in shoreline configuration and impacts on developed areas, is also recommended.

• 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 miles long from the Gulf Intracoastal Waterway (GIWW) to Grand Isle, Louisiana. These improvements were authorized by the River and Harbor Act of July 3, 1958. All work was completed in December 1967.

• On the local level, there is a West Bank Master Drainage Plan for the area. Numerous related studies have been conducted or plans have been prepared by local governmental entities that include the study area. These include, but are not limited to, the New Orleans Regional Transportation study, the Year 2000 Land Use Assessment, and the Jefferson Parish Coastal Zone Management Plan.

PROBLEM IDENTIFICATION

INTRODUCTION

To determine the problems and needs of the study area as related to hurricane protection, it is necessary to understand the national objective of water and related land resources planning as well as the past, present, and projected future conditions. This section contains a summary of information related to social, economic, and environmental resources of the study area, and provides a basis for determining the potential economic, social, and environmental effects of hurricane-induced flooding.

THE NATIONAL OBJECTIVE

The national planning objective, as defined by the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" of the U.S. Water Resources Council, is to contribute to the national economic development consistent with protecting the Nation's environment, in accord with national environmental statutes, applicable executive orders, and other national planning requirements. The Principles and Guidelines require formulation of a plan that reasonably maximizes net national economic development benefits, consistent with the national objective. Such a plan is to be identified as the national economic development (NED) plan. The Principles and Guidelines further require that "A plan recommending Federal action is to be the alternative plan with the greatest net economic benefit consistent with protecting the Nation's environment (the NED plan)...."

EXISTING CONDITIONS

LOCATION

This report addresses the need for hurricane protection for a portion of southeastern Louisiana which includes parts of Jefferson, Orleans, and Plaquemines Parishes, see Plate 1. The study area is located on the west bank of the Mississippi River and is generally bounded by the Harvey Canal to the west, the Mississippi River to the north and

east, and the Hero Canal to the south. A series of interconnected estuaries provide direct access to the Gulf of Mexico through Barataria Bay. Tidal waters are carried through Bayou Barataria to the Algiers and the Harvey Canals and into the study area. Freshwater is introduced into the study area primarily by direct rainfall, although some freshwater enters through the Harvey and Algiers Locks. To facilitate in the analysis of alternative plans, the study area was divided into separable elements. The Algiers Canal physically divides the study area into areas that can be evaluated independently. These two independent areas are referred to as the area "west of Algiers Canal" and the area "east of Algiers Canal," as shown on Plate 2.

PHYSICAL SETTING

Physiography. The study area is located on the Deltaic portion of the Mississippi River Alluvial Plain. Specifically, the area is located on the northern edge of the Barataria Basin on the western side of the Mississippi River between miles 73 to 98 above Head of Passes. The Barataria Basin is an interdistributary basin dominated by features which include natural levee ridges, crevasse-splay deposits, marsh, lakes, and swamps. The eastern and northern edge of the basin is defined by the natural levee ridge of the Mississippi River and the western edge of the basin is defined by the Bayou Lafourche natural levee ridge. The Gulf of Mexico constitutes the southern boundary. Elevations within the study area vary from approximately +10 to +15 feet National Geodetic Vertical Datum (NGVD) along the natural ridges of the Mississippi River to near sea level (0 feet NGVD) in the back swamp and lake areas to below sea level in many of the urbanized areas which are under forced drainage.

The physical and topographic characteristics of the study area have created the need for protection levees, drainage canals, and pumping stations. Protection from high seasonal flows on the Mississippi River is provided by levees constructed as part of the Mississippi River and Tributaries Flood Control Project. In addition to the threat of flooding from the Mississippi River, the study area is also at risk to inundation form hurricane surge. The surge generated by hurricanes in the Gulf of Mexico can travel across the marsh and through Bayou Barataria to threaten the area from the south. To protect the area from tidal and storm surge flooding, local interests have constructed a network of levees that provide a very limited degree of protection. Limited protection is also provided to a portion of the study area by the Algiers Canal levees, constructed as part of the Algiers Canal alternate route (GIWW).

Geology. The geologic history since the end of the Pleistocene Epoch is pertinent to the area. At the close of the Pleistocene, sea level was approximately 360 to 400 feet below present sea level and the Mississippi River was entrenched into the older Pleistocene sediments to the west of the project. As sea level rose to its present stand, the entrenched valley was filled with sediment by the Mississippi River, resulting in an increase in meandering and channel migration. This meandering and channel migration has resulted in a series of deltas extending into the Gulf of Mexico. Seven Holocene deltas are recognized in the lower Mississippi River Valley; however, only four are relevant to the project area. The oldest of the four deltas in the vicinity of the project was the Cocodrie Delta whose distal edges extended across the New Orleans area from west to east. After a diversion to the west and toe formation of the Teche Delta, the course of the Mississippi River returned to the New Orleans area forming the St. Bernard Delta which followed the same general course as the Cocodrie Delta but extended further to the east. It was during this period that maximum sedimentation into the area occurred via the Bayou Barataria and Bayou des Familles distributaries. A shifting of the river course upstream in response to a shorter route to the Gulf resulted in the formation of the Lafourche Delta southwest of the project area. A final shift of the river brought the flow into its present course forming the Plaquemine Delta just south of New Orleans, and the present Balize Delta below the Plaquemine Delta. Development of the deltas below New Orleans have resulted in the gradual degradation of the study area through subsidence and shoreline retreat.

Subsidence. The project lies in a region of active subsidence that is allowing transgression of Gulf waters. Subsidence and land loss are caused by four major natural processes:

(1) consolidation of soft, compressible sediments,

(2) eustatic sea level rise,

(3) decrease in suspended sediments reaching the marsh areas from the Mississippi River, and

(4) attack of coastal areas by wave action.

Estimated subsidence is estimated to occur at a rate of 0.65 feet per century in unleveed areas and at 2.0 feet per century in developed areas. Sea level rise has been measured at approximately 0.50 feet per century. Subsidence within the delta and sea level rise are natural processes that can be expected to continue.

Mineral Resources. There are no producing hydrocarbon fields in the immediate vicinity of the project. Sand is dredged periodically from the Mississippi River bed load.

Soils. Engineering properties of the sediments beneath the project vary greatly. Based on existing profiles and borings along the Algiers Canal and the Harvey Canal, the project is generally underlain by Holocene deposits that vary in thickness between 70 and 85 feet. These Holocene sediments are generally comprised of swamp-marsh deposits, interdistributary deposits and prodelta clays in this sequence from the surface to the top of the Pleistocene deposits. The underlying Pleistocene deposits are stiff to very stiff in consistency and yield lower water contents when compared to the Holocene deposits. An exception to the above sequence are the natural levee, crevasse-splay and point bar deposits associated with the present Mississippi River course and the abandoned distributaries which are known to extend through the area. The project area contains 13 soils series that are described in Volume 2, Appendix A, Section III. Most of the soil types in the study area will settle upon loading, will shrink and oxidize upon dewatering, and have low shear strengths. Therefore, settlement sensitive structures should be pile supported.

Climatology/Hydrology.

a. Climate. The study area is located in a subtropical latitude. The climate is influenced by the many water surfaces of the lakes, streams, and Gulf of Mexico. Throughout the year, these water areas modify the relative humidity and temperature conditions, decreasing the range between the extremes. When southern winds prevail, these effects are increased, imparting the characteristics of a marine climate.

The area has mild winters and hot, humid summers. During the summer, prevailing southerly winds produce conditions favorable for afternoon thundershowers. In the colder seasons, the area is subjected to frontal movements that produce squalls and sudden temperature drops. River fogs are prevalent in the winter and spring when the temperature of the Mississippi River is somewhat colder than the air temperature.

b. Precipitation. Precipitation generally is heavy in two fairly definite rainy periods. Summer showers last from mid-June to mid-September, and heavy winter rains generally occur from mid-December to mid-March. The annual normal precipitation for New Orleans at Algiers station is 61.67 inches, with annual variations of plus or minus 50 percent. Extreme monthly rainfalls exceeding 12 inches are not uncommon, and as much as 20 inches have been recorded in a single month. The maximum monthly rainfall at Algiers station since 1951 occurred during April 1980 with a total of 22.44 inches, and the 9.78 inches falling on 3 May 1978 was the maximum 24-hour rainfall. The 30-year

normals for New Orleans at Algiers and Audubon Park during the 1951-1980 period are presented in Volume 2, Appendix A, Section I. Snowfall amounts are generally insignificant, and hail of a damaging nature seldom occurs.

c. Temperature. Records of temperatures are available from "Climatological Data" for Louisiana, published by the National Climatic Center. Mean temperatures within the study area can be approximated using data observations from the New Orleans Audubon station and the New Orleans Moisant Airport. The average mean annual temperature based on the period 1951-1980 is 68.0°F with monthly mean temperature normals varying form 53°F in January to 82.6°F in July. Extremes at Audubon Park since 1951 were 102°F on July 6, 1980 and 10°F on December 23, 1989. Temperature normals (1951-1980) for New Orleans at Audubon Park and Moisant Airport are shown in Volume 2, Appendix A, Section I.

d. Wind. Average wind velocity is 7.5 mph, based on anemometer records at New Orleans Moisant Airport over the period 1973-1990. The predominant wind directions are north-northeast from September through February and south-southeast from March through June. The summer is often disturbed by tropical storms and hurricanes which produce the highest winds in the area. The maximum wind speed observed (highest one minute average) since 1963 was 69 mph and was a result of Hurricane Betsy in September 1965. Average monthly and annual wind speeds for this period are shown in Volume 2, Appendix A, Section I.

e. Tropical Storms and Hurricanes. Several hurricanes and tropical storms have passed through or near the study area. Some of the major storms include the 1915 hurricane, the 1947 hurricane, and Hurricanes Flossy (1956), Hilda (1964), Betsy (1965), Carmen (1974), Babe (1977), Bob (1979), Danny (1985), Juan (1985), and Andrew (1992). Hurricane Flossy brought torrential rains and tidal flooding to the study area. Golden Meadow, which is approximately 20 miles south of the study area, received 16.7 inches of rain in a 24-hour period. Hurricane Hilda raised water levels at Barataria and Lafitte to 3.6 and 4.04 feet NGVD, respectively. Hurricanes Betsy and Carmen also caused flooding to some parts of the study area. Hurricane Juan, a minimal Category 1 hurricane, broke high water records throughout the study area. Stages in the Harvey Canal were estimated to be about the 60-year event. On the west bank, three local levees were breached and several subdivisions were flooded by tidal inundation and the long duration of high stages. The total storm precipitation for Juan ranged from 8 to 12 inches over the study area. Hurricane Andrew made landfall in southern Florida as a Category 4 hurricane causing

extensive damage. After entering the Gulf of Mexico, Hurricane Andrew quickly regained its strength alarming residents throughout southern Louisiana. The potential for Andrew to turn to the north and severely impact the study area resulted in the recommended evacuation of west bank residents living in Jefferson, Orleans, and Plaquemines Parishes. Although making landfall in southcentral Louisiana, Hurricane Andrew raised water levels and caused gale force winds throughout the study area. Additional information on these hurricanes is presented in Volume 2, Appendix A, Section I.

f. Stages, Frequencies and Duration. Normal astronomical tides at the coastline are diurnal and can have a spring range of as much as 2.0 feet. Inland, this range is on the order of 0.5 feet. Winds with a strong southerly component that are sustained for 30 hours or more yield an increase in tide height of about 1 foot for each 10 miles per hour. Sometimes the passage of a front is delayed creating strong winds that lead to abnormally high tides.

Stage records are available at six locations within the study area. Hurricane Juan set record highs at four of these locations. Table 1 gives the period of record and extremes of these stations. Discharge data are not taken due to tidal influence.

Drainage problems are exacerbated when rainfall is accompanied by high tides. During May 1978 and April 1980, short duration, large accumulation rainfalls occurred in this area. On May 3, 1978, the Algiers area received 9.8 inches of rainfall. Heavy rainfall and strong onshore winds resulted in a stage of 2.3 feet NGVD at Barataria on Bayou Barataria, and 2.7 feet NGVD at the Harvey Lock on the Gulf Intracoastal Waterway. On April 13, 1980, the rainfall measured at Algiers was 9.7 inches and the accompanying stage at Barataria was 3.8 feet NGVD. At the Harvey Lock, the maximum stage recorded was 3.2 feet NGVD. The pumping stations that discharge into the marsh were forced to operate against higher than optimum outside stages during these events, reducing their pumping efficiency.

TABLE 1
GAGE DATA

Station	Period of Record	Stage Extremes (ft. NGVD) Max	Date	Min	Date
Mississippi River					
@ Harvey Lock	Jan 1924 - pres	19.42	4/24/27	-0.68	12/17/53
@ Algiers Lock	May 1956 - pres	16.11	4/7/73	-0.50	1/19/81
GIWW					
@ Harvey Lock	Jan 1925 - pres	4.74[1]	10/29/85	-1.28	1/26/40
@ Algiers Lock	May 1956 - pres	4.45[1]	10/29/85	-1.64	9/9/65
Bayou Barataria					
@ Barataria	Jan - Sep 1950 and Nov 1951 - pres	4.25[1]	10/29/85	-0.58	12/23/89
@ Lafitte	Oct 1955 - Dec 1960 and May 1963 - pres	5.05[1]	10/29/85	-0.95	12/23/89

[1] Caused by Hurricane Juan in 1985.

Intense hurricanes such as Betsy have caused high stages along the coastal area of Louisiana (10.5 ft NGVD at Grand Isle) and moderately high stages inland (3.2 ft NGVD at the Harvey Lock). High stages resulting from previous hurricanes are summarized in Volume 2, Appendix A, Section I. Detailed hurricane data is presented in a Corps publication entitled, "History of Hurricane Occurrences along Coastal Louisiana." Examination of gage records at the inland gaging stations reveals that Hurricane Juan caused the highest stage of record on October 29, 1985, along Bayou Barataria at both Barataria (4.25 ft NGVD) and Lafitte (5.05 ft NGVD) and at the Algiers (4.45 ft NGVD) and Harvey (4.74 ft NGVD) Locks.

Normal tidal influence within the study area is relatively insignificant. However, wind effects can mask the daily ebb and flow variations, and during periods of sustained southerly winds, tides rise in direct response to the duration and intensity of the wind stress. This was demonstrated in 1985 by Hurricane Juan. Although a relatively weak

storm in terms of maximum sustained windspeed. Hurricane Juan caused higher stages in much of the study area than the more intense Hurricane Betsy. This is directly attributable to the hurricane's erratic, almost stationary, path across southern Louisiana. Gale force winds over a period of five days caused tides 3 to 6 feet above normal across the entire coastal area of southern Louisiana.

EXISTING PROTECTION AND DRAINAGE

The initial development within the study area occurred along the banks and natural ridges of the present and abandoned courses and distributaries of the Mississippi River. As development continued to expand away from the river and into the lower more vulnerable areas, the need for levees, drainage canals and pumping stations became apparent. As a result, both Federal and non-Federal projects providing flood control, hurricane protection and navigation are located within the study area.

Federal flood control improvements include the mainline Mississippi River and Tributaries levee system. Elevations of the west bank Mississippi River levees between Oakville and the Harvey Lock range from 24.5 feet to 25.3 feet NGVD. The average stage in the Mississippi River at the Carrollton gage during the months of June through November (hurricane season) ranges from approximately 3 to 10 feet NGVD. The largest documented increase in stage in the Mississippi River resulting from hurricane surge was 9 feet above normal river stage. This occurred at the Carrollton gage during Hurricane Betsy. The Mississippi River levees within the study area were determined to provide adequate surge protection and will be incorporated into the hurricane protection system for the area east of the Harvey Canal.

The Algiers Canal levees which extend from the Algiers Lock to Bayou Barataria were constructed as part of the Algiers Canal alternate route, a feature of the Gulf Intracoastal Waterway (GIWW). These levees are maintained at around 7 feet NGVD. The first lift of the Harvey Canal-Bayou Barataria levee, which extends along the west bank of the Harvey Canal south of the Cousins Pumping Station, was constructed as a small Federal project under the authority of Section 205 of Public Law 87-875. The remainder of the levee system was constructed by local interests, segmentally, as expanding development demanded protection. Protection along the Harvey Canal has been constructed primarily by industries located along the canal. The existing protection is as low as 3 feet NGVD in some locations and is susceptible to overtopping during relatively minor hurricane events. A non-Federal levee runs along the east bank of Bayou Barataria

and along the north bank of the Hero Canal. The levee varies in elevation from 5 to 11 feet NGVD and stops several hundred feet short of the Mississippi River levee.

Other Federal projects within the study area include navigation works, namely the GIWW. The Harvey and Algiers Canals were constructed to aid in navigation as part of the GIWW. The Harvey Lock, completed in 1935, has a useable length of 425 feet, a width of 75 feet, and a depth of 12 feet. The Algiers Lock was completed in 1956 with a useable length of 760 feet, a width of 75 feet, and a depth of 13 feet. Both locks were constructed as part of the Flood Control, Mississippi River and Tributaries project to provide a continuous line of protection while maintaining navigation along the GIWW.

The system of local levees has evolved over an extended period. Some of these began as dredged material or "spoil" bank levees that were formed by material being placed on the bank of a drainage canal as a result of channel improvement or maintenance without regard for sound engineering practice for levee design and construction. While preventing high waters from intruding, these levees also prevent any rainwater that falls within their perimeter from draining onto the adjacent lower lands and lakes. As a solution to this problem, leveed areas are webbed with drainage outfall canals that terminate at pumping stations. There are seven pumping stations within the study area and one presently under construction. These pumping stations, located along, and discharging into the Harvey and Algiers Canals, are used to remove the flood waters that pond within the leveed areas. Table 2 provides a list of pumping stations and nominal capacities. Feasibility studies are being conducted as part of the Jefferson and Orleans Parishes, Urban Flood Control Study, to address the problems associated with storm water runoff in Jefferson and Orleans Parishes.

TABLE 2
PUMPING STATION CAPACITIES

West of Algiers Canal	
Orleans No. 13	4700 cfs
Planters	2500 cfs
Hero	3900 cfs
East of Algiers Canal	
Orleans No. 11	1600 cfs
Belle Chasse No. 2 (under const.)	1600 cfs
Plaquemines	4000 cfs
West of Harvey Canal	
Cousins	3000 cfs
Harvey	1000 cfs

Orleans Pumping Station No. 11 is located along the east bank of the Algiers Canal and drains the Lower Coast Algiers area of Orleans Parish. The Lower Coast Algiers is that potion of Orleans Parish located east of the Algiers Canal. Orleans Pumping Station No. 13, located along the west bank of the Algiers Canal, provides drainage to the portion of Orleans Parish between the Harvey and Algiers Canals. Planters Pumping Station, located along the west bank of the Algiers Canal, and the Hero Pumping Station, located along the east bank of the Harvey Canal, provide drainage to portions of Jefferson and Plaquemines Parishes located between the Harvey and Algiers Canals. The Plaquemines Pumping Station and when completed, the Belle Chasse Pumping Station No. 2, both located along the east bank of the Algiers Canal, provide drainage to Plaquemines Parish. The Cousins and Harvey Pumping Stations are both located along the west bank of the Harvey Canal and provide drainage to portions of Jefferson Parish outside of the study area.

The existing Federal and non-Federal levees which have been constructed within the study area do not provide adequate levels of protection against tidal surge. This can be demonstrated by the fact that of the 31,650 residential structures in the area, 12,627 structures (or 40%) would be flooded by the 100-year storm, 18,438 structures (or 58%) by the 200-year storm, and 26,098 houses (or 82%) by the Standard Project Hurricane. The

commercial facilities are also extremely vulnerable to flooding from tidal surge. Of the 2,710 commercial facilities located within the area, 1,001 facilities (or 37%) would be flooded from the 100-year storm, 1,755 (or 65%) facilities would be flooded by the 200-year storm, and 2,424 (or 89%) would be flooded by the SPH event.

Hurricane Juan has been classified by the National Weather Service as a minimal hurricane (Category 1 on the Saffir-Simpson Scale). Although a weak hurricane, Juan produced stages with return frequencies of 50 to 100 years at gages on the landward edge of the coastal zone in Louisiana. At the coastline, however, the stages had a return frequency on the order of 10 to 25 years. Juan's progress across the coast of Louisiana was dilatory, and, therefore, produced stages at the coast that exceeded 5 feet for 4 to 5 days. As a result of this extended duration of abnormally high tides, the inland fringes of the coastal zone experienced very high stages. Stages estimated to be about the 60-year event were recorded in the Harvey Canal.

Hurricane Juan clearly illustrated that the present local levee system is unable to provide protection against tidal surge. Extensive flooding occurred west of the Harvey Canal and only the quick action and massive flood fighting efforts of the West Jefferson Levee District, the Parish of Jefferson, the Louisiana National Guard, and thousands of volunteers prevented flooding of potentially catastrophic proportions to the 140,000 residents living within the study area.

DEVELOPMENT AND ECONOMY

Business/Industrial Activity and Regional Growth. The study area, which includes portions of Jefferson, Orleans, and Plaquemines Parishes, is part of the New Orleans Metropolitan Statistical Area (MSA). Until recent years, the economy in this part of the state was dominated by oil and gas activities. However, with the decline of this industry that began in 1981, other segments of the economy have become increasingly more important. The West Bank economy is primarily centered around the port and related commercial and manufacturing activities, such as shipbuilding, grain transport, and storage. Most of the heavy industries in Jefferson Parish are located along the Harvey Canal and the Mississippi River, including one of the largest manufacturing industries in the state at Avondale. This industrial base has attracted retail trade and services to the surrounding area. In addition to these activities, the west bank, especially Plaquemines Parish, has been a major producer of natural gas, petroleum, sulfur, salt, fish and shellfish. With the advent of the Louisiana gaming industry, and the high probability that a gambling boat will

be located on the Harvey Canal, the west bank should experience a significant growth in the tourist industry.

One of the fastest growing industries on the west bank, as well as in the entire metro area, is health care. Several new hospitals, medical complexes, and extended care facilities have been constructed on the west bank during the past few years.

The opening of the second span of the Crescent City Connection bridge and the completion of the elevated Westbank Expressway will continue to benefit the commercial activity in the area. The Oakwood Shopping Center has undergone extensive renovation during the past few years, and this was climaxed by the opening of the new Maison Blanche store. This shopping mall currently has the most retail space of any shopping center in the New Orleans area.

The establishment of a more diversified economy to offset declines in the oil and gas industry is important for future economic growth. Port activity along the Harvey Canal and the expansion of the tourist and health services industries will be major factors in promoting future economic growth.

Employment. According to a March 1994 report prepared by the Louisiana Department of Labor, the total nonagricultural employment in the New Orleans MSA was estimated to be 573,000 as of February 1994. This represents an increase of 11,600 jobs since February 1993. The majority of the new jobs (7,500) were created in the services industry. Most of these jobs were in the health, amusement, and recreation fields. Manufacturing, mining, and wholesale and retail trade showed a slight decline. Even though the number of jobs increased during the period, the unemployment rate for the New Orleans MSA rose from 6.6 percent in February 1993 to 7.0 percent in February 1994. The unemployment rate for the state of Louisiana increased from 7.7 percent to 8.0 percent during the same period. Table 3 provides a summary of the nonagricultural wage and salary employment in the New Orleans MSA.

The University of New Orleans Division of Business and Economic Research predicts that total employment in metropolitan New Orleans will increase over the next two years. The UNO Model projects employment will increase by over 3,600 jobs by the end of 1994, and by another 11,000 jobs in 1995. While the oil and gas industry is expected to remain stable, tourism and the health services industry are predicted to experience rapid growth. Construction, retail trade, and state and local government are

also expected to experience employment growth. Employment in the gaming industry will increase as the temporary land-based casino opens in late 1994 and as more riverboat casinos begin operation.

TABLE 3
NEW ORLEANS METROPOLITAN STATISTICAL AREA[1]
NON-AGRICULTURAL WAGE AND SALARY EMPLOYMENT
(In Thousands by Industry)

Nonagricultural Employment	Feb. 1994	Jan. 1994	Feb. 1993	Net Change From Jan. 1994	Net Change From Feb. 1993
TOTAL	573.0	569.7	561.4	+3.3	+11.6
Manufacturing	47.5	47.4	47.7	+0.1	-0.2
Mining	14.1	14.0	14.4	+0.1	-0.3
Construction	25.2	25.7	24.1	-0.5	+1.1
Transportation & Public Utilities	43.4	42.2	43.0	+1.2	+0.4
Wholesale & Retail Trade	139.0	138.0	139.2	+1.0	-0.2
Finance, Ins., & Real Estate	29.9	29.9	29.2	0	+0.7
Services	171.5	170.5	164.0	+1.0	+7.5
Government	102.4	102.0	99.8	+0.4	+2.6

Source: State of Louisiana, Department of Labor, "Louisiana Labor Market Information". March 25, 1994.
[1] Includes data for Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, and St. Tammany Parishes.

Income. Table 4 shows per capita personal income levels for the three parishes in the study area, the New Orleans Metropolitan Statistical Area, and the State of Louisiana. Between 1981 and 1986, the growth rate in per capita income of the New Orleans MSA averaged a modest 3.4 percent per year. However, this average almost doubled to 6.0 percent per year during the period 1987-1991. This increase is reflective of the upswing in the metropolitan economy during the same period.

TABLE 4
PER CAPITA PERSONAL INCOME 1989, 1990, AND 1991
FOR PARISHES WITHIN THE STUDY AREA, NEW ORLEANS MSA, AND STATE

Area	1991	1990	1989	Percent Change 1990-91	Average Annual Change 1987-90	Average Annual Change 1981-86
Jefferson Parish	$17,489	$16,849	$15,707	3.8%	8.1%	3.3%
Orleans Parish	17,130	16,474	15,262	4.0%	9.2%	4.2%
Plaquemines Parish	15,865	14,643	13,460	8.3%	n/a	n/a
New Orleans MSA	17,198	16,302	15,288	5.5%	8.6%	3.4%
Louisiana	15,054	14,300	13,235	5.3%	8.9%	2.8%

Source: U.S. Dept. of Commerce, Bureau of Economic Analysis, "Survey of Current Business," April 1993.

According to recent statistics released by the Commerce Department, Louisiana is one of the few states where per capita income growth exceeded the national average from 1990 to 1991. The per capita income of Louisiana averaged $15,054 in 1991. This represents a gain of 5.3 percent from 1990, and compares favorably to the national average increase rate of 2.1 percent. However, per capita income in this state is still well below the 1991 national per capita income average of $19,082.

The University of New Orleans reports that the per capita income of the New Orleans MSA increased 3.7 percent between 1992 and 1993. However, in nominal terms, this measure is expected to grow at a slower rate during the next two years.

Population and Community. The total population in the metropolitan area declined during the 1980's primarily due to a decline in the oil and gas industry. A majority of this out migration occurred on the east bank of Orleans Parish. Preliminary population estimates prepared by Louisiana Tech University show that by 1993 the population in Jefferson and Plaquemines Parishes, as well as the entire New Orleans MSA, had surpassed the 1980 levels. Only the population of Orleans Parish continued in a downward trend. Population growth is expected to continue paralleling the local economic activity.

Table 5 summarizes the 1990 Census Bureau population count for the three parishes within the project area.

TABLE 5
TOTAL POPULATION 1980, 1990, 1992, AND 1993

Area	1980	1990	1992	1993	% Change '80 - '90	% Change '92 - '93
New Orleans MSA	1,304,212	1,286,270	1,304,298	1,306,546	- 1.38	0.17
Plaquemines Parish	26,049	25,575	25,869	26,075	-1.82	0.80
Jefferson Parish	454,593	448,306	456,389	457,069	-1.38	0.15
Orleans Parish	557,515	496,938	495,116	493,021	-10.87	-0.42

Note: New Orleans Metropolitan Statistical Area (MSA) included population for Jefferson, Orleans, St. Bernard, St. Tammany, St. Charles, St. John the Baptist. Plaquemines, and St. James Parishes. Plaquemines and St. James Parishes were added to the New Orleans MSA per OMB Bulletin No. 93-50, December 28, 1992.
Sources: U.S. Census Bureau; and 1992 and 1993 figures are preliminary unpublished estimates provided by Louisiana Tech University, College of Administration and Business, Research Division.

According to the University of New Orleans, continued employment gains in excess of 7,500 jobs per year will support a 1 percent population growth in the metro area. The exact location of the population growth will be influenced by many factors including land availability, improvements to the transportation network, and improvements in the local economy. Table 6 provides the 1980 and 1990 Census Bureau population estimates for the individual communities within the project area.

The upscale subdivisions within the study area, including Stonebridge and Timberlane, experienced rapid growth, while the lower income areas in Harvey, Gretna, and Algiers showed a decline in total population. Population growth in the study area is expected to occur as more homes are constructed in existing subdivisions, and as residential development takes place in the vacant land east of the Algiers Canal.

TABLE 6
TOTAL POPULATION BY COMMUNITY
WEST BANK EAST OF HARVEY CANAL
CENSUS DATA - 1980 AND 1990

Area	Population 1980	Population 1990	Change Pop. #	Change %
Algiers	59,120	56,707	-2,413	- 4.0
Terrytown	23,548	23,787	+239	1.0
Gretna	20,615	17,208	-3,407	-16.5
Harvey	22,709	21,222	-1,487	-6.5
Stonebridge/ Timberlane	8,638	14,524	+5,886	68.0
Belle Chasse Area	8,844	8,910	+66	0.1
Total Study Area	143,474	142,358	-1,116	-0.1

Source: U.S. Census Bureau
Note: A small portion of Harvey above the West Bank Expressway is on the west side of the Harvey Canal.

Property Values and Housing. Although housing prices in the metro area generally showed a downward trend during the mid to late 1980's, they have increased between 6 percent and 7 percent per year since 1990. According to the Real Estate Market Analysis prepared by the University of New Orleans, the price of an average house in the metro area increased from a low of $82,613 in 1990 to an all time high of $98,789 in 1993. By national standards, however, the prices of homes in the New Orleans area still remain 20 percent or more below the national average. The highest average sales price in the metro area was recorded in English Turn which is located within the study area. Housing sales in this community during the first nine months of 1993 averaged $550,000. Table 7 shows the change in the total number of housing units for the three-parish area.

TABLE 7
CHANGE IN HOUSING UNITS
PARISHES WITHIN THE STUDY AREA[1]
1980 TO 1990

Parishes	1980 Census Housing Units	1990 Census Housing Units	Housing Unit Change
Jefferson[2]	166,124	185,072	18,948
Orleans	226,055	225,573	-482
Plaquemines	9,490	9,432	-58
Total	401,669	420,077	18,408

Source: U.S. Department of Commerce, Bureau of the Census
[1] The 1990 Census estimate for vacant housing units in Jefferson and Orleans Parishes was 19,207 and 38,174, respectively. Estimates for Plaquemines Parish were not available.
[2] The growth in housing units mainly occurred on the east bank of Jefferson Parish.

During the past year, there has been a shift in the real estate market throughout the area to purchases of larger homes. If the market continues its recovery and the demand for larger houses increases, there exists the potential for the average price of a house in the area to rise above $110,000. However, this price increase will only be sustained if employment gains occur in the metro area.

After nearly a decade of falling occupancy rates and rents, the apartment market has also stabilized and has begun to improve. The average occupancy rate in the metro area increased from 90.3% in mid-1993 to almost 91.5% by the end of the year. Apartment occupancy ranged from 88.5% in Orleans Parish to 92.7% in Jefferson Parish. These rates are expected to continue rising if employment gains occur due to the construction and opening of a land-based casino.

The recent gains for housing values in affluent neighborhoods and for occupancy

rates in large apartment complexes on the west bank of Orleans Parish are encouraging signs for the future.

Low occupancy rates and rents characterize the office, retail, and warehouse markets on the west bank, particularly in Algiers and Gretna. New and larger commercial construction will gain only at the expense of older and smaller buildings.

Public Facilities, Services, and Tax Revenue. The transportation network on the west bank has improved greatly with the opening of the second span of the Crescent City Connection bridge and the completion of the elevated Westbank Expressway. Also, the high-rise bridge across the Algiers Canal/GIWW has improved the access to Lower Coast Algiers and the English Turn Community. These improvements to the infrastructure of the area will have a positive impact on residential and commercial development.

There are three large military installations in the project area. The Naval Support Activity located in Algiers, the U.S. Coast Guard Station located in Lower Coast Algiers, and the U.S. Naval Air Station (Alvin Callender Field) located in Belle Chasse. Facilities located within Alvin Callender Field are used as an evacuation shelter for residents of Plaquemines Parish. Adequate drainage and flood control are necessary to sustain the continued maintenance and development of these public facilities and services. Without the additional hurricane protection which the project would provide, additional tax revenues would be needed to mitigate the effects of periodic hurricane surges and flood damage in the study area.

Economic Outlook. The establishment of a more diversified economy, along with the continued expansion of tourism and health services, is important for future economic growth. With the decline of the oil and gas industry and the continued loss of jobs in manufacturing, the area must create the climate for growth in other sectors of the economy. This growth should be separate from the potential job gains associated with the gaming industry.

As the 21st century approaches, the strategic geographical location of the New Orleans metro area could allow it to take advantage of the increased trade associated with the development of the North American Free Trade Agreement (NAFTA). With proper positioning, the New Orleans metro area could gain a share of the increased north/south commerce generated by the bill and expand its port activities. This could also create the potential for the development of satellite industries connected with the flow of trade.

Biological. Most of the wooded land within the existing hurricane protection system has already been developed. In 1989, there was approximately 11,300 acres of bottomland hardwoods in some fairly large tracts. The bottomland hardwoods have lost much of their value and function as wetland areas rather than as wildlife habitat because they have been leveed and drained. Remaining swamp occurs at the levee system near Oakville. Approximately 39 percent of the bottomland hardwoods can be classified as wetlands. A variety of wildlife species use the wetlands and non-wooded areas as habitat.

The canals in the study area provide low to moderate habitat value for fish and aquatic organisms. The larger canals do not offer much habitat diversity and the smaller canals can become choked with vegetation during the summer. The Harvey Canal experiences poor water and sediment quality from industrial pollutants, which diminishes its value for fish and other aquatic life. The Algiers Canal has somewhat better water quality, but it to contains contaminants in the sediments, especially near the Harvey Canal. Water samples taken above and below the intersection of the GIWW and the Hero Canal indicate the Hero Canal could have slightly better water quality than the Harvey Canal. However, Hero Canal sediments probably also contain some pollutants.

Water Quality. Significant waterways located in the immediate study area include the Harvey Canal, Algiers Canal, Hero Canal, and Bayou Barataria. These waterways are located in stream segment 03 of the Barataria Basin. Stream segment 03 is classified as "effluent limited." An "effluent limited" stream segment is defined as a segment where water quality is meeting and is expected to continue to meet applicable water quality standards. Stream segments where water quality does not currently meet applicable standards but will meet those standards after application of effluent limitations required by the Federal Clean Water Act are also classified as "effluent limited."

Surface waters of stream segment 03 of the Barataria Basin have been designated as suitable for primary and secondary contact recreation and for the propagation of fish and wildlife. However, persistently low dissolved oxygen concentrations and high biochemical oxygen demands, nitrogen and phosphorus levels, and fecal bacteria densities have been observed in the study area waterways. Overall, water quality in surface waters of the immediate study area can be considered only marginally acceptable. The comparatively low mean salinity in the canals and bayous of the interior of the drainage area imply that

saltwater intrusion into these areas is presently not significant.

With the exception of direct rainfall and exchange from the Mississippi River through the Harvey and Algiers locks, essentially all waters which flow through the area consist of pumped storm water runoff and wastewater treatment plant effluent. The Water Quality Management Plan for the area suggests that the Harvey Canal represents an exception to the general water quality of the area. The effects of industries along the canal, treated wastewater effluent, and stormwater discharges are compounding factors that result in poor water quality.

Cultural Resources. The study area was used by man in prehistoric as well as historic times. Most prehistoric archeological sites date to the Coles Creek period (A.D. 700 - A.D. 1200). Europeans began to settle in the region in the early 1700's. Many archeological sites in the area have been lost over time. These losses were caused by dredging, erosion, subsidence, and construction.

There are no National Register of Historic Places (NRHP) properties currently on record for any of the proposed alternatives. Two prehistoric sites and one historic site have been recorded in the project area. Over the years there have been several cultural resources investigations in portions of the project area. There is low potential that significant historic properties still exist in the canal areas because of heavy industrial use over the last 50 years. However, the Oakville area has a greater potential for containing potentially significant historic properties.

Recreation. Major recreational opportunities on the west bank consist of water-oriented sports such as fishing, boating, and hunting in the sparsely populated southern extreme of the study area. Numerous country clubs and recreational complexes are located within the more heavily developed portions of the study area. Four major recreational areas of significance adjacent to the area are the Lake Cataouatche-Lake Salvador complex (which includes the Salvador Wildlife Management Area), the Jean Lafitte National Historical Park, the Bayou Segnette State Park, and the Bayou Aux Carpes 404(c) area.

CONDITIONS IF NO FEDERAL ACTION IS TAKEN

SOCIOECONOMIC RESOURCES

Based on historical trends, population growth in the area would be expected to continue. The exact location of this growth would be influenced by many factors, including the availability of land in other areas, construction costs, interest rates, flood protection, environmental concerns, the proximity of housing to the work place and commercial centers, differences in lifestyles, the rising cost of home ownership relative to incomes, and the construction of new bridges across the Mississippi River. The economic potential of the area appears favorable in spite of declines in the petrochemical industries. The area's mild climate, natural resources, high potential for continued expansion of port activities, and tourist industries are major factors that should encourage growth. With the recent opening of the second span of the Crescent City Connection, overall growth trends are expected to continue.

The lands considered for additional hurricane protection are within a 35,000-acre leveed area along the west bank of the Mississippi River which extends from the Harvey Canal in Jefferson Parish to the Hero Canal below Belle Chasse in Plaquemines Parish. A portion of Orleans Parish is also included within the study area. Jefferson, Orleans, and Plaquemines Parishes are part of the New Orleans Metropolitan Statistical Area (MSA), which also includes St. Bernard, St. Charles, St. John the Baptist, and St. Tammany Parishes (Plaquemines and St. James were added to the MSA in 1993). Most of the area's 22,000 acres of urban developments are above the Gulf Intracoastal Waterway (GIWW) alternate route. Most of the remaining 11,300 acres of forested or undeveloped lands are below the GIWW alternate route, along with an estimated 800 acres of agricultural land. The area below the Algiers Canal includes two large tracts of land currently used for a U.S. Coast Guard Reservation and a U.S. Naval Air Station (Alvin Callender Field), which also includes about 4,500 acres of undeveloped land. Residential communities include Harvey, Gretna, Algiers and Terrytown west of the Algiers Canal, and Belle Chasse east of the Algiers Canal.

The recently completed second span of the Crescent City Connection bridge has created the potential for the future development of remaining vacant lands below the GIWW. Much of the land used for industrial development is located along the Mississippi River and the Harvey and Algiers Canals. In 1990, the New Orleans Planning

Commission approved a land-use plan for the Lower Coast Algiers that allocated 1,000 acres to be developed as part of an upscale urban development called English Turn, and another 2,600 acres available for development outside of English Turn. The plan includes locations for major streets, sites for schools, fire stations, district police headquarters, and industrial development. Eventually, 35,000 to 40,000 people are expected to live on the Lower Coast Algiers. A 900-acre golf course and recreation complex has already been completed, along with approximately $50 million in residential activity.

Without Federal action, the general pattern of land use within the study area should continue. However, future growth and development will depend on future economic conditions in the area. Future patterns and directions of development expected to occur through the year 2040 are as follows:

• Residential land use will continue to expand. With the exception of the Stonebridge subdivision, the portion of the study area west of the Algiers is almost completely developed. Minimal growth is expected in this area.

• Residential land use will continue to expand in the portion of the study area east of the Algiers Canal, where there are large tracts of undeveloped land. Population growth is expected in these areas as people move from the urbanized areas of the New Orleans MSA to these newer, more rural areas.

• Commercial land uses in the area east of the Algiers Canal should increase in order to support the population increases. Low occupancy rates and rents characterize the office, retail, and warehouse markets on the west bank, particularly in Algiers and Gretna. New and larger commercial construction will gain only at the expense of older and smaller buildings.

• The opening of the second span of the Crescent City Connection bridge will benefit commercial activity, but the driving force has to be the establishment of a more diverse economy. Port activity along the Harvey Canal and the tourist industry could also be major factors encouraging economic growth.

• Industrial land uses along the Harvey Canal, Algiers Canal, and the Mississippi River have the potential to grow with the recent passage of NAFTA. The west bank economy is largely centered around the port and related commercial and manufacturing activities, mineral production particularly in Plaquemines Parish, and in recent years a

growing tourist industry. Most of the heavy industries in Jefferson Parish are located along the Harvey Canal on the west bank, attracting retail sales and services. In addition to ship building, grain transport and storage, and other port activities, the west bank and adjacent coastal areas have been major sources of natural gas, petroleum, sulfur and salt, as well as fish and shellfish.

The 1990 projections for the New Orleans MSA prepared by the Bureau of Economic Analysis (OBERS) were based on historical trends for population, per capita income, and employment. These projections which are shown in Table 8 include only six parishes rather than the newly expanded eight parish metropolitan area. The projected compounded annual population growth rate is 0.03 percent during the 50-year period, while the per capita income and employment were projected at 0.9 percent and -0.2 percent, respectively, during the same period. The population projections were recently adjusted to reflect the 1990 Census data for the entire eight-parish area. In the revised projection, the compounded annual population growth rate falls to 0.02 percent.

In view of the preliminary population estimates prepared by Louisiana Tech University, and a historical average population growth rate of 1% per year, the OBERS projections, which show practically no-growth for the next fifty years, appears to be overly conservative. According to Louisiana Tech estimates, the current population in the New Orleans Metro area has already surpassed the OBERS population projection for the year 2000. It should also be noted that the projections do not consider the population shifts that will occur as people move from urban areas to newer more rural areas within the MSA. Consequently, OBERS population projections were not directly used for future development projections in the area east of the Algiers Canal through the year 2040. As with any long term projection, a high degree of uncertainty is implicit. Population projections are addressed in more detail in Volume 2, Appendix B.

TABLE 8
NEW ORLEANS, LA (MSA)
Population, Per Capita Income, and Employment, 1973-1988, and Projected, 1995-2040

	1973	1979	1983	1988	1995	2000	2005	2010	2020	2040
Population as of July 1 (thousands)	1,1525	1,1238	1,320	1,307	1,304	1,306	1,307	1,312	1,333	1,322
Per capita personal income (1982 dollars)	9,242	11,050	11,373	11,272	12,509	13,383	14,116	14,772	15,862	18,750
	Thousands of Jobs									
Total employment	520.4	616.0	636.9	632.4	654.1	671.0	676.6	674.7	646.4	604.9
Farm	1.4	1.5	1.6	1.4	1.4	1.3	1.3	1.3	1.1	1.0
Nonfarm	518.9	614.5	635.3	630.9	652.7	669.7	675.3	673.4	645.2	603.9
Private	436.5	521.5	535.4	533.9	557.6	574.9	581.7	581.4	558.4	524.2
Agricultural services, forestry, fisheries,	2.1	2.4	2.7	(D)	3.9	4.3	4.6	4.7	4.8	4.7
Mining	(D)	(D)	22.0	(D)	16.4	16.0	15.5	14.9	13.6	11.9
Construction	35.1	45.5	42.7	30.5	29.6	29.2	28.6	27.9	25.9	23.3
Manufacturing	58.3	60.5	51.0	45.2	44.7	44.8	44.5	43.9	41.6	38.3
Nondurable goods	28.3	28.4	24.9	22.0	20.9	20.5	20.0	19.5	18.1	16.3
Durable foods	30.0	32.1	26.0	23.2	23.9	24.3	24.4	24.4	23.5	22.0
Transportation and public utilities	48.2	57.3	53.7	48.0	47.9	48.3	47.9	47.3	44.7	41.3
Wholesale trade	(D)	(D)	38.6	34.4	34.2	34.2	34.0	33.8	32.2	29.9
Retail trade	82.4	104.9	109.0	115.8	120.0	123.9	125.2	125.0	119.7	111.7
Finance, insurance, and real estate	33.8	43.4	46.5	50.0	51.5	52.8	53.2	53.0	50.7	47.6
Services	122.2	145.3	169.1	189.1	209.2	221.3	228.2	231.0	225.3	215.4
Government and government enterprises	82.4	92.9	99.9	97.0	95.1	94.8	93.6	92.0	86.67	79.7
Federal, civilian	33.8	43.4	46.5	50.0	51.5	52.8	53.2	53.0	50.7	47.6
Federal, military	8.6	8.5	9.2	10.1	10.1	10.1	10.1	10.1	10.1	10.1
State and local	60.6	68.9	75.8	71.0	69.4	69.2	68.3	67.0	62.8	57.0

Source: OBERS, Bureau of Economic Analysis, Regional Projections To 2040, Volume 2, 1990

Please Note: Not Revised to include 1990 Census Data and only includes Six Parishes as part of the N. O. Metro area: Jefferson, Orleans, St.Bernard, St. Charles, St. John the Baptist, and St. Tammany.

ENVIRONMENTAL RESOURCES

Biological. Undeveloped lands within the existing levee system will continue to be developed for residential and commercial purposes and, therefore, lose their value to wildlife. Calculations based on the loss rate from 1978 to 1989 show that approximately 10,000 acres of bottomland hardwoods would remain in the year 2000 and that 2,900 acres would remain in the year 2095. Development will probably occur first in non-wetland portions of the project area. As development continues, alteration of drainage patterns could reduce the extent and quality of wetlands in the area. If most non-wetlands are developed, and the need for a project can be established, development in wetlands may be allowed. Public land in the project area encompasses approximately 4,500 acres or 37 percent of remaining developable land. The land is located on two Federal installations, Alvin Callender Field Naval Air Station in Belle Chasse and the U. S. Coast Guard facility at English Turn. Expansion of these installations could impact forested lands on these sites. Closure of these installations could result in various scenarios of development occurring on these sites resulting in a reduction of forested lands. As subsidence and saltwater intrusion continue to occur, most of the swamp and bottomland hardwoods outside of the levee system near Oakville will probably be lost by 2090. Fishery resources will gradually become more saltwater oriented in the canals outside of the protection system. Implementation of the proposed freshwater diversion projects in the Barataria Basin could slow the wetland loss and possibly allow swamp and marsh habitat to persist in the area. Inside the protection system, there would be little change in fishery resources when compared to existing conditions.

Sea Level Rise and Subsidence. The climate, water, and land resources of the study area are significantly influenced by the Gulf of Mexico. The gulf is also influenced by the rise in sea level caused by global warming which results in thermal expansion of water and melting of glaciers. The historical rate of sea level rise is estimated at 0.5 feet per century. The study area is also influenced by subsidence. Unleveed areas are subject to natural subsidence and will become increasingly vulnerable to flooding from the combined effects of subsidence and sea level rise. Subsidence also occurs within the protected areas as pumping stations lower the water table and soft, compressible sediments are consolidated. Subsidence is estimated to occur at a rate of 0.65 feet per century in unleveed areas and at 2 feet per century in the developed areas.

Water Quality. It is not likely that the general level of water quality in the project

area will be significantly improved in the foreseeable future. Substantial improvement could result from cessation of municipal and industrial wastewater discharges into the area's waters. However, stormwater discharges to the waterways, with attendant water quality degradation, will continue.

Cultural Resources. It is probable that known cultural resources, as well as those that have not yet been discovered, would continue to be adversely affected as a result of urban growth, industrialization, and other development. Development would soon expand into presently undeveloped areas. Destructive natural forces such as erosion and possible subsidence would have an adverse impact on cultural resources. Other adverse impacts resulting from indiscriminate human actions would most likely increase with an increase in population. Not only could potential vandalism of cultural properties occur, but many recorded and unrecorded sites could be unknowingly destroyed.

Recreation. Future recreational use of the study area should increase due to the proximity of recreation/natural areas such as Lake Cataouatche-Lake Salvador (including the Salvador Wildlife Management Area), Jean Lafitte Natural Historical Park, Bayou Segnette State Park, Bayou Aux Carpes 404(c) area, Brechtel Memorial Park and Golf Course, English Turn Country Club, Stonebridge Country Club, Lakewood Country Club, Timberlane Country Club, Plantation Golf Club, and Bayou Barriere Country Club. Bicycle transportation, ie. bicycle paths, may be incorporated within the project levee based upon the newly enacted Intermodal Surface Transportation Efficiency Act of 1991. Development of levee bicycle transportation corridors could be approved by the local levee board, state bicycle coordinators, and metropolitan planning organizations.

PLAN FORMULATION

PROBLEMS, NEEDS, AND OPPORTUNITIES

The primary problems, needs, and opportunities identified in this study relate to the need for improving hurricane protection in the study area and the need to protect natural resources.

PROBLEMS AND NEEDS RELATED TO HURRICANE PROTECTION

Early development within the study area occurred primarily along the banks of the Mississippi River. Land near the river had been built up by years of overflow and was less susceptible to flooding. These areas also provided easy access to navigation. As developments expanded away from the river and into lower more vulnerable areas, it became necessary to construct drainage canals, pumping stations and levees. Improving interior drainage within these developments lowered the water table causing the sediments to consolidate. The levees constructed along the banks of the Mississippi River have further compounded the problem by eliminating the seasonal sediment-laden overflow that once nourished adjacent wetlands. The consolidation of sediments and the loss of Mississippi River sediments has resulted in high rates of subsidence in some areas. The resulting ground elevations within the developed areas are often below sea level, placing additional importance on interior drainage and hurricane protection.

The population of the study area based on the 1990 Census is approximately 142,000. Population growth in the New Orleans metropolitan area is expected to increase as the local economy continues to improve. The west bank economy is largely centered around the port and related commercial and manufacturing activities, mineral production, and in recent years, a growing tourist industry. Most of the heavy industries are located along the Harvey and Algiers Canals. The second span of the Crescent City Connection appears to have encouraged future development of remaining lands south of the Algiers Canal. Construction is well underway to transform the Lower Coast Algiers into an upscale urban development called English Turn. A 900 acre golf course and recreation complex have already been completed along with approximately $50 million in residential development.

Currently, there are no Federally authorized hurricane protection projects on the west bank of the Mississippi River for the area east of the Harvey Canal. Construction of the Westwego to Harvey Canal Hurricane Protection Project was authorized by the Water Resources Development Act of 1986. This project, located adjacent to the study area, will provide a SPH level of protection to the area between Bayou Segnette and the Harvey Canal.

Hurricane protection to the study area is currently provided by Federal levees along the Mississippi River and the Algiers Canal and by non-Federal levees along the Hero Canal. The industries along the Harvey Canal have also attempted to provide protection to their facilities. These Federal and non-Federal levees provide various levels of hurricane protection. Elevations of the levees along the west bank of the Mississippi River in the vicinity of the study area range from 24.5 feet to 25.3 feet NGVD. Historical records show that stages on the Mississippi River during hurricane season (June through November) vary form 3 to 10 feet NGVD. Even with the maximum projected stage increase of 10 feet due to hurricane surge, the Mississippi River levees provide adequate protection against tidal surge and will be incorporated into the protection.

The area west of Algiers Canal is currently provided with protection by the Mississippi River levees, the levee along the west bank of the Algiers Canal, and the Harvey Canal-Bayou Barataria levee. Levee heights along the Algiers Canal average 7 feet NGVD and are maintained by the Federal government. Under existing conditions these levees are subject to overtopping from tidal surge at around the 100-year event. Under future conditions these levees would be subject to overtopping at around the 50-year event (assuming the levees are maintained at their current levels). The Harvey Canal-Bayou Barataria levee was constructed on the west bank of the Harvey Canal south of the Cousins Pumping Station. The first lift was constructed as a feature of the Harvey Canal-Bayou Barataria project and all subsequent work has been accomplished by local interests. The protection along the east bank of the Harvey Canal was constructed by the industries located along the canal and varies considerably in height and integrity. The protection is provided by a series of floodwalls, bulkheads, and levees and varies in height from below 3 feet NGVD in some locations to as high as 8 feet NGVD in others. Overtopping along the Harvey Canal can occur in some locations from only the 10-year event. Even a stalled frontal system with strong southerly winds is capable of creating a tidal surge which necessitates sandbagging of the low spots along the Harvey Canal.

The area east of Algiers Canal is protected by the Mississippi River levees, the

levee along the east bank of the Algiers Canal, and the Hero Canal levee. The levee along the east bank of the Algiers Canal is maintained at around 7 feet NGVD and would be subject to overtopping form the 100-year event under existing conditions and the 50-year event under future conditions. A non-federal levee has been constructed along the north bank of the Hero Canal at the southern boundary of the study area. This levee extends from Bayou Barataria to the head of the Hero Canal. The levee varies in elevation from 5 feet to 9 feet NGVD. This levee is subject to overtopping or failure from around the 50-year event under existing conditions. Under future conditions the levee would be subject to overtopping from the 20-year event.

The hydraulic analysis for the without project conditions was conducted assuming that the Federally constructed levees do not fail. Rates of overtopping, where applicable, were computed for these levees based on the height of the levee relative to the predicted surge height for a given storm. Hurricane Juan (1985) provided a recent hurricane event to observe the behavior of both the Federal and non-Federal levees within the study area. Based on the actual failures that occurred during Hurricane Juan, two major failures were assumed in the non-Federal levees, one along the Harvey Canal just below the Hero Pumping Station and the other along the east bank of Bayou Barataria near the Hero Canal (see Plate A-II-1). These failures were assumed to be 1,000 feet in length and were assumed to occur when the hurricane surge reached an elevation within 2 feet of the top of the levee. Rates of overtopping were computed for the remaining reaches of non-Federal levee assuming the levee remained intact. The performance of the Federal and non-Federal levees are based on existing geologic information and on the past performance of similar levees during Hurricane Juan. These assumptions are conservative with respect to the guidance contained in Policy Guidance Letter No. 26, Benefit Determination Involving Existing Levees and Engineering Technical Letter 1110-2-328, Reliability Assessment of Existing Levees for Benefit Determination. A detailed stability analysis for the non-Federal levees would likely result in failure and non-failure points well below the top of the existing levee. This would result in multiple failures occurring over considerably greater lengths. Interior stages for existing conditions would increase resulting in greater without project equivalent annual damages.

Hurricane Juan demonstrated a recognizable potential for the occurrence of hurricane flooding events that would easily exceed any protection afforded by existing levees within the study area. Juan began as a tropical depression on October 26th and grew into a category 1 hurricane by October 27th. The storm remained along the Louisiana coast for 2 days before moving east and making landfall between Alabama and

the Florida panhandle. Torrential rain for several days, coupled with tides as high as 8 feet above normal, caused extensive flooding in coastal Louisiana. Stages reached in the Harvey Canal during Juan were estimated at about a 60-year event. More than 2,200 homes on the west bank of Jefferson Parish were affected by storm waters. This resulted in $46 million in damages to homes with an additional $6 million in damages to vehicles. The needs of the study area related to hurricane protection can be demonstrated by the fact that of the 31,650 residential structures in the area, 12,627 would be flooded by the 100-year storm, 18,438 by the 200-year storm, and 26,098 (over 82 percent) by the 500-year storm. Of the 2,715 commercial facilities also located within the study area, 1,001 would be flooded by the 100-year storm, 1,755 by the 200-year storm, and 2,424 (over 89 percent) by the 500-year storm. The equivalent annual damages for the without project conditions are $41,209,000 for the area west of Algiers Canal and $2,702,000 for the area east of Algiers Canal.

Although the majority of damages on the west bank resulting from Hurricane Juan were located between Westwego and the Harvey Canal, it clearly demonstrated the need for increased protection east of the Harvey Canal. Extensive sandbagging was required along the Harvey Canal to prevent overtopping of existing protection. The present local levee system is unable to provide adequate protection against tidal surge. The quick action and massive flood fighting efforts by the West Jefferson Levee District, the Parish of Jefferson, the Louisiana National Guard, and thousands of volunteers prevented more extensive flooding of potentially catastrophic proportions. As the population and development in the area increases, the potential for loss of life and property damage from a hurricane will escalate. Therefore, improved hurricane protection is needed in the area.

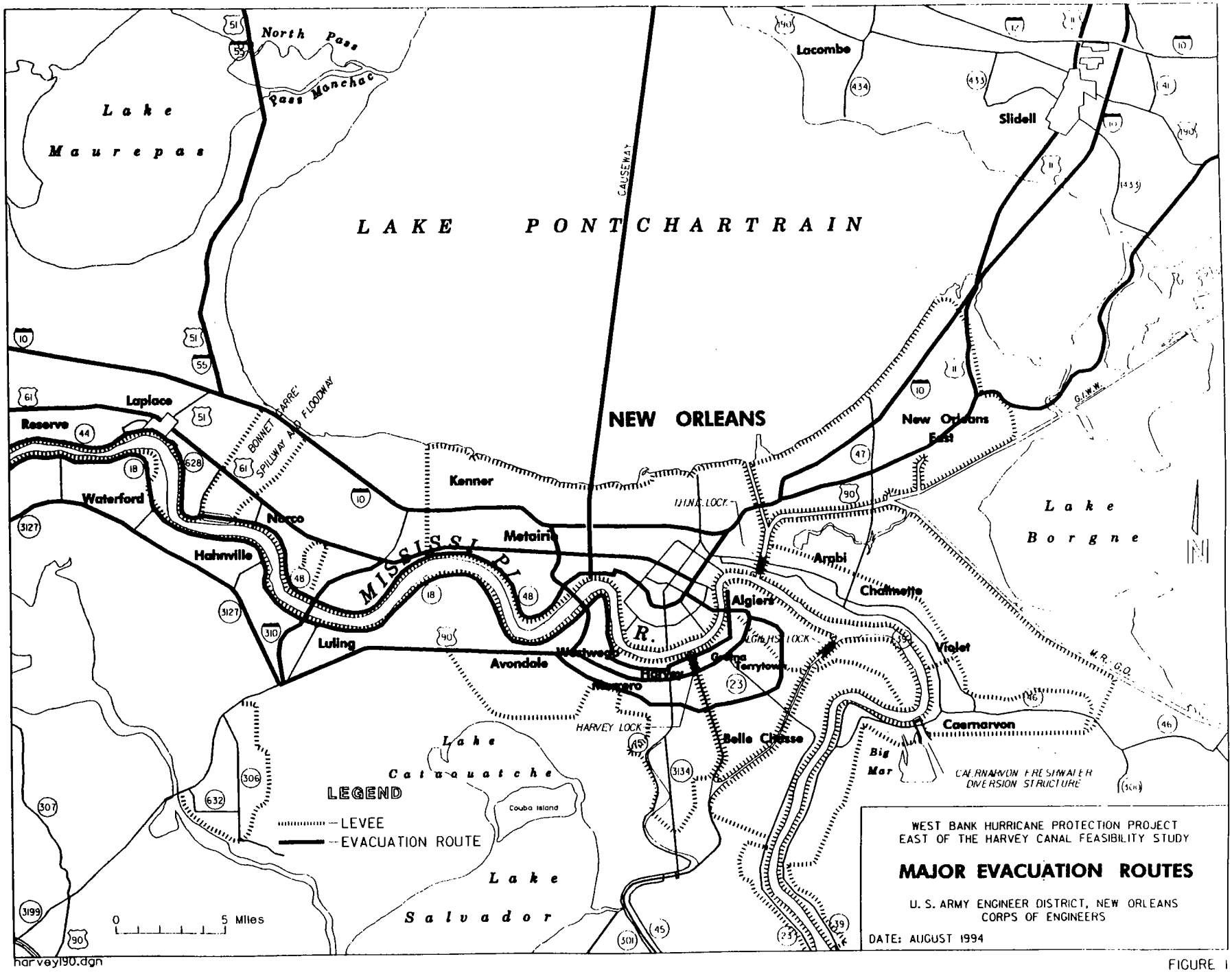
PROBLEMS RELATED TO HURRICANE EVACUATION

Between 1886 and 1993, 35 hurricanes passed within 125 miles of New Orleans. With the widespread use of satellite and radar images, there is a perception that technology has greatly increased the ability to predict the path of a hurricane. However, the improvements in hurricane forecasting for lead times in excess of 24 hours falls far short of the public's perception. Forecast errors for hurricane predictions issued 24 hours prior to projected landfall average 100 miles. The forecast error increases to 220 miles for 48 hour forecasts and 400 miles for 72 hour forecasts. These error statistics are based on the use of present day surveillance methods, including the most accurate method, hurricane hunter aircraft. Other surveillance methods are not as accurate until the center of the hurricane is within the range of coastal radar, about 200 miles.

Not only do errors occur in predicting the path of a hurricane, but also in predicting the hurricane's strength. A hurricane can intensify by 20 percent in a 24-hour period. A hurricane projected to impact the coast within 24 hours could intensify from a 200-year storm to a 500-year storm prior to making landfall. An evacuation order based on projected limits of inundation for a 200-year storm could potentially leave the additional areas vulnerable to a 500-year storm at the mercy of the hurricane. Additional protection is a needed safety factor given the difficulty in predicting the path and intensity of a hurricane.

The evacuation roadway network for the New Orleans metropolitan area is largely east-west, linked by elevated highways, bridges, and tunnels, and is inadequate for a massive evacuation (see figure 1). Preliminary clearance times for evacuating the New Orleans metropolitan area in response to a hurricane threat have exceeded 48 hours for a category 4 or 5 hurricane. Depending on when the evacuation is ordered, residents may require an additional 6 hours to mobilize in response to the evacuation order. Evacuations should be completed prior to the arrival of sustained gale force winds (40 mph) in order to avoid deteriorating weather conditions. Continuing an evacuation beyond the arrival of gale force winds would endanger the lives of those evacuating. Winds in excess of 40 mph can arrive up to 12 hours before the eye of the hurricane, depending on the storms size and forward speed. An additional 4-12 hours should therefore be added to the clearance time to account for pre-landfall hazards time. A category 4 or 5 hurricane with a projected landfall along the southeastern Louisiana coast would place local officials in the unenviable position of needing to issue widespread evacuation orders nearly 60 hours prior to the projected landfall. Evacuation orders issued in excess of 48 hours prior to landfall would, in 9 out of 10 instances, be issued for areas not directly impacted by the storm.

Behavioral patterns suggest that residents living in threatened communities do not begin evacuating in significant numbers until an evacuation order has been issued. A "Hurricane Watch" is issued by the National Hurricane Center covering a 300-mile stretch of coastline 36 hours before the eye of the hurricane is expected to make landfall. This is changed to a "Hurricane Warning" 24 hours prior to landfall. The inability to accurately predict the path of a hurricane in excess of 24 hours prior to landfall is responsible for the reluctance of local officials to order early evacuations. Hurricane Andrew (1992) provides a recent example of the problems associated with evacuating the New Orleans metropolitan area. Although Andrew ultimately made landfall in south-central Louisiana, the potential for the storm to take a more northwesterly track caused local officials to issue evacuation orders for most of the west bank residents, including those within the study area. Prior to



harvey190.dgn

FIGURE 1

entering the Gulf of Mexico, Hurricane Andrew left its mark on southern Florida. This allowed coverage of the widespread devastation in Florida to be broadcast to Louisiana residents before evacuation orders were issued. Even with this added incentive, evacuation rates throughout southeast Louisiana were still quite low. Upon returning to their homes and learning that the hurricane had in fact made landfall well to the west of New Orleans, many evacuees criticized local officials for ordering an evacuation in the first place.

Historical data suggests that a category 1 hurricane can be expected to pass within 75 miles of New Orleans once every nine years. The frequency of occurrence decreases as the size of the storm increases. A category 2 hurricane has a mean return period of 18 years; a category 3, 30 years; a category 4, 60 years; and a category 5, 130 years. Based on the current level of protection, significant flooding within the study area would begin to occur within the study area for a category 2 hurricane. The frequent threat of hurricanes coupled with long evacuation times and reduced levels of protection create the potential for repeated evacuations of the study area. Increasing the level of hurricane protection would reduce the frequency of evacuation, thereby increasing evacuation rates when evacuation orders are necessary.

NEEDS AND OPPORTUNITIES FOR NATURAL RESOURCE PROTECTION

Wetlands in the project area have lost much of their value. They are almost entirely enclosed in a levee system and under forced drainage. These wetlands will be lost gradually to development. The remaining tracts of forested wetlands will have much reduced wetland functions and value within 100 years. Many of the remaining wooded wetlands offer valuable habitat for fish and wildlife species. There is a need to protect the remaining wooded wetlands in the study area and an opportunity to avoid and/or mitigate impacts to these areas in the development of hurricane protection or any other land development plans.

IMPROVEMENTS DESIRED

The West Jefferson Levee District, Jefferson Parish, Orleans Parish, Plaquemines Parish, and the State of Louisiana desire a Federal project to provide hurricane protection for the study area. The desire for improvements in the study area stems from the natural growth of development on the west bank of the Mississippi River opposite New Orleans. Continued growth has resulted in the development of lands more vulnerable to flooding from storm tides and local rainfall.

Hurricane Betsy was the impetus for the congressional resolutions that provide authorization for this study. More recently, Hurricane Juan inflicted severe damage on certain portions of the west bank area. Had it not been for the extensive flood fighting efforts by several state and local agencies for an extended period of time, damage would have been considerably worse. Hurricane Andrew, the last hurricane to make landfall in Louisiana, caused local officials to recommend the evacuation of residents living on the west bank of the Mississippi River in Jefferson, Orleans, and Plaquemines Parishes. Although Andrew ultimately made landfall in south-central Louisiana, actions by local officials clearly illustrated the lack of protection within the study area. Public officials and residents fear a hurricane on a critical path to their area and desire protection comparable to that provided to other portions of metropolitan New Orleans. Protection to the surrounding areas is a result of the Westwego to Harvey Canal Hurricane Protection Project authorized in 1986 and the Lake Pontchartrain, Louisiana, and Vicinity Hurricane Protection Project that was authorized in 1965. Both projects were authorized to provide Standard Project Hurricane levels of protection and are currently under construction.

PLANNING CONSTRAINTS

Legislative and executive authorities have specified the range of impacts to be assessed, and have set forth the planning constraints and criteria that must be applied when evaluating alternative plans. Plans must be developed with due regard to the benefits and costs, both tangible and intangible, as well as associated effects on the ecological, social and economic well-being of the region. Federal participation in developments should also ensure that any plan is complete in itself, efficient and safe, economically feasible in terms of current prices, environmentally acceptable, and consistent and acceptable in accordance with local, regional, and state plans and policies. As far as practical, plans should be formulated to maximize the beneficial effects and minimize the adverse impacts of the considered improvements.

PLANNING OBJECTIVES

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

- Provide adequate hurricane protection for the west bank of the Mississippi River

in the vicinity of New Orleans for the area generally bounded by the Harvey Canal to the West, the Mississippi River to the north and east, and the Hero Canal to the south. The study area is referred to as the area east of the Harvey Canal.

- Contribute to the Nation's economic development by reducing hurricane-related flood damages.

- Minimize adverse impacts on the natural environment and social well-being.

- Retain unhindered access to the Harvey and Algiers Canals for adjacent industries.

MANAGEMENT MEASURES

Structural management measures considered for providing hurricane protection for the west bank area were limited to those such as levees, floodwalls, floodgates and pumping stations to reduce flooding from hurricane driven tides.

Non-structural measures such as flood-forecasting, combined with evacuation and the national flood insurance program, are currently being employed in the study area and will continue to be employed, with or without further Federal action. A hurricane task force consisting of members from nine southeastern Louisiana parishes was formed in late 1988. Their goal is to develop comprehensive regional evacuation plans for a wide range of hurricane scenarios. The Corps of Engineers, in conjunction with the Federal Emergency Management Agency (FEMA), has completed a hurricane preparedness study in southeast Louisiana. The study is a cooperative effort of Federal, state and local agencies. The purpose of the study is to provide pertinent, quantitative information for state and local agency use in the development of local and regional hurricane evacuation plans. The study was completed in August 1994. The Louisiana Office of Emergency Preparedness has developed a regional evacuation and sheltering plan for southeast Louisiana. This plan provides a framework within which the parishes can coordinate with state government in order to deal with a catastrophic hurricane. There are no other practical non-structural measures for improving hurricane protection in the study area.

FORMULATION PRINCIPLES

The Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100) requires the systematic development of alternative plans which contribute to the Federal objective. Alternatives should be formulated in consideration of four criteria: completeness; effectiveness; efficiency; and acceptability.

- Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

- Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

- Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

- Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

In general, when formulating alternative plans, an effort is made to include only increments that increase the net NED benefits on a first- and last-added basis.

PLAN FORMULATION RATIONALE

To facilitate in the formulation and analysis of hurricane protection plans, the study area addressed in this report was divided into separable elements. The Algiers Canal physically divides the study area, creating two separable areas that can be evaluated independently. For the purposes of this report, the areas are referred to as the area "west of Algiers Canal" and the area "east of Algiers Canal." The area "west of Algiers Canal" is bordered by the Harvey Canal on the west, the Mississippi River on the north, and the Algiers Canal on the southeast. The area "east of Algiers Canal" is bordered by the Algiers Canal on the west, the Mississippi River on the north and east, and the Hero Canal

on the south, see Plate 2. Hurricane protection could be provided to one area without significantly impacting the other area. This allows the economic and environmental analysis of each of the areas independently. The independent analysis of each area provides a greater opportunity for identifying the best overall plan.

In the development of plans for addressing the problems and needs relative to hurricane flooding within the study area, structural and non-structural alternatives were considered. Because of the extent and types of existing development, limitations on the times for advance flood forecasting, and limitations on the capacities of hurricane evacuation routes, the development of strictly non-structural measures would not be responsive to the problems and needs of the area related to hurricane flooding. Structural alternatives addressing the problems and needs of the study area were limited to barriers to hurricane surges, such as levees, floodwalls, floodgates, and pumping stations.

Two approaches were considered for improving hurricane protection for the area west of Algiers Canal, one approach was considered for improving protection for the area east of Algiers Canal, and one approach was considered for jointly protecting both the areas east and west of Algiers Canal. The plan which would jointly protect both areas would result in a much shorter alignment than independent plans for each area, but would require a floodgate across the GIWW and a large pumping station. The various approaches are discussed below.

Area West of Algiers Canal. Protection to the area west of Algiers Canal is currently provided by the Mississippi River levee to the north, the Algiers Canal levee to the southeast, and to a very limited degree by bulkheads, floodwalls, earthen dikes, and other structures along the east bank of the Harvey Canal to the west. The Mississippi River levee and Algiers Canal levee are features of Federal projects and are structurally sound. The Mississippi River levees provide hurricane protection which meets or exceeds the SPH event, but the levees along the Algiers Canal are subject to overtopping from around the 100-year event. The line of protection along the east side of the Harvey Canal was constructed by the industries along the canal under an agreement with the West Jefferson Levee District. The level of protection and structural integrity varies considerably. Heights of the existing protection vary from below 3 feet NGVD in some locations to over 8 feet NGVD in others and overtopping can occur from events as frequent as the 10-year storm. One approach would provide for the construction of levees and floodwalls along the east side of the Harvey Canal and the raising of the Algiers Canal

levee. This approach is presented as Plan 1. The alignment for Plan 1 is shown on Plate 3.

The second approach was evaluated to determine if protection could be provided to the industries along the Harvey Canal without impacting existing access. This approach requires the construction of a navigable floodgate in the Harvey Canal and the enlargement of the Algiers Canal levee. The navigable floodgate would tie the line of protection to the adjacent Westwego to Harvey Canal project which has been authorized to provide SPH protection for residents living between Bayou Segnette and the Harvey Canal. This approach resulted in the development of Plans 2 and 3. The alignments for Plans 2 and 3 are shown on Plates 5 and 6 respectively. These plans would significantly reduce or eliminate the need for the construction of levees and floodwalls along each side of the Harvey Canal between the new floodgate and the Harvey Lock. These plans would, however, require some modification of existing drainage facilities.

Area East of Algiers Canal. The area east of Algiers Canal is currently provided with protection by the Mississippi River levee to the north and east, the Algiers Canal levee to the west, and the locally-constructed Hero Canal levee to the south. The Mississippi River levee and the Algiers Canal levee are features of Federal projects and are structurally sound. The Mississippi River levees provide sufficient levels of hurricane protection but the Algiers Canal levee is subject to overtopping from around the 100-year event. The Hero Canal levee varies in elevation from 5 to 9 feet NGVD and is subject to overtopping or failure from the 50-year event. The Hero Canal levee also stops several hundred feet from the Mississippi River levee. This gap must be closed by sand bags during hurricane events. The existing line of protection provides the most cost effective means of increasing the protection for the area east of Algiers Canal. Alternative alignments would require additional rights-of-way and modifications of existing drainage facilities. The improvement of the existing line of protection was included as a separable feature of Plans 1, 2, or 3. The alignment for this plan is shown on Plate 6.

Joint Protection for Areas West and East of Algiers Canal. Protection to the areas both east and west of the Algiers Canal could be provided by the construction of a floodgate across the Gulf Intracoastal Waterway just south of the Harvey and Algiers Canals. Levees would be constructed to tie-back into the Westwego to Harvey Canal project at the Estelle Pumping Station and to the existing Plaquemines Parish levee near Oakville. This plan would also require the construction of a high-capacity pumping station adjacent to the floodgate to pump rainfall run-off out of the Algiers and Harvey Canals

during a hurricane. In addition to protecting the entire study area, this plan would eliminate the need for construction of hurricane protection measures along both the Harvey Canal and the Algiers Canal. This approach is presented as Plan 4. The alignment for Plan 4 is shown on Plate 7.

The alternative plans for providing hurricane surge protection were evaluated at various levels of protection, generally 100-year, 200-year and Standard Project Hurricane. The 30-year and 70-year levels of protection were also evaluated for the area west of Algiers Canal. Lower levels of protection were not considered for the area east of Algiers Canal because the majority of the existing levees provide a relatively high degree of protection. The costs and benefits for each plan were evaluated at different levels of protection to determine the plan and level of protection which provides the greatest net annual benefits. The plans were also evaluated based on their environmental impacts. Evaluating the plans at different levels of protection develops the information needed to determine the best overall plan for providing hurricane protection for the area. The storm events used to evaluate alternative plans are based upon estimated probabilities of various hurricanes occurring with given magnitudes of certain storm parameters such as central barometric pressure, wind speed, forward translation speed, and storm track. The selection of the value(s) of the parameters is based on historic data and experience. The storm parameters are not based upon one theoretical event, but upon several events, each of which would be critical to the study area.

PLANS CONSIDERED

A brief description of each of the alternatives considered in this study are presented below:

PLAN 1, WEST OF ALGIERS CANAL

Plan 1 would provide for the construction of levees and floodwalls along the east side of Harvey Canal and the enlargement of the existing levee along the west bank of the Algiers Canal. Different alignments and floodwall/levee combinations were initially considered for the east side of the Harvey Canal. The area from just east of Peters Road to the Harvey Canal is an industrial corridor. The industries within this corridor require access to the Harvey Canal. These industries have strongly opposed any alignment that would affect their access to the canal. Severe access problems would be created by

alignments which followed either Peters Road or the east bank of the Harvey Canal. These alignments also required the use of levee/floodwall combinations consisting primarily of floodwall. The alignment which varied one to two blocks east of Peters Road was the only alternative that would not create severe access problems. This alignment would also allow for the construction of levees south of Lapalco Boulevard. As a result, the alignment east of Peters Road was used in the development of Plan 1.

This plan would provide for the construction of a floodwall extending from the Harvey Lock to Lapalco Boulevard. The alignment would vary one to two blocks east of Peters Road. Gates would be provided in the floodwall to facilitate vehicular access to the industries and businesses along the Harvey Canal. South of Lapalco, a combination of levees and floodwalls would connect to the Hero Pumping Station. The protection would extend south from the Hero Pumping Station around the peninsula of land, connecting with the existing Algiers Canal levee. Alignments which extend directly across the peninsula, although shorter in length, would require substantial modifications to existing drainage facilities. These alignments would also exclude several industries from the protection. The levee along the west bank of the Algiers Canal would be enlarged from Bayou Barataria to the Algiers Lock. The features of Plan 1 are shown on Plate 3.

This plan would provide protection for all residents and most businesses west of the Algiers Canal. The industries located along the Harvey Canal would, however, remain unprotected.

PLAN 2, WEST OF ALGIERS CANAL

Plan 2 would provide for the construction of a navigable floodgate in the Harvey Canal and for the enlargement of the existing levee along the west side of the Algiers Canal as in Plan 1. The floodgate would be located just north of the Hero Pumping Station. The construction of a floodgate in the Harvey Canal would provide protection to those industries along the canal north of the floodgate. A new levee constructed from the floodgate to the Estelle Pumping Station would tie the line of protection to the Westwego to Harvey Canal project. East of the floodgate, the existing protection would be upgraded from the Hero Pumping Station to the Algiers Lock. During a hurricane, both the floodgate and the Harvey Lock would be closed to prevent flooding. Rainfall, however, would continue to be discharged into the canal from the Harvey and Cousins Pumping Stations. The operation of these pumping stations would increase stages in the canal until the existing protection would be overtopped. A new pumping station would therefore be

required to evacuate water discharged into the canal. The new pumping station would be located adjacent to the floodgate and would have a capacity of approximately 6,000 cfs. Operation of the pumping station would only be required during those times when the floodgate structure is closed.

The new pumping station, located adjacent to the floodgate, would minimize stage increases between the lock and the floodgate. However, the lag time associated with closing the floodgate and beginning operation of the pumping station would necessitate increased protection along the Harvey Canal north of the floodgate. Protection would be required along both banks of the Harvey Canal (parallel protection) to an elevation of 4.0 feet NGVD. The floodwall feature of the authorized Westwego to Harvey Canal project which extends from the Cousins Pumping Station to the Harvey Lock would be modified to accommodate the reduced stages. Increasing protection would allow for the temporary storage of rainwater discharged into the Harvey Canal. The features of Plan 2 are shown on Plate 4.

PLAN 3, WEST OF ALGIERS CANAL

Plan 3 was developed to evaluate the feasibility of constructing a floodgate in the Harvey Canal at a location that would still provide protection to industries along the canal but would not require the construction of a new pumping station. This plan would provide for the construction of a navigable floodgate in the Harvey Canal about 3,600 feet south of Lapalco Boulevard, the construction of levees and floodwalls along the east side of the Harvey Canal between the floodgate and the Hero Pumping Station, and the enlargement of existing levees along the west bank of the Algiers Canal. A diverted outfall canal for the Cousins Pumping Station, discharging below the navigable floodgate, would eliminate the need to construct a new pumping station. The new outfall canal would also serve as a temporary bypass channel to accommodate traffic in the Harvey Canal while the floodgate is under construction. When the floodgate structure is closed, the existing Harvey Pumping Station would be shut-down and interior drainage would be diverted to the Cousins Pumping Station. The capacity of the Cousins Pumping Station would be increased by 1,000 cfs and the 1st Avenue Canal which connects the Harvey and Cousins Pumping Stations, would be enlarged to handle the additional drainage.

Protection along the west side of the diverted outfall canal for the Cousins Pumping Station would be provided by a levee which extends from the pumping station to just below the floodgate where it would tie-in to the Westwego to Harvey Canal project. The

east side of the outfall canal would be protected by a floodwall extending from the pumping station to the navigable floodgate. On the east side of Harvey Canal, a combination of levees and floodwalls would provide protection from the navigable floodgate to the Hero Pumping Station. From the Hero Pumping Station the protection would follow the existing bank line along the peninsula of land just to the south. This alignment provides protection to the industries located in this area and avoids impacts to existing drainage facilities. The protection would tie-in to the existing levee along the west bank of the Algiers Canal. The Algiers Canal levee would be upgraded from Bayou Barataria to the Algiers Lock. The features of Plan 3 are shown on Plate 5.

The construction of a floodgate in the Harvey Canal combined with the increased capacity of the Cousins Pumping Station and the diverted outfall canal not only protects the industries along the canal, but also eliminates the need for parallel protection north of the floodgate. The Westwego to Harvey Canal project includes a floodwall along the west bank of the Harvey Canal from the Cousins Pumping Station to the Harvey Lock. The estimated first cost of this feature is $15,052,000. Construction of the floodwall is currently scheduled to begin in late 1998 with completion in 2001. This feature of the authorized project would be eliminated if Plan 3 were implemented.

EAST OF ALGIERS CANAL

A single plan was developed for providing increased levels of hurricane protection to the area east of Algiers Canal. This plan would provide for the enlargement of existing levees along both the Algiers and the Hero Canals. From the Algiers Lock, the existing levee would be upgraded along the east side of the Algiers Canal and along the north bank of the Hero Canal. The protection would wrap around the head of the Hero Canal and continue approximately 2,700 feet west along the south bank of the Hero Canal. A new levee would be constructed along the western edge of the community of Oakville connecting the Hero Canal levee with an existing Plaquemines Parish levee. The portion of the Plaquemines Parish levee which extends back toward Hwy. 23 would also be enlarged. The features of this plan are shown on Plate 6.

The area east of Algiers Canal includes Alvin Callender Field, a large military installation located south of Belle Chasse. This facility would be incorporated within the protection by following the existing levees. Consideration was given to construction of a northern alignment that would tie-in to the Mississippi River north of Alvin Callender Field. This alignment was considered to ensure that following the existing levees was in

fact the most cost effective means for providing increased levels of hurricane protection. Although shorter in length, the northern alignment would require approximately 2 miles of floodwall through residential and commercial land and would impact existing interior drainage facilities. There are currently two pumping stations located along the east bank of the Algiers Canal and one additional pumping station under construction. These pumping stations, which are interconnected by drainage canals, discharge rainfall run-off into the Algiers Canal. Construction of the northern alignment would significantly alter existing drainage patterns. This alignment would also require the acquisition of expensive rights-of-way and extensive relocations. The tie-in to the Mississippi River levee would occur in a heavily developed commercial area requiring additional relocations. The cost for this alignment, given the length of floodwall, the impacts to interior drainage facilities, the additional rights-of-way, and the extensive relocations, would exceed the cost of following the existing levees. This alignment also significantly reduces potential benefits by excluding Alvin Callender Field. The northern alignment was eliminated from further consideration due to the higher initial costs and lower potential benefits.

PLAN 4

Plan 4 was the only alternative considered that would provide protection to the areas both east and west of the Algiers Canal. This plan would include the construction of a navigable floodgate in the Gulf Intracoastal Waterway (GIWW) below the junction of the Harvey and Algiers Canals. There are currently seven pumping stations which discharge into the Harvey and Algiers Canals, with two additional stations under construction. In order to minimize rainfall flooding, these pumping stations would continue to operate during hurricane events even though the floodgate would be closed. A new high-capacity pumping station would be required to compensate for the continuous discharge of water into the Harvey and Algiers Canals. The new pumping station would be located adjacent to the proposed structure and would have a capacity of approximately 25,000 cfs. Protection to the west of the structure would be provided by a levee connecting to the Estelle Pumping Station. Protection to the east of the structure would be provided by enlarging the existing Hero Canal levee. The protection would wrap around the head of the Hero Canal and continue west along the south bank of the Hero Canal. A new levee would be constructed paralleling the western edge of Oakville, connecting the Hero Canal levee with an existing Plaquemines Parish levee. The existing Plaquemines Parish levee extending back towards Hwy. 23 would also be enlarged. The features of Plan 4 are indicated on Plate 7.

PLAN ASSESSMENT AND EVALUATION

A detailed analysis was conducted to determine the ability of each alternative plan to provide hurricane protection for the study area, protect natural resources, allow industries to continue unhindered operations along the Harvey and Algiers Canals, and be accepted by the public. The economic and environmental impacts associated with each alternative serve as the basis for the analysis. Impacts to known or suspected hazardous, toxic, or radioactive waste (HTRW) sites were also considered in the analysis.

The alternative plans were evaluated from an economic standpoint by comparing estimated equivalent annual benefits with estimated average annual costs. A description of the methodology used to determine economic damages and benefits for with and without project conditions is presented in Volume 2, Appendix B.

Alternative plans were also evaluated based on environmental impacts. Each of the alternatives considered would cause similar adverse environmental impacts. Impacts do, however, differ in magnitude from plan to plan. A comprehensive analysis is discussed in detail in the Environmental Impact Statement (EIS) and is supported by the environmental documentation contained in Volume 2, Appendix C. Mitigation plans provide for land acquisition measures to offset project induced impacts. To offset habitat losses, the same general mitigation measures would be used. The variable for all plans would be the amount of land acquisition necessary to fully offset these impacts.

Habitat evaluation processes were conducted utilizing two separate but comparable methods. The Habitat Evaluation Procedures (HEP) methodology is included within the Fish and Wildlife Coordination Act Report and is found in Appendix D. The Habitat Evaluation System (HES) methodology is included within the Mitigation Report/ Incremental Analysis within Appendix C, Section IV.

PLAN 1, WEST OF ALGIERS CANAL

Plan Description. Plan 1 would provide for the construction of levees and floodwalls along the east side of the Harvey Canal and the enlargement of the existing levee along the west bank of the Algiers Canal. The floodwall would extend from the Harvey Lock to Lapalco Boulevard and would vary from one to two blocks east of Peters Road. A combination of levees and floodwalls would extend south to the Hero Pumping Station. From the Hero Pumping station, the protection would continue south around the

peninsula of land, connecting with the Algiers Canal levee. The levee along the west bank of the Algiers Canal would be enlarged from Bayou Barataria to the Algiers Lock. This plan was analyzed for the SPH, 200-year, 100-year, 70-year, and 30-year levels of protection.

Environmental Impacts. Environmental Impacts would include the potential loss of bottomland hardwoods along the Harvey and Algiers Canals. Plan 1 constructed to provide SPH protection would result in 57 acres of impacts to bottomland hardwoods with corresponding losses of 23 annualized habitat unit values (AHUV's). The average annual cost of mitigation for SPH protection is approximately $14,000. The 200-year, 100-year, 70-year, and 30-year levels of protection would result in 51, 46, 30, and 30 acres of impacts to bottomland hardwoods with the corresponding losses of 21, 18, 12, and 12 AHUV's. The associated average annual mitigation costs are $13,000 for 200-year protection, and $11,000 for 100-year, 70-year, and 30-year levels of protection. Mitigation would be provided to compensate for unavoidable impacts. The mitigation plan would provide for the purchase, preservation, and management of up to 59 acres of bottomland hardwoods in the Bayou Bois Piquant area in St. Charles Parish.

Plan 1 requires the construction of a floodwall through a heavily industrialized area extending from the Harvey Lock to Lapalco Boulevard. A number of high interest HTRW sites were identified along the alignment for this alternative. Results of the Initial Assessment and the Land Use History are presented in Volume 2, Appendix E. Because the alignment is located one to two blocks east of Peters Road, many of the industries along the Harvey Canal would be avoided. However, according to records maintained by the Louisiana Department of Environmental Quality (DEQ), two industries along Peters Road had extensive hazardous waste files. These files contained numerous reports of spills and violations at several different locations, many of which fall along the proposed alignment. Adjustments to the alignment to avoid these sites would be difficult given the number of violations and different locations. A number of underground storage tanks (UST's) are also located on properties which fall along the proposed alignment for Plan 1. Because the location of the floodwall would generally be located near the edge of the property, many of these UST's would be avoided. If the UST's were to be located along the proposed alignment, removal of the tanks and contaminated sediments would be required. The potential, although much lower, also exists for encountering hazardous substances along the alignment south of Lapalco, along Bayou Barataria, and along the west bank of the Algiers Canal. One industry located near the southern end of the Harvey Canal had barge cleaning pits located on the property. The proposed alignment would

avoid this property. The impacts along Bayou Barataria and along the west bank of the Algiers Canals would be common to Plan 1, Plan 2, and Plan 3.

Economic Summary. The first cost of Plan 1 is estimated at $77,194,000 for the SPH event, $70,297,000 for the 200-year event, $55,100,000 for the 100-year event, $46,321,000 for the 70-year event, and $44,168,000 for the 30-year event. Average annual costs were determined using a project life of 100 years and an interest rate of $8^1/_2$ percent. The period of construction for Plan 1, including three lifts on selected levees, is approximately 15 years. A summary of the gross investment and average annual costs for Plan 1 are shown in Table 9.

TABLE 9
WEST OF ALGIERS CANAL, PLAN 1
SUMMARY OF GROSS INVESTMENT COST
AND AVERAGE ANNUAL CHARGES
$8^1/_2$ PERCENT
($1,000)

	SPH	200-YR	100-YR	70-YR	30-YR
Project First Cost	$77,194	$70,297	$55,100	$46,321	$44,168
Interest During Const.	26,836	25,574	20,959	19,353	18,801
Gross Investment Cost at end of Installation Period	104,030	95,871	76,059	65,674	62,969
Project Avg. Annual Cost[1]	9,192	8,434	6,705	5,803	5,561
Mitigation Avg. Annual Cost	14	13	11	11	11
Total Avg. Annual Cost West of A.C.	$9,206	$8,447	$6,716	$5,814	$5,572

[1] This figure includes interest, amortization, and operations and maintenance, repair, replacement, and rehabilitation costs.

The estimated equivalent annual benefits for Plan 1 for the SPH level of protection are $37,970,000. For 200-year, 100-year, 70-year, and 30-year levels of protection, the estimated equivalent annual benefits are $37,893,000, $36,876,000, $33,209,000, and $30,705,000 respectively. The resulting benefit to cost ratios (BCR's) are 4.12 to 1 for SPH protection, 4.48 to 1 for 200-year protection, 5.49 to 1 for 100-year protection, 5.81 to 1 for 70-year protection and 5.62 to 1 for 30-year protection.

PLAN 2, WEST OF ALGIERS CANAL

Plan Description. Plan 2 would provide for the construction of a navigable floodgate in the Harvey Canal just north of the Hero Pumping Station. A new pumping station would be constructed adjacent to the floodgate with a capacity of approximately 6,000 cfs. The Harvey and Cousins Pumping Stations would continue to discharge into the Harvey Canal during a hurricane to prevent rainfall flooding. A hurricane would require the closure of both the floodgate and Harvey Lock, and the pumping stations would be discharging into a closed system. The construction of a new pumping station would prevent stages in the Harvey Canal between the floodgate and the Harvey Lock from exceeding the protection. The cost of the pumping station alone would be approximately $60,000,000. The total estimated first cost of Plan 2 would be in excess of $120,000,000.

Cost estimates for Plan 2 were only developed for providing SPH protection. The line of protection for Plan 2 ties-in to the Westwego to Harvey Canal project near the Estelle Pumping Station. Since the Westwego to Harvey Canal project was authorized to provide SPH protection, construction of the floodgate to less than SPH protection would jeopardize protection to the authorized project.

Rationale for Elimination. The project first costs for Plan 2 are approximately $20,000,000 greater than the costs for Plan 3. Both alternatives would provide protection to the industries along the Harvey Canal and would have similar quantities of benefits. Environmental impacts would include the loss of drained bottomland hardwoods at the site of the new pumping station, the outfall canal, the floodgate, and along the west bank of the Algiers Canal. In addition, the location of the proposed floodgate and pumping station would be in areas where DEQ has expressed concern about the heavy contamination of sediments. Plan 2 would result in greater environmental impacts than Plan 1 and would also have a high probability of impacting hazardous and toxic wastes. As a result of the excessive cost, Plan 2 was eliminated from further consideration.

PLAN 3, WEST OF ALGIERS CANAL

Plan Description. Plan 3 would provide for the construction of a navigable floodgate in the Harvey Canal south of Lapalco Boulevard, the construction of levees and floodwalls along the east side of the Harvey Canal and the enlargement of the existing levee along the west bank of the Algiers Canal. The capacity of the Cousins Pumping Station would be increased by 1,000 cfs and the outfall canal would be diverted to discharge below the floodgate. The increased capacity of the Cousins Pumping Station is to account for the additional drainage coming from the Harvey Pumping Station during hurricane events.

The proposed location of the floodgate structure in Plan 3 provides protection for all businesses and almost all of the industries located along the Harvey Canal. The diverted outfall canal for the Cousins Pumping Station allows continuous operation of the station even during periods when the floodgate is closed. The additional 1,000 cfs of capacity added to the Cousins Pumping Station would offset the lost capacity of the Harvey Pumping Station during hurricane events (minimum facilities are maintained). The levee along the west side of the diverted outfall canal for the Cousins Pumping Station would tie-in to the Westwego to Harvey Canal project on the west side of the Harvey Canal just below the navigable floodgate. This would tie the line of protection for the area west of Algiers Canal directly to the Westwego to Harvey Canal project.

Alternative Alignments Considered. Five alternative alignments for the protection were evaluated to ensure that the best overall plan was identified. Four alternatives (Plans 3A, 3B, 3C, and 3D) only considered various alignments for the protection along the east side of the Harvey Canal. One alternative (Plan 3E) was considered to determine if the pumping station required in Plan 2 could be eliminated by diverting the outfall canal for the Cousins Pumping Station. The SPH level of protection was initially used to evaluate the alternatives. Additional levels of protection were considered once the selected alignment was determined.

The alignment for alternatives 3A, 3B, 3C, and 3D are identical except for the area between the floodgate and the Hero Pumping Station. The alignment for Plan 3A would vary from 2,000 to 5,000 feet east of the Harvey Canal from the floodgate to Bayou Barataria. From Bayou Barataria, the protection would extend south to the Hero Pumping Station. The alignment for Plan 3B would generally follow the Murphy Canal from the east side of the floodgate to the Hero Pumping Station. The alignment for Plan 3C would follow Peters Road from the floodgate to the Hero Pumping Station. The alignment for

Plan 3D would follow the east bank of the Harvey Canal from the floodgate to the Hero Pumping Station. The estimated first costs for Plans 3A, 3B, 3C, and 3D are $103,161,000, $100,298,000, $106,349,000, and $100,927,000, respectively.

Plan 3E differs from the other Plan 3 alternatives in that the proposed floodgate would be located at the lower end of the Harvey Canal similar to the location of the floodgate for Plan 2. The 1st Avenue Canal would still be enlarged and the capacity of the Cousins Pumping Station would be increased by 1,000 cfs. The outfall canal for the Cousins Pumping Station would be diverted and extended approximately 2 miles south to discharge below the floodgate. This would alleviate the need to construct a new pumping station adjacent to the floodgate as in Plan 2. The estimated first cost of Plan 3E is $118,359,000.

The costs for Plans 3A, 3B, 3C, and 3D are within a range of $6,000,000. Each plan would provide protection to industries located along the Harvey Canal north of the floodgate and would have similar quantities of equivalent annual benefits. The project costs for Plan 3E would be 10 to 18 percent higher than for other Plan 3 alternatives due to the length of the diverted outfall canal. Plan 3E would provide protection to the same industries along the Harvey Canal as the other Plan 3 alternatives and would have similar quantities of benefits.

Environmental impacts for each alternative would result from the loss of bottomland hardwoods caused by the extension of the Cousins Pumping Station outfall canal, the temporary stockpile area, and the upgrading of the Algiers Canal levees. The environmental impacts would be similar for Plans 3A, 3B, 3C, and 3D. Due to the extended length of the outfall canal in Plan 3E, extensive woodland losses would occur. Plan 3E has greater environmental impacts than the other Plan 3 alternatives.

Due to excessive costs, greater environmental impacts and similar quantities of benefits, Plan 3E was eliminated from further consideration. The four remaining alternatives (Plans 3A, 3B, 3C, and 3D) vary only in their alignment between the floodgate and the Hero Pumping Station. The quantity of benefits and the environmental impacts for each alternative are similar. Plan 3B was therefore selected as the best overall alignment based on lowest estimated project cost. For consistency, all references to Plan 3, west of Algiers Canal in the following sections of this report will be indicated as Plan 3B, west of Algiers Canal.

Impacts to Westwego to Harvey Canal Project. The authorized Westwego to Harvey Canal project includes the construction of a combination of levees and floodwalls along the west bank of the Harvey Canal. The floodwall would extend along Destrehan Avenue from the Cousins Pumping Station to the Harvey Lock. Constructing a navigable floodgate in the Harvey Canal to the SPH level of protection along with diverting the outfall canal for the Cousins Pumping Station (Plan 3B) eliminates the need for parallel protection north of the Cousins Pumping Station. Eliminating the floodwall along the west bank of the Harvey Canal would result in a savings of $15,052,000 to the Westwego to Harvey Canal project. The full $15,052,000 savings can only be claimed as a reduction in the cost of the East of Harvey Canal project if the construction of the floodgate does not delay benefits to the Westwego to Harvey Canal project.

A schedule for construction of the floodwall feature of the authorized Westwego to Harvey Canal project extending from the Cousins Pumping Station to the Algiers Lock was prepared, taking into consideration the need to conduct investigations to determine if there is a potential for encountering hazardous, toxic, and radioactive waste. These investigations are required given the heavy industrialization in the area. There have also been strong objections raised by the industries which would be located on the floodside of the proposed floodwall. These objections would likely result in additional delays in acquiring the necessary rights-of-way. Taking these factors into consideration, the schedule would provide for construction of the floodwall beginning in late 1998 with completion of the floodwall scheduled for late 2001. If hazardous waste sites requiring remediation were to be discovered, additional delays would result. Beneficial completion of the Westwego to Harvey Canal project would not be obtained prior to completion of the floodwall. The schedule for the construction of the East of Harvey Canal project would provide for beneficial completion for west of Algiers Canal in 2002. Completion of the floodgate feature of Plan 3B is scheduled for completion in 2001. With the floodgate feature of Plan 3B scheduled for completion in the same year as the Westwego to Harvey Canal floodwall, there would be no delay in benefits. The $15,052,000 savings have therefore been claimed as a reduction in the total project first cost of Plan 3B.

Environmental Impacts. Environmental impacts for Plan 3B would include the direct loss of 204 acres of bottomland hardwoods with the corresponding loss of 83 AHUV's. The proposed mitigation plan would provide for the purchase, preservation, and management of approximately 211 acres of high quality wetlands in the Bayou Bois Piquant area in St. Charles Parish. The average annual cost of mitigation for Plan 3B is approximately $51,000.

The construction of a navigable floodgate in the Harvey Canal and the construction of a temporary bypass channel/diverted outfall canal has the potential to impact hazardous and toxic substances. Sampling and testing was conducted to determine the extent of contamination which has occurred in the vicinity of the proposed navigable floodgate. The results indicated that contaminated sediments were present but that the levels were well below EPA's regulatory levels for classification as hazardous wastes (see Volume 2, Appendix C, Section VIII). There were, however, high interest HTRW sites identified along the proposed alignment on the east side of the Harvey Canal. Results of the Initial Site Assessment and Land Use History are presented in Volume 2, Appendix E. Files at DEQ showed that one industry, located south of the point where the alignment crosses the east bank of the Harvey Canal, had experienced previous spills and violations. Files at DEQ also showed that barge cleaning pits are located on one property near the southern end of the Harvey Canal. The proposed alignment would avoid these sites. There were also several UST's located on properties along the proposed alignment. The alignment would generally follow the edge of individual properties thereby eliminating most of the UST's. The UST's that could not be avoided, would be removed along with any of the surrounding sediments which were contaminated. Impacts along Bayou Barataria and the west bank of the Algiers Canal would be the same as Plan 1 and Plan 2.

Navigation Impacts. Plan 3B would provide for the construction of a navigable floodgate in the Harvey Canal approximately 3,600 feet south of Lapalco Boulevard. A cofferdam would be placed in the canal and the structural excavation site would be dewatered. This would force the closure of the Harvey Canal to through traffic for 15 months while the floodgate is under construction. In order to accommodate traffic on the Harvey Canal, Plan 3B would provide for the construction of a temporary bypass channel. If a bypass channel was not provided, traffic on the Harvey Canal would be forced to select an alternate route. Traffic would most likely select the Algiers Lock, which connects the Algiers Canal with the Mississippi River. Current delays at the Algiers Lock are in excess of 3 hours. Diverting traffic from the Harvey Lock to Algiers Lock would only increase existing delays. An analysis was performed to determine the economic viability of constructing the bypass channel versus forcing traffic to select an alternate route. The General Equilibrium Model (GEM) was used to estimate the total transportation costs, including congestion costs, incurred by each alternative. A detailed discussion is presented in Volume 2, Appendix B. The costs to navigation resulting from the closure of the Harvey Canal were estimated at $11,625,000. These costs were well in excess of the $3,628,000 necessary to construct the bypass channel. Annualizing these costs and benefits over the project life results in a BCR of 3.3 to 1.

Once completed, the floodgate would remain open except during hurricane events. The floodgate would provide an opening of 110 feet and would be aligned with the existing opening under the Lapalco Bridge. The gate opening was sized to conform with the 110 foot standard opening being evaluated for other navigation structures along the GIWW. Construction of the floodgate to a width of less than 110 feet would not be sufficient given the fabrication of offshore equipment along the canal. The existing Harvey Lock, located north of the floodgate, only provides an opening of 75 feet. Current delays at the Harvey Lock average 30 minutes. Heavy industrial development along the Harvey Canal in conjunction with restrictions at the Harvey Lock and the Lapalco Bridge create very congested conditions. These conditions limit the speed of barge traffic in the canal. The navigable floodgate feature of Plan 3B should not further impact navigation along the Harvey Canal.

Economic Summary. The majority of the costs for providing protection to the area west of Algiers Canal is associated with the sector gate. The first cost of the sector gate complex, which includes the navigable floodgate, temporary bypass channel, increased pumping capacity for Cousins Pumping Station, levees and floodwalls along the outfall canal, and the enlarged 1st Avenue Canal is $55,513,000 for SPH protection, $54,633,000 for 200-year protection and $53,861,000 for 100-year protection. The cost of constructing the sector gate complex to provide SPH protection is $880,000 more than providing 200-year protection and $1,652,000 more than providing 100-year protection. Construction of the sector gate to a level of protection lower than SPH would not provide the authorized level of protection to those areas west of the Harvey Canal. A floodwall, although reduced in size, would still be required along the west bank of the Harvey Canal to provide an SPH level of protection. This would substantially reduce the savings to the authorized Westwego to Harvey Canal project. The additional cost to provide SPH protection is more than offset by the continued need for a floodwall along the west bank of the Harvey Canal if the floodgate provides less than SPH protection. The potential savings of $15,052,000 to the Westwego to Harvey Canal project justifies constructing the floodgate to provide SPH protection. For these reasons, only the SPH level of protection for Plan 3B was evaluated in greater detail.

The first cost of Plan 3B is estimated to be $100,298,000 for the SPH event. A summary of gross investment and average annual costs for Plan 3B is shown in Table 10. The savings to the Westwego to Harvey Canal project are shown as a reduction in the total project first cost for East of Harvey Canal.

TABLE 10
WEST OF ALGIERS CANAL, PLAN 3B
SUMMARY OF GROSS INVESTMENT COST
AND AVERAGE ANNUAL CHARGES
$8^1/_2$ PERCENT
($1,000)

	SPH
Project First Cost West of A.C.	$100,298
Interest During Construction	35,388
(Reduction in First Cost for Westwego to Harvey Canal Project)	(15,052)
(Interest Savings During Construction)	(4,157)
Gross Investment Cost at End of Installation Period	116,477
Project Average Annual Cost[1]	10,318
Mitigation Average Annual Cost	51
Total Average Annual Cost West of A.C.	$ 10,369

[1] This figure includes interest, amortization, and operations, maintenance, repair, replacement, and rehabilitation costs.

The estimated equivalent annual benefits for Plan 3B for the SPH level of protection are $41,245,000. As discussed previously, lower levels of protection were not evaluated further. The BCR for Plan 3B is 3.98 to 1.

EAST OF ALGIERS CANAL

Plan Description. The alternative considered for providing increased levels of hurricane protection to the area east of Algiers Canal includes raising the existing levees along the Algiers and Hero Canals. The existing levee along the east bank of the Algiers Canal would be enlarged from the Algiers Lock to Bayou Barataria. From Bayou Barataria, the levee along the north bank of the Hero Canal would be enlarged. The protection would wrap around the head of the Hero Canal and continue approximately

2,700 feet west along the south bank of the canal. A new levee would be constructed along the western edge of the community of Oakville connecting the Hero Canal levee with an existing Plaquemines Parish levee. That portion of the existing Plaquemines Parish levee which extends back toward Hwy. 23 would also be enlarged.

Alternative Alignments. Alternative alignments were considered for the new levee near Oakville to ensure that the best overall plan was identified. A tie-in levee extending from the head of the Hero Canal to the Mississippi River levee was considered. This alignment, although shorter in length, required a ramp to cross Hwy. 23 and a swing gate at the railroad tracks. Hwy. 23 provides the only evacuation route for the residents living on the east bank in lower Plaquemines Parish. The construction of a floodgate would prevent the continued use of this evacuation route during hurricane events. The close proximity of Hwy. 23 and the railroad tracks necessitates the construction of a retaining wall for 200-year and SPH levels of protection. The retaining wall is required to avoid impacting the railroad tracks by the construction of a ramp at Hwy. 23. The cost for this alternative closure is $1,520,000 for a 100-year level of protection, $2,530,000 for a 200-year level of protection and $3,600,000 for SPH protection. The cost for constructing a levee along the proposed alignment previously identified is $1,040,000 for a 100-year protection, $1,310,000 for a 200-year level of protection and $1,650,000 for SPH protection. Although shorter in length, the high cost of the ramp at Hwy. 23, the retaining wall, and the swing gate at the railroad tracks, make the alternative alignment more expensive.

The alignment which wraps around the head of the Hero Canal would close a gap in the Plaquemines Parish levee system near Oakville. The Plaquemines Parish levee parallels the Mississippi River and extends to the south over 7 miles below Oakville. Closing the gap would provide additional protection to residents and businesses within this area. More importantly, the proposed alignment would protect Hwy. 23, which is the sole evacuation route for the west bank of lower Plaquemines Parish. This alignment also provides protection to the community of Oakville which is presently outside of the levee system. Protecting the community of Oakville results in an additional $5,800 of equivalent annual benefits. The alignment which provides for connecting the Hero Canal levee with the existing Plaquemines Parish levee was selected as the best overall alignment. The alternative closure was eliminated from further consideration.

Elevations of the existing Plaquemines Parish levee to which the proposed levee would tie-in, average approximately 7 feet NGVD. This levee is currently maintained by

Plaquemines Parish. Still water stages in the area for SPH, 200-year, and 100-year storms are 7 feet, 6 feet, and 5 feet NGVD, respectively. The Plaquemines Parish levee provides protection for the 200-year and more frequent storms but would be subject to overtopping from waves produced by the SPH storm. The water which might overtop the levee during the SPH event would drain south away from the study area and would be collected by a system of interior drainage canals. Minor wave overtopping of this levee would not cause flooding to occur in the area east of Algiers Canal.

To ensure that the integrity of the protection for the area east of Algiers Canal is not dependent on the performance of the non-Federal Plaquemines Parish levee, the impacts of a failure were evaluated. A failure in the Plaquemines Parish levee of 1,000 feet in length was assumed to occur when the exterior stage reached an elevation of 4.5 feet NGVD. The resulting interior stages would be 3.2 feet NGVD for the 100-year storm, 4.6 feet NGVD for the 200-year storm, and 5.6 feet NGVD for the SPH event. The elevation of Hwy. 23 where the proposed alignment would tie-in is approximately 6.0 feet NGVD. The interior stages resulting from a failure in the Plaquemines Parish levee would not be sufficient to cause water to flow across Hwy. 23 and into the study area.

Environmental Impacts. Environmental Impacts would include the direct loss of cypress swamp in the Oakville area and some bottomland hardwoods along the Algiers Canal. Losses for providing SPH protection would include 46 acres of cypress habitat with a corresponding loss of 21 AHUV's. Losses of bottomland hardwoods habitat would include 29 acres with a corresponding loss of 12 AHUV's. Environmental impacts for providing a 200-year level of protection would result in the loss of 45 acres of cypress swamp with a corresponding loss of 21 AHUV's and the loss of 23 acres of bottomland hardwoods with a corresponding loss of 9 AHUV's. The 100-year level of protection would result in the loss of 44 acres of cypress swamp with a corresponding loss of 21 AHUV's and the loss of 17 acres of bottomland hardwoods with a corresponding loss of 7 AHUV's. The average annual cost for the mitigation plans to offset these environmental impacts is approximately $20,000 for SPH protection, $19,000 for 200-year protection and $18,000 for 100-year protection. The mitigation plan would provide for the purchase, preservation, and management of up to 101 acres of bottomland hardwoods and cypress swamp.

The potential for impacts to hazardous substances along the east bank of the Algiers Canal and along the north bank of the Hero Canal is low. One high interest HTRW site was identified along the east bank of the Algiers Canal. This site did not have any

compliance violations and appeared to be free of HTRW materials. The north bank of the Hero Canal did not have any areas that were of high HTRW interest. Results of the Initial Assessment and Land Use History are presented in Volume 2, Appendix E. The alignment in the Oakville area would parallel an existing construction demolition landfill. According to DEQ, no known or suspected HTRW materials have been identified or landfilled at this site. The proposed alignment would enclose the landfill reducing the potential for exposure to surrounding areas.

Economic Summary. The alignment for the area east of Algiers Canal was analyzed for the SPH, 200-year, and 100-year events. Lower levels of hurricane protection were not evaluated. The majority of the costs associated with raising the protection would not vary significantly with the level of protection. Although many of the existing levees provide relatively high levels of protection, additional work would be required before the levees could be incorporated as part of the Federal project. The side slopes of the existing levees are in many cases inadequate; floodgates would be required at a number of ramp crossings; T-walls would be required in the heavily congested areas to minimize disruptions to industries; floodwalls would be required at existing pumping stations; acquisition of additional rights-of-way would be required; and a number of relocations would be necessary regardless of the level of protection. In addition, the costs for mobilization and demobilization, clearing and grubbing, and fertilizing and seeding would be similar for the different levels of protection. The costs for these items of work comprise almost 70 percent of the total cost for the area east of Algiers Canal. These costs would remain essentially unchanged for lower levels of protection and the benefits would be substantially less.

The first cost for the area east of Algiers Canal is $13,826,000 for the SPH event, $9,748,000 for the 200-year event, and $6,975,000 for the 100-year event. A summary of gross investment costs and annual charges is shown in Table 11. The alignment for the area east of Algiers Canal may be combined with any of the west of Algiers Canal alternatives to provide protection for the entire study area.

Providing SPH protection to the area east of Algiers Canal would result in $2,718,000 of equivalent annual benefits. Equivalent annual benefits for the 200-year and 100-year levels of protection would be $2,716,000 and $2,476,000, respectively. The BCR is 1.92 to 1 for SPH protection, 2.66 to 1 for 200-year protection and 3.32 to 1 for 100-year protection.

TABLE 11
EAST OF ALGIERS CANAL
SUMMARY OF GROSS INVESTMENT COST
AND AVERAGE ANNUAL CHARGES
8 1/2 PERCENT
($1,000)

	SPH	200-Year	100-Year
Project First Cost East of A.C.	$13,826	$9,748	$6,975
Interest During Construction	1,337	989	750
Gross Investment Cost at End of Installation Period	15,163	10,737	7,725
Project Average Annual Cost[1]	1,397	1,002	727
Mitigation Average Annual Cost	20	19	18
Total Average Annual Cost East of Algiers Canal	$1,417	$1,021	$745

[1] This figure includes interest, amortization, and operations, maintenance, repair, replacement, and rehabilitation costs.

PLAN 4

Plan Description. Plan 4 would provide for the construction of a navigable floodgate in the Gulf Intracoastal Waterway below the junction of the Harvey and Algiers Canals. This plan would also require the construction of a 25,000 cfs pumping station located adjacent to the floodgate.

Rationale for Elimination. Due to the large capacity of the new pumping station, the estimated project first costs would be in excess of $200,000,000. The location of the floodgate would provide protection to the areas both east and west of the Algiers Canal and equivalent annual benefits would be similar in magnitude to a combination of Plan 3, west of Algiers Canal and the plan for east of Algiers Canal. The costs for Plan 4 are, however, in excess of $85,000,000 greater than the costs for a combination of these plans. Plan 4 was eliminated from further consideration due to excessive cost.

SUMMARY OF PLAN ASSESSMENT

A detailed analysis was conducted to determine the ability of each plan to provide hurricane protection to the study area and to protect natural resources. Alternative plans were evaluated from an economic standpoint by comparing estimated equivalent annual benefits with estimated average annual costs. The amount of environmental impacts that would likely result from the implementation of each plan were also considered in the analysis. Plan 2 was eliminated from further consideration due to excessive cost and greater environmental impacts than Plan 1. Plan 4 was also eliminated due to excessive cost. The remaining plans for the area west of Algiers Canal are; Plan 1 at the SPH, 200-year, 100-year, 70-year, and 30-year levels of protection and Plan 3B at the SPH level of protection. For the area east of Algiers Canal, only one plan was considered. This plan was evaluated at the SPH, 200-year and 100-year levels of protection. The plan for the area east of Algiers Canal could be combined with either Plan 1 or Plan 3B to provide protection to the entire study area. A total of three plans remain, each of which will be evaluated further in the remainder of the report.

COMPARISON OF PLANS

Comparative information on the remaining plans is presented in this section, along with the rationale for determining which of the plans approximates the national economic development (NED) plan.

All of the remaining plans fulfill the primary planning objective by providing more adequate hurricane protection to the study area. For the area west of Algiers Canal, Plans 1 and 3B warrant further evaluation. For the area east of Algiers Canal, only one alignment was considered in detail. All of the plans considered are structural plans. Practical non-structural measures, such as zoning and building regulations, flood-forecasting and warning, and flood-fighting and evacuation plans, are currently in place in the study area and will remain in use as features of any plan, including the no action plan.

The remaining plans are economically justified and would result in benefit-to-cost ratios greater than unity. Environmental impacts would be associated with each plan. Significant environmental damages would be mitigated to the extent justified. A summary comparison of the plans is shown in Table 12, "Effects Display and System of Accounts".

TABLE 12

EFFECTS DISPLAY AND SYSTEM OF ACCOUNTS

ITEM	NO FEDERAL ACTION	WEST OF THE ALGIERS CANAL		EAST OF THE ALGIERS CANAL
		PLAN 1	PLAN 3B	
I. PLAN DESCRIPTION	No Federal Project and continued maintenance of existing local levees.	This plan includes a floodwall and levee combination aligned parallel to the Harvey Canal. The alignment would generally vary from one to two blocks east of Peters Road from the Harvey Lock to Lapalco Boulevard. Below Lapalco, a combination of levees and floodwalls would connect to the Hero Pumping Station. From the Hero Pumping Station the existing line of protection would be upgraded to the Algiers Lock. Mitigation for Plan 1 would include aligning levees to avoid and minimize impacts to forested wetlands. Unavoidable impacts would be mitigated by the purchase, preservation, and management of up to 59 acres of bottomland hardwoods.	This plan proposes constructing a floodgate structure in the Harvey Canal about 3,600 feet south of Lapalco Boulevard. Prior to the construction of the floodgate, a navigation bypass channel would be constructed to temporarily accommodate Harvey Canal traffic. The Cousins Pumping Station would be increased by 1,000 cfs and its outfall canal would be diverted to discharge below the floodgate. Parallel protection along the outfall canal would be provided. The connecting canal between the Harvey and Cousins Pumping Stations would be enlarged. On the east side of the Harvey Canal, a combination of levees and floodwalls would provide protection below the structure to the Hero Pumping Station. Protection from the Hero Pumping Station to the Algiers Lock would be provided by upgrading existing protection. Mitigation for Plan 3B includes the avoidance and minimization of impacts to forested wetlands through levee alignment and the purchase, preservation, and management of up to 211 acres of bottomland hardwoods for unavoidable impacts.	From the Algiers Lock, this plan upgrades the existing protection along the east bank of the Algiers Canal and along the north bank of the Hero Canal. The protection would wrap around the head of the Hero Canal and connect with an existing Plaquemines Parish levee near Oakville. Mitigation for this portion of the project incorporates aligning of the levee to avoid or minimize impacts to both wet and nonwet forrest lands. Borrow material would be taken from nonwet pasture lands. Unavoidable impacts would be mitigated by the purchase, preservation, and management of up to 101 acres of bottomland hardwoods and cypress swamp.

TABLE 12

EFFECTS DISPLAY AND SYSTEM OF ACCOUNTS

ITEM	NO FEDERAL ACTION	WEST OF THE ALGIERS CANAL						EAST OF THE ALGIERS CANAL		
		PLAN 1					PLAN 3B			
II. SIGNIFICANT IMPACTS		SPH	200 year	100 year	70 year	30 year	SPH (NED&RP)	SPH (RP)	200 year	100 year (NED)
1. Nat. Economic Development										
a. Equivalent Annual Benefits	Not Applicable	$37,970,000	$37,893,000	$36,876,000	$33,209,000	$30,705,000	$41,245,000	$2,718,000	$2,716,000	$2,476,000
b. Total Avg. Annual Costs[1]		$9,206,000	$8,447,000	$6,716,000	$5,814,000	$5,572,000	$10,369,000	$1,417,000	$1,021,000	$745,000
1) Interest & Amortization		$8,845,000	$8,151,000	$6,467,000	$5,584,000	$5,353,000	$9,903,000	$1,289,000	$913,000	$657,000
2) Operations & Maintenance[2]		$347,000	$283,000	$238,000	$219,000	$208,000	$415,000	$108,000	$89,000	$70,000
3) Mitigation		$14,000	$13,000	$11,000	$11,000	$11,000	$51,000	$20,000	$19,000	$18,000
c. First Cost		$77,194,000	$70,297,000	$55,100,000	$46,321,000	$44,168,000	$85,246,000[3]	$13,826,000	$9,748,000	$6,975,000
d. Net Annual Benefits		$28,764,000	$29,446,000	$30,160,000	$27,395,000	$25,133,000	$30,876,000	$1,301,000	$1,695,000	$1,731,000
e. Benefit/Cost Ratio (BCR)		4.12	4.48	5.49	5.81	5.62	3.98	1.92	2.66	3.32
2. Environmental quality										
a. Bottomland Hardwoods Losses[4]	Undeveloped lands within existing levees would continue to be developed for residential and commercial purposes. Most of this habitat within existing levee system would be lost to development by the year 2000.	57 acres 23 AHU	51 acres 21 AHU	46 acres 18 AHU	30 acres 12 AHU	30 acres 12 AHU	204 acres 83 AHU	29 acres 12 AHU	23 acres 9 AHU	17 acres 7 AHU
b. Swamp Losses[4]	The swamp would slowly subside and erode over the next 100 years.	0	0	0	0	0	0	46 acres 21 AHU	45 acres 21 AHU	44 acres 21 AHU

[1] Based on 1991 price levels with a project life of 100 years and an interest rate of 8 1/2 percent.

[2] Operations and maintenance costs include operations, maintenance, repair, replacement, and rehabilitation.

[3] Implementation of Plan 3B to the SPH level of protection results in a savings of $15,052,000 by deleting a floodwall feature of the Westwego to Harvey Canal project. This savings has been subtracted from the $100,298,000 total first cost of Plan 3B.

[4] Impacts for Plan 1 or Plan 3 would be in addition to the impacts for "No Federal Action"; all losses would be mitigated.

TABLE 12

EFFECTS DISPLAY AND SYSTEM OF ACCOUNTS

ITEM	NO FEDERAL ACTION	WEST OF THE ALGIERS CANAL		EAST OF THE ALGIERS CANAL
		PLAN 1	PLAN 3B	
II. IMPACTS (continued)				
c. Aquatic Resources	Gradual shift to a more brackish environment.	Same as No Federal Action but with approximately 92 acres of low quality habitat created.	Same as Plan 1 plus 3 acres of impacts to low quality habitat due to construction of the floodgate in the Harvey Canal.	Same as No Federal Action.
d. Water Quality	No impacts.	No impacts.	Short-term impacts in the Harvey Canal in the vicinity of the floodgate.	No impacts.
e. National Register of Historic Places	No known impact.	No known impact.	No known impact.	No impacts.
f. Air Quality	Not evaluated.	Minor adverse impact from dust and internal combustion engines during construction.	Minor adverse impact from dust and internal combustion engines during construction.	No known impact.
g. HTRW Impacts	Not evaluated.	High potential for encountering HTRW sites along floodwall alignment.	Contaminated sediments excavated from Harvey Canal will be hauled to an industrial landfill.	Low potential for encountering HTRW.
3. Regional Development				
a. Effects on Employment and Income	Not evaluated.	Minor additional opportunities generated by construction.	Minor additional opportunities generated by construction.	Minor additional opportunities generated by construction.
b. Land Use	Continued urban growth.	Area is almost entirely developed. Continued development in Stonebridge subdivision is expected.	Same as Plan 1.	Development is expected to continue in the lower coast of Algiers and in the Belle Chasse area.
c. Regional Growth and Business Activity	Continued growth to support development.	Commercial activity should increase to support the potential residential development.	Same as Plan 1.	Commercial activity should increase to support the potential residential development.
d. Tax Revenue	Increases in tax revenue.	Same as No Federal Action.	Same as No Federal Action.	Same as No Federal Action.

TABLE 12

EFFECTS DISPLAY AND SYSTEM OF ACCOUNTS

ITEM	NO FEDERAL ACTION	WEST OF THE ALGIERS CANAL		EAST OF THE ALGIERS CANAL
		PLAN 1	PLAN 3B	
II. IMPACTS (continued)				
4. Other Social Effects				
a. Community Cohesion	No impact.	Positive impact to residents sense of security.	Same as Plan 1.	Positive impact residents sense of security.
b. Property Values	Increases related to economic factors.	Same as No Federal Action, however, the additional flood protection will have a qualitative impact on property in the area.	Same as Plan 1.	Same as No Federal Action, however, the additional flood protection will have a qualitative impact on property.
c. Community Growth , Public Facilities, and Services	Continued growth.	Slight positive increase can be expected.	Slight positive increase can be expected.	Slight positive increase can be expected.
d. Leisure/Recreation Opportunities	Continued loss of wetlands.	Minor adverse impacts to recreational use of levees due to construction activities.	Similar to Plan 1.	Similar to Plan 1.
e. Security of Life, Health, and Safety	No change.	SPH would reduce the risk of hurricane flooding and disaster including loss of life, property, and essential services; lesser levels of protection would provide less security. Induced damages to industries along the Harvey Canal would exceed $11 million for 50-year event.	SPH would reduce the risk of hurricane flooding and disaster including loss of life, property, and essential services. Most industries along the Harvey Canal would be protected.	SPH would reduce the risk of hurricane flooding and disaster including loss of life, property, and essential services; lesser levels of protection would provide less security.
f. Displacement of People	Frequent evacuations due to lack of protection.	Reduction in number of future evacuations.	Same as Plan 1.	Same as Plan 1.
g. Esthetic Values	No impact.	Esthetic values would be reduced due to floodwall construction. Loss of natural habitat could reduce values slightly.	Esthetic values would be slightly reduced due to floodgate construction. Loss of natural habitat could also reduce values slightly.	Esthetic values would remain essentially the same as they are now; however, the loss of natural habitat would reduce values slightly.
h. Noise	No impact.	Residences and industries near construction would be adversely impacted by construction noise.	Residences and industries near construction would be adversely impacted by construction noise.	Residences and industries near construction would be adversely impacted by construction noise.

TABLE 12

EFFECTS DISPLAY AND SYSTEM OF ACCOUNTS

ITEM	NO FEDERAL ACTION	WEST OF THE ALGIERS CANAL		EAST OF THE ALGIERS CANAL
		PLAN 1	PLAN 3B	
III. OTHER FACTORS IN PLAN FORMULATION				
a. Acceptability	Does not alleviate the possibility of catastrophic damages and loss of life by a hurricane.	Because Harvey Canal industries are not protected, the Harvey Canal Industrial Association and numerous individuals strongly oppose this plan.	This plan is solidly supported by local, state, and regional entities.	This plans alignment is supported by local, state, and regional entities.
b. Completeness	Not Applicable	The SPH Plan would afford required protection and prevent possible catastrophic loss of life and property. The 200 year, 100 year, 70 year, and 30 year plans would provide lesser protection. Would Induce damages to industries along the Harvey Canal	The SPH plan would afford maximum required protection and prevent possible loss of life and property thus minimizing risks and uncertainty. This plan provides protection for industries along the Harvey Canal. The plan has the support of the public and is compatible with local plans.	The SPH plan would afford maximum required protection and prevent possible loss of life and property. The 200 year and 100 year plans would provide lesser protection. The plan has the support of the public and is compatible with local plans.
c. Effectiveness	The existing condition is the least effective condition in meeting the primary objectives.	SPH - Very effective 200 year - Effective 100 year - Less effective 70 year - Less effective than 100 year 30 year - Less effective than 70 year	SPH - Extremely effective	SPH - Very effective 200 year - Effective 100 year - Less effective
d. Efficiency	Least efficient	100 year - Very efficient 200 year - Slightly less efficient SPH - Less efficient 70 year - Less efficient than SPH 30 year - Less efficient than 70 year	SPH - Estimated to be the most efficient plan.	100 year - Estimated to be the most efficient plan 200 year - Slightly less efficient SPH - Less efficient

TABLE 12

EFFECTS DISPLAY AND SYSTEM OF ACCOUNTS

ITEM	NO FEDERAL ACTION	WEST OF THE ALGIERS CANAL						EAST OF THE ALGIERS CANAL		
		PLAN 1					PLAN 3B			
IV. IMPLEMENTATION POSSIBILITIES		SPH	200 year	100 year	70 year	30 year	SPH	SPH	200 year	100 year
1. First Cost										
a. Federal	Not Applicable	$50,176,000	$45,693,000	$35,815,000	$30,109,000	$28,709,000	$55,410,000	$8,987,000	$6,336,000	$4,534,000
b. Non-Federal		$27,018,000	$24,604,000	$19,285,000	$16,212,000	$15,459,000	$29,836,000	$4,839,000	$3,412,000	$2,441,000
c. Total		$77,194,000	$70,297,000	$55,100,000	$46,321,000	$44,168,000	$85,246,000[1]	$13,826,000	$9,748,000	$6,975,000
2. Annual Cost[2]										
Total	Not Applicable	$9,206,000	$8,447,000	$6,716,000	$5,814,000	$5,572,000	$10,369,000	$1,417,000	$1,021,000	$745,000

[1] Implementation of Plan 3B to the SPH level of protection results in a savings of $15,052,000 by deleting a floodwall feature of the Westwego to Harvey Canal project. This savings has been subtracted from the $100,298,000 total first cost of Plan 3B.

[2] Based on 1991 price levels with a project life of 100 years and an interest rate of 8 1/2 percent.

ECONOMIC CONSIDERATIONS

The economic analysis was performed using the Hydrologic Engineering Center - Flood Damage Analysis Package, which includes the Structure Inventory for Damage Analysis (SID) and the Expected Annual Damage Computation (EAD) interactive computer programs. Inputs to these programs include floodplain structure inventory, depth damage relationships, and stage probabilities obtained from stage-frequency curves. A 100 percent field survey was conducted to determine the slab elevation and value of each structure at risk within the study area. The depreciated replacement value of each residential structure was calculated by using the Marshall and Swift Residential Estimator Program. Ground elevations were determined using 1-foot contour maps. First floor elevations were based on visual observations using hand levels to ensure accuracy. This information was used by the SID program to generate elevation-damage curves for each hydrologic reach for existing and future conditions. These results were then used by the EAD program to determine the expected average annual damage. The stream of expected annual flood damages are then discounted back to the base year and amortized over the period of analysis in order to calculate equivalent annual damages.

The remaining alternatives consist of Plan 1 (floodwall along the Harvey Canal) and Plan 3B (floodgate in the Harvey Canal) for the area west of Algiers Canal and a single alignment for the area east of Algiers Canal. These alternatives were evaluated by comparing estimated equivalent annual benefits that would accrue to the study area over the life of the project with estimated average annual costs. Average annual costs were determined using a Federal discount rate of $8^1/_2$ percent and a project life of 100 years. The areas east and west of the Algiers Canal are separable elements and were therefore evaluated independently.

In all reaches with the SPH level of protection in place, residual damages up to the SPH event result from ponded rainfall. In all reaches with a 100-year or a 200-year level of protection in place, residual damages between the 100-year or 200-year event and the SPH event result from ponded rainfall plus wave overtopping or routing of hurricane wave overtopping from an adjacent area. The location of the floodwall along the Harvey Canal in Plan 1 would result in induced damages to the industries along the canal. A detailed analysis of residual damages for each plan and the induced damages for Plan 1 are presented in Volume 2, Appendix B.

Area West of Algiers Canal. Two alternative plans were evaluated for the area west of Algiers Canal. These plans differ in the types of flood control structures used to provide protection and in the alignment of the protection along the Harvey Canal. Both plans would provide positive equivalent annual net benefits and would result in benefit-to-cost ratios (BCR's) of greater than unity. Plan 3B, providing SPH protection has the greatest amount of equivalent annual net benefits, $30,876,000; followed by Plan 1 with 100-year protection, $30,160,000; Plan 1 with 200-year protection, $29,446,000; and Plan 1 with SPH protection, $28,764,000. Plan 3B, SPH protection, has a BCR of 3.98 to 1.0. Plan 1, 100-year protection, has a BCR of 5.49 to 1. The BCR for Plan 1 drops to 4.48 for 200-year protection and 4.12 for SPH protection. The difference between Plan 3B, SPH protection and Plan 1, 100-year protection, is $4,369,000 in equivalent annual benefits and $3,653,000 in average annual cost. The resulting incremental BCR is 1.20.

The area west of Algiers Canal is a densely populated residential community with a population of over 130,000. There is also heavy industrial development along both the Harvey and Algiers Canals. There are a total of over 29,890 residential structures and 2,295 commercial facilities located within this area. Of these, approximately 25,571 (85%) residential and 2,076 (90%) commercial structures are within the existing 500-year floodplain. Total expected damages under existing conditions for the SPH event exceed 2 billion dollars. Providing less than the SPH level of protection would subject residents and their property to increased stages for storms which exceed the design level of protection. With a 100-year level of protection, the overtopping caused by the SPH event would result in stage increases of between 1.8 and 2.5 feet under existing conditions. Although these increases do not seem catastrophic, considerable damage would result. With 100-year protection, the SPH event would result in the inundation of 10,335 residential structures and 725 commercial facilities. The resulting damages would be in excess of $355 million. There is also the potential for damages to increase over time as sea level rise and subsidence result in future stage increases. Overtopping caused by the SPH event under future conditions would increase stages from between 2.3 and 3.1 feet with a 100-year level of protection in place. These stage increases would result in the inundation of 11,765 residential structures and 815 commercial facilities. The total damage resulting from the SPH event would be in excess of $436 million under future conditions.

Providing SPH protection to the area west of Algiers Canal reduces the number of structures that would be inundated from the SPH event to 650 residential and 80 commercial under both existing and future conditions. Damages resulting from the SPH event would be reduced to $25 million. Although the additional cost for providing SPH

protection over the 100-year level of protection is substantial, the damages resulting from the SPH event are reduced by $330 million under existing conditions and $411 million under future conditions.

The major difference between Plan 1 and Plan 3B, given the same level of protection, is the impacts to industries located along the Harvey Canal. Development along the banks of the Harvey Canal is comprised almost entirely of industrial complexes that utilize the waterway. The without project damages to these industrial complexes, which were included in the damage totals presented above, as a result of the SPH event were estimated to be in excess of $67 million for existing conditions and $94 million for future conditions. Plan 1 would provide for the construction of a floodwall parallel to the Harvey Canal approximately one to two blocks east of Peters Road. The alignment for the floodwall was determined based on minimizing access problems to the Harvey Canal. Although access problems would be minimized, the proposed alignment places industries located between the floodwall and the Harvey Canal on the floodside of the protection. The industries would not only be excluded from the protection but would also be subject to increased stages. Water overflowing the banks of the Harvey Canal under the without project conditions would disburse as it flows away from the canal and into the surrounding residential areas. The floodwall would trap the water resulting in increased stages. During a hurricane event these industries would experience the same stages as those in the Harvey Canal. The equivalent annual damages increase from $2,686,000 under the without project condition to $3,285,000 with Plan 1 in place. This represents an increase of $599,000, or just over 22 percent, in equivalent annual damages. Because the economy of the west bank is clearly tied to this industrial base, the inundation of these industries would affect the economic health of the entire area.

Plan 3B has the advantage of being the only plan that provides protection to the businesses and industries along the Harvey Canal. Plan 3B would also avoid impacting existing access to the Harvey Canal. By protecting the industries along both the east and west banks of the Harvey Canal north of the floodgate, a feature of the authorized Westwego to Harvey Canal project can be eliminated. The Westwego to Harvey Canal project includes the construction of a floodwall extending along the west side of the Harvey Canal from the Cousins Pumping Station to the Harvey Lock, a distance of nearly 3 miles. The implementation of Plan 3B would eliminate this feature resulting in a savings of $15,052,000. The floodwall feature of the Westwego to Harvey Canal project currently is scheduled for award in late 1998 with completion scheduled for late 2001. Beneficial completion of the Westwego to Harvey Canal project is scheduled for 2001. With

completion of the floodgate feature of Plan 3B also scheduled for 2001, there would be no loss in benefits to the Westwego to Harvey Canal project. Beneficial completion for Plan 3B, west of Algiers Canal, is scheduled for 2002. Those industries which would have been located on the floodside of the authorized floodwall will be protected by the construction of the floodgate. Providing protection to the industries along both the east and west banks of the Harvey Canal results in additional equivalent annual benefits of $2,676,000.

Area East of Algiers Canal. Plans for the area east of Algiers Canal were evaluated at three levels of protection. The 100-year level of protection has the greatest equivalent annual net benefits, $1,731,000; followed by the 200-year level of protection, $1,695,000; and SPH protection, 1,301,000. The BCR is 3.32 to 1.0 for 100-year protection, 2.66 to 1.0 for 200-year protection, and 1.92 to 1.0 for SPH protection.

The area east of Algiers Canal, although sparsely populated in areas, contains some of the last available undeveloped land within the New Orleans metropolitan area. Continued growth of the area is expected with the population projected to eventually reach 75,000 to 80,000. The economic analysis is based on past historical trends which would provide for the population to increase from approximately 9,250 in 1990 to over 30,500 in the year 2040. The long-term population projections presented in Volume 2 Appendix B, are consistent with the short term population growth that took place between 1990 and 1993. Construction has recently begun on five new upscale subdivisions in the Belle Chasse area of Plaquemines Parish. New development is also occurring in the Lower Coast Algiers area of Orleans Parish. Approximately 1,000 acres are currently being developed as part of English Turn, a residential and recreational community developed by Jack Nicklaus. A land use plan has been approved which includes an additional 2,600 acres for future development outside of English Turn. The economic analysis was based on the assumption that an additional 7,950 residential structures would be constructed within the next 50 years.

The new development, although assumed to be constructed at or above the 100-year floodplain, would still be vulnerable to flooding from storms which exceed the 100-year event. The without project damages occurring from the SPH event under existing conditions are estimated at $139 million. This increases to $864 million under future conditions. With a 100-year level of protection in place, the damages from the SPH event are reduced to $46 million under existing conditions and $200 million under future conditions. Providing SPH protection further reduces the damages to less than $1 million

under existing and future conditions. Providing SPH protection instead of 100-year protection reduces damages from the SPH event by over $45 million under existing conditions and $200 million under future conditions.

SOCIAL CONSIDERATIONS

The social impacts of the alternative plans vary primarily with the level of protection provided and are similar for the area east of Algiers Canal and the area west of Algiers Canal.

Residents living throughout southeast Louisiana have become accustomed to the sight of levees and floodwalls. These common features of the landscape are needed to prevent flooding from high stages on the Mississippi River and from hurricane-induced tidal surge. The construction of Federal hurricane protection projects providing SPH protection have been authorized for the adjacent Westwego to Harvey Canal area and for the east bank of the Mississippi River in Jefferson, Orleans, and St. Bernard Parishes. The protection provided by these levees and floodwalls has in many cases tended to create a false sense of security to the residents living within the project area. Behavioral surveys have shown that the biggest challenge facing emergency managers is to effectively communicate the actual risk faced if a major hurricane were to threaten the New Orleans metropolitan area. Providing less than the SPH level of protection to one portion of the metropolitan area while remaining portions are provided with SPH protection would only complicate the job facing emergency managers. Residents could find themselves in the unenviable position of being told to evacuate when neighboring communities are not being evacuated. The effectiveness of an evacuation depends heavily on minimizing confusion among residents being asked to evacuate. Most residents would be unable to distinguish between a project that provides a 100-year level of protection and one that provides SPH protection, and would not understand the implications of each. Providing similar levels of hurricane protection throughout the metropolitan area is the only effective way to minimize confusion.

The close proximity of New Orleans to the Gulf of Mexico places 1 million people living in areas at risk to inundation from storm surge. The potential problems associated with evacuating the entire metropolitan area are further complicated by the limited number of evacuation routes available to evacuees. With evacuation times for the New Orleans metropolitan area exceeding 48 hours, the decision to evacuate must be made when the hurricane is still hundreds of miles away. The probability of being directly impacted by

the storm is only between 10 and 15 percent when making decisions in excess of 48 hours prior to projected landfall. When a hurricane is threatening, residents must decide if the severity of the storm warrants evacuating. The inability to accurately predict the behavior of hurricanes coupled with long evacuation times creates the potential for repeated evacuations of the study area. Based on information contained in the Southeast Louisiana Hurricane Preparedness Study, a 100-year level of protection would generally provide protection up to a slow moving category 2 storm. The SPH level of protection would provide the additional levee height necessary to protect residents against tidal surge for slow moving category 2 and fast moving category 3 storms. Providing the area with SPH protection would reduce the number of times that public officials would be forced to recommend an evacuation of the study area, thereby increasing participation rates when evacuation orders are necessary.

Levees and floodwalls have proven to be extremely effective at preventing inundation from hurricane surge. These barriers are, however, vulnerable to events which exceed their design criteria. Once overtopped, these levees and floodwalls are just as effective at preventing the water from draining out of the protected areas. The only way to remove the water is to pump it out. Depending on the condition of the pumping stations and on the extent of flooding, it could take several days to over a week to completely drain the area. Flood waters remaining in the homes and businesses for several days results in additional damages, not to mention the extremely difficult living conditions that would exist for those who did not evacuate. Providing SPH protection would reduce the potential for overtopping of the protection to occur.

The alternative plans would not noticeably impact such factors as property values, housing, community growth, public facilities and services. The existing levees have to a great extent established the limits of growth within the areas both east and west of the Algiers Canal. The plans under consideration would generally follow the existing line of protection and would not impact the limits of development. With the large tracts of undeveloped land in the area east of Algiers Canal, additional development occurring outside the protected area would most likely be minimal.

ENGINEERING CONSIDERATIONS

The remaining plans are feasible from an engineering standpoint and would provide a greater degree of hurricane protection to the study area. These plans include Plan 1 (floodwall along the Harvey Canal) and Plan 3B (floodgate in the Harvey Canal) for the

area west of Algiers Canal and a plan which follows the existing line of protection for the area east of Algiers Canal. Each plan was evaluated at different levels of protection, generally the 100-year, 200-year, and SPH. Similar levels of detail were prepared for each plan. The types of construction required in these plans are similar to other work which has been performed by the New Orleans District. Designs were based on previous jobs which involved similar construction techniques. The cost engineers met with the design engineers to determine the appropriate contingencies to use on each item in the cost estimates.

Relatively poor foundation conditions and the absence of higher quality borrow material will require the levees to be constructed in lifts. Designs of the flood protection features were prepared with limited soil borings and without detailed surveys. The geotechnical uncertainties are common to all plans and would not effect plan formulation. These uncertainties have been accounted for in the contingencies which range from 20 to 30 percent. A 30 percent contingency was used for most of the levee work. Additional borings and detailed surveys will be obtained during preparation of the design memorandums. Based on experience with levee construction in similar areas, this project will require 1 to 3 lifts to attain a sustained project grade. The enlargement of existing levees would be accomplished in 1 lift, newly constructed levees would require 3 lifts. The proposed floodgate structure in Plan 3B will consist of a pile supported reinforced concrete structure. The use of I-walls , I-wall/earth combinations, vehicular gates, and inverted T-walls in all plans assure a continuity of protection through congested areas. The plans would not be readily reversible because of their massive scope and regional extent. Cost estimates for each alternative are presented in Volume 2, Appendix A, Section IV.

Standard hydrologic and hydraulic methods were used to analyze the flooding potential of the areas east and west of the Algiers Canal. Stage-frequency tables provided in Volume 2, Appendix A, show interior stages for both the with- and without-project conditions for storms up to the SPH event. The integrity of the existing protection was considered in determining the without project interior stages. Interior stages for events which exceed the with-project level of protection were computed with the assumption that the protection remains in place (i.e. no erosion or failure occurs). Overtopping of the levees and floodwalls will occur when the intensity of the storm exceeds the provided level of protection. The amount of overtopping may not be significant if the intensity of the storm only slightly exceeds the level of protection. However, with a 100-year level of protection in place, substantial overtopping would occur from the SPH event. The overtopping would raise interior stages from between 1.8 and 3.4 feet (depending on

hydrologic reach) within the protected area. As the rate of overtopping increases, parts of the levee would likely begin to erode. Erosion occurring in the crown of a levee or along the backside of a floodwall could reach a point at which the integrity of the protection was compromised. Continued erosion could even lead to a complete failure in the protection. The potential loss of life and property damage resulting from a failure in the protection would be catastrophic. By providing SPH protection, the project would eliminate overtopping from storms except those exceeding the 500-year event and reduce the probability for a catastrophic levee failure.

Historical evidence of sea level rise and subsidence indicates the need for a projection of future storm surge heights and their effect on the alternative plans. Using a projected sea level rise of 0.5 feet in the next 100 years and the appropriate subsidence rate in coastal zones bordering the study area, expected hurricane surge for the year 2040 was computed, see Volume 2, Appendix A, Sections I and II. The stages increased by 1.8 feet for the SPH storm, 1.5 feet for the 200-year storm, and 1.3 feet for the 100-year storm. The three remaining plans were evaluated to determine which features should be designed based on projected future conditions. Individual features of a plan that would be difficult to raise in the future (the navigable floodgate for Plan 3B) would be initially constructed to the required height for future conditions. The levees and floodwalls would initially be overbuilt to account for projected subsidence and sea level rise during the first 10 years of the project life. This would insure that the authorized level of protection is maintained during the early years of the project. The protection would be raised to account for future conditions around year 10 or when deemed necessary based on actual subsidence and sea level rise. The cost for raising the protection would be considered deferred construction. The additional cost of raising the protection did not vary significantly from Plan 1 to Plan 3B, west of Algiers Canal or for the area east of Algiers Canal and therefore did not effect plan selection. The costs for raising the protection to account for sea level rise and subsidence have been included in the economic analysis.

Consideration was given to alternative methods for raising the protection to account for future conditions. The levees, floodwalls, and floodgates could be initially constructed to account for changes projected to occur throughout the project life. Initially raising the levees an additional 1.8 feet would likely require the acquisition of additional rights-of-way, thereby significantly increasing the cost. The design of the project would also be based on conditions which are only projected to occur during the next 50 years. Even though sea level rise and subsidence are based on past historical trends, our ability to accurately predict future changes in these parameters is highly suspect. If the projections

were found to be in error at some point in the future, additional work on the levees and floodwalls would likely be required. Another option would be to periodically (approximately every 10 years) raise the protection. In order to maintain SPH protection, the levees and floodwalls would have to be raised by 1.8 feet during the next 50 years. This equates to an increase of less than 0.5 feet every 10 years. A large portion of the cost to raise the protection by such a small amount would be associated with items (mobilization, clearing, grubbing, fertilizing, seeding, and demobilization) which are relatively independent of the increase in the protection. These costs would be incurred on a periodic basis increasing the overall costs for raising the protection. This option would also disrupt the lives of residents and businesses located adjacent to the protection on a periodic basis. Monitoring the effects of sea level rise and subsidence and determining the appropriate time to raise the protection is the best available option.

ENVIRONMENTAL CONSIDERATIONS

The primary environmental concerns aside from avoiding any possible spread of contaminants to the aquatic as well as human environment, consist of minimizing adverse impacts to bottomland hardwood and swamp forests and, thus, wildlife habitat. There is also a concern for avoiding any impacts to any proposed or listed threatened or endangered species. A bald eagle nest is close to a common feature of each alternative, but is not sufficiently near to be affected. Environmental impacts have been minimized in the planning process by using existing levee alignments and developed corridors and by avoiding wetlands including forested wetlands wherever possible. The primary impacts of any alternative would be the possible loss of wildlife habitat as a result of new levee construction, levee upgrading, and possible borrow pit construction in the Oakville area. Currently, project design is to take borrow material from an open pasture, and losses of openland are considered insignificant. Adverse impacts to woodlands on the area east of Algiers Canal are essentially the same with all levels of protection. Plan 3B, west of Algiers Canal, would produce additional impacts due to the construction of a new Cousins Pumping Station outfall canal and the requirement of a stockpile area for excess excavated material taken from the outfall channel which would be used in future levee lifts. Measures are included in each of the alternative plans to mitigate unavoidable impacts. Additional discussions on the environmental impacts and proposed mitigation plans are included in the EIS and in Appendix C, Section IV.

HTRW CONSIDERATIONS

Industrial activities within the study area are located primarily along the Harvey and Algiers Canals. Because many of these industries deal in activities that produce and use hazardous materials, it was necessary to research the history of all the industries in the project area. Each of the high interest HTRW sites identified along the various alignments were inspected by vehicle and on foot. The hazardous waste files at DEQ were inspected for industries that were permitted to store, transport, or produce hazardous wastes. Most of the industries had very good records of compliance and hazardous wastes were handled properly. There were, however, two industries located along the Harvey Canal which had numerous violations of spills and improper handling of hazardous wastes. Another industry located at the southern end of Peters Road, near the Hero Pumping Station, had barge cleaning pits on the property. The results of the Initial Assessment and Land Use history are presented in Volume 2, Appendix E.

West of Algiers Canal. The two alternatives being considered for the area west of Algiers Canal are similar except for the alignment of the protection along the Harvey Canal.

Plan 1 would provide for the construction of a floodwall along the east side of the Harvey Canal extending from the Harvey Lock to Lapalco Boulevard. South of Lapalco, a combination of levees and floodwalls would extend to the Hero Pumping Station. The floodwall between the Harvey Lock and Lapalco Boulevard would be constructed through a heavily industrialized corridor and would have a high potential for encountering HTRW. A number of high interest HTRW sites were identified within this area, including one industry which had an extensive hazardous waste file with numerous spills and improper handling violations on various properties along Peters Road. Sampling and testing would be required to determine the extent of contamination along this alignment. Several sites might need remediation prior to construction.

Plan 3B would provide for the construction of a navigable floodgate in the Harvey Canal just south of the Lapalco Bridge. This alignment would avoid the area along the east side of the Harvey Canal between the Harvey Lock and Lapalco Boulevard where there is a high potential for encountering HTRW. Construction of the navigable floodgate and temporary bypass channel/diverted outfall canal would, however require the excavation of material from the Harvey Canal. A sampling plan was developed to determine the concentration of pollutants in the vicinity of the navigable floodgate. Test results showed

the presence of contaminants but did not warrant being classified as a hazardous and toxic waste. A plan for disposal of contaminated sediments excavated from the Harvey Canal was developed and coordinated with DEQ to minimize environmental impacts. Sediments excavated from the Harvey Canal will be hauled to a nearby industrial landfill. Results of the sampling plan and details of the sediment disposal plan are presented in Volume 2, Appendix C, Section VIII. One industry, located just south of the point at which the proposed alignment crosses the east bank of the Harvey Canal, was found to have a file at DEQ containing reports of hazardous waste spills on the property. Another industry located at the southern end of the Harvey Canal, near the Hero Pumping Station, was found to have barge cleaning pits located on the property. These sites would be avoided by the proposed alignment.

The alignments for Plans 1 and 3B are similar from the Hero Pumping Station to the Algiers Lock. It does not appear that any of the industries located south of the Hero Pumping Station would present any significant HTRW problems to the proposed alignment. The alignment could easily be adjusted to miss problem sites in this area. The potential for encountering HTRW sites along the Algiers Canal is considered low. A number of underground storage tanks (UST's) are located on the properties of many of the industries along the alignments for both Plan 1 and Plan 3B. In areas where the alignment cannot be adjusted to avoid the UST, the tank would be removed along with any of the surrounding soil which had become contaminated.

Given the findings of our initial investigations , it appears that the greatest potential for encountering a serious HTRW problem lies along the alignment for the floodwall feature of Plan 1. Sampling and testing along the Plan 1 alignment would be required to fully define the extent of the problem.

East of Algiers Canal. The plan for the area east of Algiers Canal would follow the existing levee along the east bank of the Algiers Canal and along the north bank of the Hero Canal. The potential for encountering hazardous materials along this alignment is low. Only one high interest HTRW site was identified along the east bank of the Algiers Canal. This site did not have any compliance violations and appeared to be free of HTRW materials. The recommended alignment would also enclose a demolition landfill within the protection near Oakville. There are no known hazardous materials landfilled at this site.

PUBLIC INTEREST CONSIDERATIONS

A project providing increased levels of hurricane protection to west bank residents living between Westwego and the Harvey Canal was authorized in 1986. This project, when completed, will provide the area with SPH protection. To be acceptable to local entities and the public, an equivalent level of protection is necessary east of the Harvey Canal. The Harvey Canal Industrial Association, which represents the industries along the canal, has expressed a great deal of concern over the potential for increased flooding and the access problems associated with the construction of a floodwall parallel to the Harvey Canal.

A behavioral survey was recently conducted as part of the Southeast Louisiana Hurricane Preparedness Study to determine expected participation rates in response to a hurricane evacuation order. Even with aggressive action taken by local officials, participation rates in metropolitan New Orleans can be expected to average only 80 percent. With less aggressive action by local officials, the participation rate would likely drop to around 60 percent. This means that between 28,500 and 57,000 residents living within the study area would decide to ignore the evacuation order. Those remaining behind would be left at the mercy of the storm. Providing SPH protection would minimize the potential for catastrophic loss of life due to flooding among those who do not evacuate.

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

The NED plan is that plan which reasonably maximizes net economic development benefits (the difference between equivalent annual benefits and average annual costs), consistent with the Federal objectives.

West of Algiers Canal. A review of economic data related to the benefits accruing from each of the alternatives, shows that Plan 3B (navigable floodgate below Lapalco Boulevard) to the SPH level of protection best approximates maximization of net tangible benefits over costs. The plan with the second greatest net benefits is Plan 1 (floodwall along the Harvey Canal) providing a 100-year level of protection. Although the first cost for Plan 3B, SPH protection, is considerably higher than Plan 1, 100-year protection, the incremental BCR is 1.20. With the total difference in net benefits between the two plans being less than 3 percent, selection of the NED plan is not clearly defined. Other factors (tangible and intangible) must be taken into consideration before identifying the NED plan.

We selected Plan 3B as the NED plan because, that in addition to providing greater net benefits ($716,000), Plan 3B has a number of other advantages. Plan 3B does not induce damages to the industries along the Harvey Canal and, in fact, not only provides protection to these industries but also avoids impacting existing access to the canal. The alignment for Plan 3B avoids the industrialized corridor along the Harvey Canal north of Lapalco Boulevard where there is a high potential for encountering hazardous and toxic wastes. Plan 3B would also eliminate a feature of the authorized Westwego to Harvey Canal project, resulting in a savings of $15,052,000. The implementation of Plan 3B would provide SPH protection, a level of protection that is consistent with protection that has been authorized for the surrounding metropolitan area. Providing SPH protection would also minimize the potential for catastrophic loss of life due to the occurrence of an extreme event. Plan 3B was therefore selected as the NED plan for the area west of Algiers Canal.

East of Algiers Canal. For the area east of Algiers Canal, the remaining alignment was evaluated at three levels of protection. A review of the economic data shows that the 100-year level of protection provides the greatest net benefits over costs and was therefore identified as the NED plan. However, the difference in equivalent annual net benefits between the 100-year level of protection and the 200-year level of protection is $36,000, a difference of only 2 percent.

The NED plan is therefore, a combination of Plan 3B, SPH protection for the area west of Algiers Canal and a 100-year level of protection for the area east of Algiers Canal.

DETERMINATION OF THE RECOMMENDED PLAN

The recommended plan was determined after a review of economic, social, engineering, environmental, and public interest considerations. Table 12, "Effects Displays and System of Accounts," indicates the major effects of the plans.

A review of the remaining plans resulted in the selection of Plan 3B constructed to the SPH level of protection, as the recommended plan for the area west of Algiers Canal. Plan 3B was also previously identified as the NED plan. In addition to providing the greatest net benefits, Plan 3B was selected to avoid inducing damages to the industries located along the Harvey Canal and to minimize potential access problems that would be

created by the construction of a floodwall parallel to the canal. The SPH level of protection was also selected as the recommended plan for the area east of Algiers Canal. Selecting the SPH level of protection is a deviation from the NED plan. The area east of Algiers Canal is expected to experience continued growth throughout the project life and providing less than SPH protection would jeopardize the lives of current and future residents in this area. The adjacent Westwego to Harvey Canal Hurricane Protection Project and the Lake Pontchartrain and Vicinity Hurricane Protection Project on the east bank were authorized to provide SPH protection and local interests within the study area desire a comparable level of protection. If the surge produced by a hurricane were to overtop a project constructed to provide a lesser degree of protection, the potential for loss of life and property would be catastrophic. Implementing the recommended plan would provide protection to those areas east of the Harvey Canal and would tie the line of protection to the authorized Westwego to Harvey Canal project. The two projects would provide protection to over 190,000 west bank residents living in Jefferson, Orleans, and Plaquemines Parishes.

RATIONALE FOR DEVIATING FROM THE NED LEVEL OF PROTECTION

The NED plan for the area west of Algiers Canal is Plan 3B providing SPH protection. The NED plan for the area east of Algiers Canal would provide a 100-year level of protection. The benefit to cost ratio (BCR) for the NED plan is 3.98 to 1.0 for the area west of Algiers Canal and 3.32 to 1.0 for the area east of Algiers Canal. The recommended plan is a combination of the NED plan west of Algiers Canal and the SPH level of protection east of Algiers Canal. The BCR for SPH protection east of Algiers Canal is 1.92 to 1.0.

Providing SPH protection to the area east of Algiers Canal would provide an additional $242,000 in equivalent annual benefits. The difference in first cost between the NED plan ($6,975,000) and the recommended plan ($13,826,000) is $6,851,000. This results in an increase in the average annual cost of $672,000 (including OMRR&R and mitigation costs). The resulting incremental BCR is 0.36.

The area east of Algiers Canal is currently provided with a limited degree of protection by the Algiers and Hero Canal levees. The Algiers Canal levee is subject to overtopping from around the 100-year event. The Hero Canal levee is a non-Federal levee which is subject to overtopping or failure from around the 50-year event. There is also a small non-Federal levee which runs along the Donner Canal and separates the Lower Coast

Algiers area (Orleans Parish) from the Belle Chasse area (Plaquemines Parish). Deficiencies in the existing levee system are compounded by ongoing subsidence and sea level rise. The NED plan would only provide protection up to the 100-year event. The overtopping caused by the SPH event would subject the area to increased stages. Providing SPH protection over the NED protection results in a stage lowering of 3.4 feet in the Belle Chasse area and 2.1 feet in the Lower Coast Algiers. Under future conditions, providing SPH protection over the NED protection results in a stage lowering of 4.3 feet in the Belle Chasse area and 2.7 feet in the Lower Coast Algiers.

Under the existing conditions the SPH event would result in the inundation of 622 residential structures and 365 commercial structures within the area east of Algiers Canal. With a 100-year level of protection, the number of structures inundated from the SPH event is reduced to 193 residential and 208 commercial. Total expected damages from the SPH event with a 100-year level of protection in place are $44.5 million. Providing the area with SPH protection removes an additional 193 residential structures and 207 commercial facilities from the floodplain associated with the SPH event. Total expected damages with SPH protection are reduced to $51,000. Providing SPH protection over a 100-year level of protection reduces the total damages from the SPH event by over $44 million.

The area east of Algiers Canal contains some of the last available undeveloped land within the New Orleans metropolitan area. The area is experiencing continued growth and projections have been made for the development that is expected to occur by the year 2040. The economic analysis is based on past historical trends which would provide for the population to increase from approximately 9,250 in 1990 to over 30,500 in the year 2040. This would involve the development of an additional 7,950 residential structures. All of this development has been placed at or above the 100-year base flood elevation. No attempt was made to project future increases in commercial development. A complete description of the future development is provided in Volume 2, Appendix B.

The SPH event under the future without project conditions would result in the inundation of 9,225 residential structures and 365 commercial structures. Providing the area with a 100-year level of protection would reduce the number of structures inundated by the SPH event to 5,111 residential and 229 commercial. Total damages resulting from the SPH event with a 100-year level of protection in place would be in excess of $189 million. Providing SPH protection removes all of the residential and all but one of the commercial facilities from the SPH floodplain. Total damages with SPH protection are

$51,000. Providing SPH protection reduces the total expected damage occurring from the SPH event under future conditions by nearly $189 million over the NED level of protection.

Alvin Callender Field is a large military installation located just south of Belle Chasse. Facilities located on the base include residential housing, industrial maintenance and repair facilities, and storage warehouses for equipment, ammunition, vehicles and airplanes. Due to the increasing reliance on the reserves in the military, Alvin Callender Field was assumed to maintain its current size throughout the project life. The expected damages to Alvin Callender Field, which were included in the damage totals presented earlier, during the SPH event under existing conditions exceeds $89 million. Providing a 100-year level of protection reduces the damages from the SPH event to just over $31 million. Increasing the protection to the SPH level eliminates all damages from the SPH event due to tidal surge. The SPH level of protection reduces the expected damages to Alvin Callender Field from the SPH event by $31 million over the NED level of protection. The reduction in damages by providing the SPH level of protection as compared to the NED level of protection increases to $49 million under future conditions.

A number of communities are located along the west bank of the Mississippi River south of the study area in lower Plaquemines Parish. These communities stretch for over 60 miles along a narrow strip of land that is protected by both Federal and non-federal levees. Highway 23 is the only evacuation route for the 20,000 residents living within these communities. The Red Cross designated public shelters for residents of lower Plaquemines Parish are located in the Belle Chasse area. Designated public shelters are also located within Alvin Callender Field. These shelters would only be protected up to the 100-year storm with the NED level of protection. Evacuees located in these shelters would be at risk from events exceeding the 100-year storm. Providing less than SPH protection could result in the need to relocate evacuees' to safer shelters late in an evacuation when weather conditions have deteriorated and evacuation routes are inundated. The evacuees' degree of safety is directly related to the level of protection offered by the study area.

In addition to providing shelter to evacuees during a hurricane, Alvin Callender Field would also be used as the main staging area for relief supplies after the hurricane had passed. Recent experiences with Hurricanes Hugo and Andrew have demonstrated the importance of quickly initiating relief efforts. With a 100-year level of protection in place, the SPH project would place up to 3.5 feet of water over Alvin Callender Field. The

existing pumping stations provide the only means of removing the water, assuming they were not heavily damaged during the hurricane. It would take as long as a week to completely drain the area. Delays in the re-opening of Alvin Callender Field would adversely impact the ability to quickly organize relief efforts.

Recent improvements in forecasting the track of an approaching hurricane for lead times in excess of 24 hours falls far short of the public's perception. Forecast errors for hurricane predictions issued 24 hours prior to projected landfall average 100 miles. This increases to 220 miles for 48 hour forecasts and 400 miles for 72 hour forecasts. Thus, if a storm were forecast to make landfall due south of New Orleans in 24 hours, and if, in fact, it made landfall between Dauphin Island, Alabama, and Marsh Island, Louisiana, the forecasting errors would be no worse than average. Not only do errors occur in predicting the path of a hurricane, but also in predicting the hurricane's strength. A hurricane can intensify by 20 percent in a 24-hour period. A hurricane projected to impact the coast within 24 hours could intensify from a 200-year storm to a 500-year storm prior to making landfall. Additional protection is a needed safety factor given the difficulty in predicting the path and intensity of a hurricane.

The social, engineering and public interest considerations previously presented supporting the SPH level of protection are applicable to the area east of Algiers Canal. Levees constructed to a 100-year level of protection would be subject to erosion as a result of overtopping from events exceeding the 100-year storm. The erosion could jeopardize the integrity of the protection, possibly leading to a complete failure. The potential for loss of life and property damage resulting from a failure in the protection would be catastrophic. Residents living within the area east of Algiers Canal would expect a level of protection consistent with the surrounding metropolitan area. An evacuation of just the area east of Algiers Canal would be extremely ineffective because of the confusion that would be created. A similar situation occurred during Hurricane Andrew in 1992 and the percentage that evacuated was very low.

The Lake Pontchartrain and Vicinity Hurricane Protection Project and the Westwego to Harvey Canal Hurricane Protection Project were both authorized to provide SPH protection to surrounding portions of the New Orleans metropolitan area. Expenditures on these projects through 1993 have totaled in excess of $410 million. Future expenditures on these projects are estimated at nearly $400 million. This feasibility report has also determined that the NED plan would provide SPH protection to the area west of Algiers Canal at a cost of over $100 million. This brings the total expenditures for providing SPH

protection to the New Orleans metropolitan area to over $900 million. The additional $6.8 million necessary to provide SPH protection to the area east of Algiers Canal is less than 1 percent of the total cost of protecting the metropolitan area.

Considering the tangible and intangible benefits, the costs, the risks and uncertainties involved in predicting hurricanes, and the obvious potential for considerable loss of life in the study area, the benefits of deviating from the NED level of protection to the SPH level of protection far outweigh the costs. Thus, we recommend that the area east of Algiers Canal be provided with SPH protection.

SENSITIVITY

The purpose of a sensitivity analysis is to determine how sensitive the recommended plan is to assumptions used in the calculation of economic benefits. Critical assumptions and parameters are varied to determine what changes would be required to effect the report recommendations or to cause feasible projects to become infeasible. A detailed description of the sensitivity analysis is presented in Volume 2, Appendix B.

Even though every attempt has been made to ensure the accuracy of each variable in the analysis, a degree of uncertainty is implicit in many areas of water resources planning. The potential for error exists in all parameters that have been assigned a single point value rather than a range of values. Sensitivity analysis can be performed on each of these variables in order to determine how much the equivalent annual benefits of the project will change as a result of a change in the estimation of that variable. A sensitivity analysis was performed on the contents-to-structure values, and on the future conditions for both the areas east and west of the Algiers Canal.

The contents-to-residential structures value ratios were based on relationships established in the 1981 Lake Pontchartrain and Vicinity Hurricane Protection Project. These ratios ranged from 48 to 75 percent, with the lower valued structures having a higher contents percentage. With the residential contents capped at 50 percent, the total equivalent annual benefits in the area west of Algiers Canal decreased by $2,200,000. This is a decrease of only 5.3 percent which would reduce the BCR to 4.31 to 1. The total equivalent annual benefits for the area east of Algiers Canal decreased by only $2,000 with residential contents capped at 50 percent. This is a decrease of only 0.07 percent which would not change the BCR. Capping the contents ratio at 50 percent has almost no effect on project benefits and would not effect plan selection.

A total of three different scenarios were analyzed to see the effects of varying future conditions projected to occur within the study area. The first scenario excludes all benefits from future development and all benefits resulting from changes in the hydraulics due to sea level rise and subsidence. Future development assumptions only effect the area east of Algiers Canal, future development was not projected for the area west of Algiers Canal. The second scenario assumes that no future development will take place, but that projected sea level rise and subsidence will occur. The final scenario assumes that the maximum amount of residential development will take place on the vacant land east of the Algiers Canal. The effects of these changes on the equivalent annual benefits and on the benefit-to-cost ratio (BCR) are shown in Table 13.

TABLE 13
SENSITIVITY ANALYSIS

	Scenario 1	Scenario 2	Scenario 3
West of Algiers Canal			
Annual Benefits	$23,175,000	$41,245,000	$41,245,000
Change in Benefits	($18,070,000)	N/C	N/C
Percentage Change	(43.8)	N/C	N/C
Resulting BCR	2.23	3.98	3.98
East of Algiers Canal			
Annual Benefits	$1,116,000	$1,600,000	$6,855,000
Change in Benefits	($1,602)	($1,118,000)	$2,787,000
Percentage Change	(58.9)	(41.1)	102.5
Resulting BCR	0.79	1.13	4.83

The numbers presented in Table 14 demonstrate that the economic viability of the recommended plan for the area west of Algiers Canal is not sensitive to projections concerning the future conditions. The benefit-to-cost ratio is 2.23 to 1.0 without claiming benefits for future hydraulics or future development. The recommended plan for the area east of Algiers Canal is sensitive to changes in the future conditions. Computing the benefits based on existing conditions alone (no future hydraulics or future development) results in a BCR of 0.78 to 1.0. Sea level rise and subsidence and future development are all based on past historical evidence and it would not be realistic to exclude these factors.

By just taking into consideration changes in future hydraulics, the BCR for east of Algiers Canal increases to 1.13. Increasing projections for future development can raise the BCR to as high as 4.83 to 1.0. Although the area east of Algiers Canal is sensitive to changing future conditions, these factors are based on past historical trends and would be expected to continue.

CONCLUSIONS

The recommended plan is a combination of Plan 3B, west of Algiers Canal and the alignment for the area east of Algiers Canal both providing the SPH level of protection. Considering the tangible and intangible benefits, the costs, the risks, and the potential for loss of life within the study area, the recommended plan is the best plan for providing increased levels of hurricane protection to the study area.

RECOMMENDED PLAN

PLAN DESCRIPTION

The recommended plan, as shown on Plates 8 through 13, provides SPH protection for the west bank of the Mississippi River in the vicinity of New Orleans for the area generally bounded by the Harvey Canal on the west, the Mississippi River to the north and east, and the Hero Canal to the south. This area is referred to as the area east of the Harvey Canal. Implementation of the recommended plan would provide SPH protection to over 142,000 residents living in Jefferson, Orleans, and Plaquemines Parishes.

The recommended plan includes the construction of a navigable floodgate in the Harvey Canal about 3,600 feet south of Lapalco Boulevard, see Plates 14 through 17. The recommended plan would provide protection for all businesses and most industries located along the Harvey Canal. The authorized Westwego to Harvey Canal project includes the construction of a floodwall along the west bank of the Harvey Canal from the Cousins Pumping Station to the Harvey Lock. The construction of a navigable floodgate in the Harvey Canal along with a diverted outfall canal for the Cousins Pumping Station would eliminate the need for parallel protection along the Harvey Canal north of the Cousins Pumping Station. The floodwall along the west bank of the Harvey Canal, extending from the Cousins Pumping Station to the Harvey Lock, would be deleted as a feature of the Westwego to Harvey Canal project. This would result in a savings of $15,052,000. These savings are being claimed as a reduction in the first cost for the recommended plan for the area west of Algiers Canal.

Prior to construction of the floodgate, a navigation bypass channel would be constructed to temporarily accommodate Harvey Canal traffic while the floodgate is under construction. After the floodgate is completed, the bypass channel would become the outfall canal for the Cousins Pumping Station. When the floodgate structure is closed, the existing Harvey Pumping Station would be shut-down and interior drainage would be diverted to the Cousins Pumping Station. The 1st Avenue Canal which connects the Harvey and Cousins Pumping Stations would be increased to handle the additional drainage. The capacity of the Cousins Pumping Station would be increased by 1,000 cfs to handle drainage from the Harvey Pumping Station. The outfall canal for the Cousins Pumping Station would be diverted to discharge below the navigable floodgate.

Excavation will be kept to a minimum by incorporating the temporary bypass channel into the diverted outfall canal. Protection along the west side of the diverted outfall canal would be provided by a levee extending from the Westwego to Harvey Canal project just below the floodgate to the Cousins Pumping Station. The east side of the outfall canal would be protected by a floodwall extending from the Cousins Pumping Station to the floodgate. On the east side of Harvey Canal, a combination of levees and floodwalls would provide protection from the navigable floodgate to the Hero Pumping Station. The protection would extend south from the Hero Pumping Station around the peninsula of land, connecting with the existing Algiers Canal levee. This alignment provides protection to the industries located below the Hero Pumping Station and avoids impacts to existing drainage facilities. The levee along the west bank of the Algiers Canal would be upgraded from Bayou Barataria to the Algiers Lock.

Protection for the area east of Algiers Canal would be provided by upgrading the existing levees along the Algiers and Hero Canals. From the Algiers Lock, the existing levees would be upgraded along the east side of the of the Algiers Canal and along the north bank of the Hero Canal. The protection would wrap around the head of the Hero Canal and continue approximately 2,700 feet west along the south bank of the canal. A new levee would be constructed behind the community of Oakville connecting the Hero Canal levee with an existing Plaquemines Parish levee. The portion of the Plaquemines Parish levee which extends back toward Hwy. 23 would also be enlarged.

Environmental impacts of the recommended plan have been minimized by using existing levee alignments, developed corridors and minimizing the destruction of bottomland hardwoods. The primary impact of the recommended plan would be the possible loss of 233 acres of bottomland hardwood habitat and 46 acres of wooded swamp habitat as a result of levee, outfall canal, and temporary stockpile area construction. The mitigation plan would include the purchase and management of 312 acres of high quality wooded wetlands. Implementation of this mitigation feature would compensate all significant project-induced fish and wildlife losses to the fullest extent possible. The complete mitigation analysis is described in the EIS and in Appendix C, Section IV.

A sediment disposal plan, developed and coordinated with DEQ, would provide for hauling the contaminated sediments excavated from the Harvey Canal to an approved industrial landfill. Silt curtains would be used to help confine sediments during excavation of the temporary bypass channel. A cofferdam would be constructed in the Harvey Canal enabling the structural excavation site to be dewatered. Construction of the floodgate

would be accomplished in the dry. The sediment disposal plan is included in Volume 2, Appendix C, Section VIII.

PLAN ACCOMPLISHMENTS

The recommended plan would provide SPH protection for the area bounded by the Harvey Canal to the west, the Mississippi River to the north and east, and the Hero Canal to the south; would avoid impacting existing access to the Harvey Canal; and would also mitigate for significant environmental losses.

The recommended plan would provide a level of protection to the 142,000 residents living within the areas east and west of the Algiers Canal that is consistent with the protection provided to the surrounding metropolitan area. The total number of structures inundated from the SPH event would be reduced from 28,522 under the without project condition to 761 with the recommended plan in place, a decrease of over 97 percent. Implementation of the recommended plan would result in a $45 million reduction in the equivalent annual damages. Total equivalent annual benefits for the study area are estimated to be $44,549,000 west of Algiers Canal and $3,220,000 east of Algiers Canal. These benefits result from prevention of flood damages to existing and future development and reduction in emergency costs.

SUMMARY OF ECONOMIC ANALYSIS

Upon selection of the recommended plan, an M-CACES cost estimate, Gross Appraisal and Real Estate Supplement were prepared for this plan only. The revised costs for the recommended plan are presented in Table 14. The additional level of detail resulted in a cost increase for the recommended plan over that presented in the Plan Formulation section of this report. The total project costs for the recommended plan for the area west of Algiers Canal increased from $85,246,000 to $99,665,000, an increase of $14,419,000. The cost for the area east of Algiers Canal increased from $13,826,000 to $20,016,000, an increase of $6,190,000. The majority of the additional costs were due to increases in the costs for acquiring the real estate interests. The real estate costs increased from $8,351,000 in plan formulation to $22,527,000 upon completion of the Gross Appraisal and Real Estate Supplement. This represents an increase of $14,176,000, or nearly 70 percent of the total increase in project costs. The increased real estate costs are

due, in large part, to the costs for acquiring real estate interests along the Algiers and Hero Canals ($8,352,000). Due to existing easements owned by the Federal Government, these costs were not included in the estimates prepared to evaluate the alternative plans. The remainder of the increased real estate costs are due to higher acquisition costs and the indexing of land values to October 1993. The additional real estate interests along the Algiers and Hero Canals are common to each alternative, except Plan 4, and the additional cost would not effect plan formulation.

TABLE 14
RECOMMENDED PLAN
SUMMARY OF PROJECT COSTS AND BENEFITS[1]

	West of Algiers	East of Algiers
Project First Cost	$99,665,000[2]	$20,016,000
Equivalent Annual Benefits	$44,549,000	$3,220,000
Total Avg. Annual Cost[3]	$9,779,000	$2,077,000
Interest & Amortization	$9,211,000	$1,945,000
Operations & Maintenance	$228,000	$12,000
Future Protection	$289,000	$100,000
Mitigation	$51,000	$20,000
Net Annual Benefits	$34,770,000	$1,143,000
Benefit Cost Ratio	4.56	1.55

[1] Based on Oct. 93 price levels with a project life of 100 years and an interest rate of 8%.
[2] Implementation of the recommended plan results in a savings of $15,052,000 by deleting a floodwall feature of the Westwego to Harvey Canal project. These savings have been subtracted from the $114,717,000 first cost for the area west of Algiers Canal.
[3] The base year for the areas both east and west of Algiers Canal is 2002.

Increases in the project first cost were also due to the indexing of construction costs to October 1993 price levels. Similarly, the benefits attributable to the project were also indexed to October 1993. Equivalent annual benefits and average annual costs were

determined using the current Federal discount rate of 8 percent and a project life of 100 years. The costs presented for the recommended plan in the remainder of the report cannot be compared to the costs for alternative plans because they contain different levels of detail.

ENGINEERING DESIGN

The recommended plan involves typical flood control structures (floodwalls, floodgates, levees, pumping stations, etc) which have been designed and constructed by the New Orleans District in the past. The designs and cost estimates presented for the recommended plan are based on previous jobs which involved similar construction techniques. Although the designs were prepared without the benefit of detailed surveys and with limited soil boring information, contingencies have been used to account for the uncertainties. Detailed designs will be prepared during the preparation of three feature design memorandums (FDM's) and a soils report. The Sector Gate Complex FDM will present the detailed designs for the navigable floodgate and associated work from Cousins Pumping Station to Hero Pumping Station. The West of Algiers FDM will cover design of the work from Hero Pumping Station to Algiers Lock. The East of Algiers FDM will cover the design of the protection along the east side of the Algiers Canal from Algiers Lock to Hero Canal. A soils report will be prepared to cover the design of the work along the north bank of the Hero Canal to the tie-in with the existing Plaquemines levee near Oakville. Additional information concerning the preparation of these documents is contained in the Project Management Plan (PMP).

FLOODGATE STRUCTURE

The proposed floodgate structure would be a sector gate type structure, consisting of a pile supported reinforced concrete structure with structural steel sector gates. The floodgate would be constructed in the Harvey Canal, approximately 3,600 feet south of the Lapalco Bridge. The floodgate would provide a 110-foot opening, with a sill elevation of -16.0 feet NGVD to match the existing bottom elevation of the canal. The proposed location and details of the floodgate are depicted on Plates 14 through 17.

The 110-foot opening would be provided to allow navigation of large oil and gas drilling equipment manufactured along the Harvey Canal on the north side of the Lapalco Bridge. The Lapalco Bridge provides a 130-foot clear opening for navigation; however, a

sector gated structure of this size would not be economically feasible at this location. The Harvey Canal Industrial Association concurred in the use of a 110-foot opening.

A temporary navigation bypass channel would be excavated along the west bank of the Harvey Canal to maintain navigation during construction of the sector gate structure. This channel would also be used as the permanent discharge canal for the Cousins Pumping Station located near the Lapalco Bridge. The location of this canal is shown on Plates 10 and 14.

LEVEES

The levees would be constructed in lifts using semicompacted and uncompacted fill. Grass would be planted on the levees for aesthetic reasons and to help reduce soil erosion on the levee slopes. The existing levees adjacent to Algiers and Hero Canals would be enlarged to ultimate design grade in one lift using semicompacted fill. The levee along the north bank of the Hero Canal would include a wave berm. The fill material would be hauled from a borrow area located below the Naval Air Station as shown on Plates 9 and 13.

The new levee along the west side of the Cousins Pumping Station outfall canal would be constructed in three lifts with uncompacted fill. Material excavated during construction of the temporary bypass channel/diverted outfall canal would be stockpiled adjacent to the new channel and would be used to construct the levee in separate lifts. The new levee south of Hero Canal in the vicinity of Hwy. 23, would also be constructed in three lifts with uncompacted fill. Material hauled from a nearby borrow pit would be used for construction of the levee. Typical levee sections are shown on Plate 18.

FLOODWALLS

Design considerations and cost estimates for structural features of the proposed study included I-walls, I-wall/earth combinations, vehicular gates, and inverted T-walls. These structures assure a continuity of protection between full earth levee sections and pumping stations, and allow economical protection through congested areas while minimizing adverse effects. The exposed areas of the floodwalls, particularly those in areas of high visibility, would be provided with architectural finishes for aesthetic reasons. An example of a typical architectural wall treatment, a fractured fin finish, is shown on Plate 19A.

I-wall and/or I-wall-earth sections are proposed in congested areas, such as the area between the navigable floodgate and the Hero Pumping Station and along the Algiers Canal. These walls would form a line of protection between the full earth levee sections and the pumping stations. The sections are necessary to reduce down drag forces and improve stability in the sections near the pumping stations. Typical T-wall, I-wall and I-wall-earth combinations are shown on Plate 19.

Vehicular access is provided at existing roads by gates in the floodwalls and ramps over levee sections. Due to the many gates and time required to operate them, swing gates are assumed advantageous. Roller gates would be used where space requirements dictate. Typical gate details are shown on Plates 20 and 21. The approximate locations for the gates are shown on Plates 10 through 13.

PUMPING STATIONS

The Planters, Orleans No. 11, Orleans No. 13, and Plaquemines Pumping Stations would be modified by constructing floodwalls on the discharge side, passing the discharge pipes through the floodwalls, and by installing butterfly pipe valves on the discharge pipes for positive cut-off. These modifications would have negligible effects of the existing discharge capacities of these stations.

The Hero Pumping Station would be modified by installing butterfly pipe valves on the discharge pipes, raising the existing protection wall on the discharge side of the station, and adding tie-back anchors for improving the stability of the wall. These modifications would have negligible effects on the existing discharge capacity of this station.

Expansion and modification of the Cousins Pumping Station is planned to include an additional 1,000 cfs discharge capacity, raising the existing protection wall on the discharge side of the station, installing sluice gated structures on the discharge end of the horizontal pumps concrete culverts, installing butterfly pipe valves on the discharge pipes, and by diverting the existing discharge canal to a point south of the proposed sector gate structure in the Harvey Canal. The existing 1st Avenue Canal, connecting the Cousins Pumping Station and the Harvey Pumping Station, would be enlarged to accommodate the additional flow to the Cousins station. Details of the proposed modifications to the Cousins Pumping Station are depicted on Plates 14A through 14D.

The Belle Chasse No. 2 Pumping Station on the east bank of the Algiers Canal, now

under construction by Plaquemines Parish, incorporates protection to the SPH level. No additional work would be required under the East of Harvey Canal project at this location.

The proposed Verret Pumping Station on the west bank on the Algiers Canal, to be constructed by Jefferson Parish, will incorporate protection to the SPH level. No further work would be required under the east of Harvey Canal project at this location.

RELOCATIONS

There are several relocations, consisting of pipelines, powerlines, fences, gates, and ramps along the Harvey, Algiers, and Hero Canals that may be impacted by the project. These utilities would be relocated to cross the project in accordance with the existing hurricane protection standards. Disruptions to existing facilities would be kept to a minimum. The cost associated with the performance or construction of the relocations is estimated at $4,730,000.

REAL ESTATE CONSIDERATIONS

The study area includes portions of Jefferson, Orleans and Plaquemines Parishes. The Louisiana Department of Transportation and Development (DOTD) will serve as the non-Federal sponsor for the project. Secondary agreements between DOTD and the West Jefferson Levee District, the Orleans Levee District, and Plaquemines Parish Government, will provide for the local assuring agencies to acquire the lands necessary for construction of the project. The real estate requirements for the recommended plan are presented in Table 15. Additional information on the real estate requirements are presented in Volume 2, Appendix F.

The total acreage for the project is approximately 1,139 acres. The total estimated costs for acquiring the real estate interests are $22,527,000. There are no houses, other dwellings, or places of business located within the proposed limits of work that are eligible for URA benefits. There are no churches, schools or cemeteries within the project area that would be affected. Several items of personal property are located near the proposed alignment. URA payments are estimated at $100,000. No current tract ownership data has been compiled. However, records of the Gulf Intracoastal Waterway - Algiers Canal Alternate Route, and the Harvey Canal project maps indicate that there are approximately 300 ownerships affected, of which 250 are located along the Algiers Canal. There are no

present or expected future hydrocarbon activities within the immediate vicinity of the project area.

TABLE 15
REAL ESTATE REQUIREMENTS

FEE	ACREAGE
Mitigation	312
EASEMENTS	
Channel	47.85
Levee, Floodwall/Channel	18.70
Levee/Floodwall	566.80
Borrow	92.00
Temporary Construction	1.70
Temporary Stockpile	100.00
Total	1,139.05

OPERATION AND MAINTENANCE CONSIDERATIONS

The leveed portion of the study area is currently drained by gravity to pumping stations. The stations lift the water over the levees and into canals and bayous that discharge into the Barataria Basin. Operation and maintenance of the pumping stations is a local responsibility. The floodgate feature of the recommended plan would be operated and maintained by the local interest. Maintenance of the structure is required to insure that the gates would close in the event of a hurricane or other abnormally high tide. The replacement of floodgate machinery would also be required during the 100 year project life. Operating procedures for the floodgate would be developed to insure that closure occurs when a pre-determined stage is reached.

Initial construction of the levees and floodwalls would include projected subsidence and sea level rise during the first 10 years of the project life. The protection would be raised to account for future settlement and sea level rise around year 10 or when deemed necessary based on actual conditions. The cost of raising the protection would be considered deferred construction and included as a project cost.

Operation and maintenance would also include mowing and periodic inspection and repair of levees, floodwalls and floodgates. Operation and maintenance does generally not include potential repair costs that would be involved should the occurrence of an extreme event exceed the design criteria and cause extensive failures in the protection. These costs, once multiplied by the probability of occurrence and amortized over the life of the project, would likely be insignificant. Operation, maintenance, repair, replacement, and rehabilitation costs are estimated to be approximately $240,000 per year. Eliminating the floodwall north of Cousins Pumping Station as authorized in the Westwego to Harvey Canal project would reduce the required operation and maintenance. This results in a savings to the authorized project of $7,000 per year. In addition, operation and maintenance of the mitigation feature would be about $1,300 per year. Operation and maintenance of the project, including the mitigation features, is a non-Federal responsibility.

SUMMARY OF SOCIAL, ENVIRONMENTAL, HTRW, AND PUBLIC INTEREST EFFECTS

SOCIAL EFFECTS

Implementation of the recommended plan would result in improved hurricane protection for the residents, businesses, and industries in the study area. Providing the area with SPH protection would reduce the number of times that public officials would be forced to recommend an evacuation, thereby increasing participation rates when evacuation orders are necessary. There may be minor, temporary degradation of air quality and temporary noise impacts during construction. Esthetic values in some areas could also be reduced during construction.

ENVIRONMENTAL EFFECTS

Approximately 279 acres of wildlife habitat could be lost as a direct result of levee and outfall channel construction and a temporary stockpile area. These lands are predominantly bottomland hardwoods but also contain some wooded swamp. Some species commonly associated with these habitats include swamp rabbit, gray squirrel, and mink. Aquatic resource impacts would be temporary and localized in the vicinity of the structural excavation site in the Harvey Canal. Contaminated sediments excavated from the Harvey Canal would be transported to an industrial landfill thus minimizing the risk of

spreading the contamination to surrounding areas.

Environmental damage would be mitigated by purchase, preservation and management of approximately 312 acres of high quality wooded lands including wetlands in the Bayou Bois Piquant finger-ridge area, St. Charles Parish, Louisiana or other suitable locations.

HTRW EFFECTS

The recommended plan would include hauling the contaminated sediments excavated from the Harvey Canal to an industrial landfill. The recommended plan would eliminate the need for the construction of floodwalls parallel to the Harvey Canal, thus avoiding a heavily industrialized area where the potential for encountering HTRW is considered high.

PUBLIC INTEREST EFFECTS

The recommended plan would provide a level of protection to the areas both east and west of the Algiers Canal that is consistent with the protection provided to the surrounding metropolitan area. The recommended plan would also protect the industries located along the Harvey Canal.

RELATIONSHIP TO WESTWEGO TO HARVEY CANAL PROJECT

The implementation of recommended plan would provide for the construction of a navigable floodgate in the Harvey Canal. The location of the floodgate would not only tie the line of protection to the Westwego to Harvey Canal project, but would also delete a feature of the authorized project. The floodwall feature of the Westwego to Harvey Canal project extending from the Cousins Pumping Station to the Harvey Lock would be eliminated. This feature of the project is currently scheduled for construction beginning in late 1998, with completion in 2001. This modification would result in a savings of $15,052,000 in the total project first cost. The total savings, including interest during construction is $18,936,000. Beneficial completion of the Westwego to Harvey Canal project is currently scheduled for 2001. Completion of the floodgate is also scheduled for 2001, with beneficial completion of East of Harvey Canal scheduled for 2002. The proposed modification to the Westwego to Harvey Canal project would not result in a delay in benefits. The savings were taken as a cost offset in calculating the average annual

cost for the recommended East of Harvey Canal project. No adjustments were made to the Westwego to Harvey Canal project. Table 16 shows that the combination of the Westwego to Harvey Canal project modified to include the East of Harvey Canal project provides greater net benefits than the Westwego to Harvey Canal project alone.

TABLE 16
COMPARISON OF RECOMMENDED PLAN
TO EXISTING PROJECT

	Westwego to Harvey[1]	East of Harvey Canal	Sum of Projects
Westwego to Harvey Canal Project Alone (Existing Project)			
First Cost	$89,885,000	$0	$89,885,000
Gross Investment	$191,190,000	$0	$191,190,000
Avg. Annual Costs	$15,388,000	$0	$15,388,000
Equivalent Annual Benefits	$29,609,000	$0	$29,609,000
Net Benefits	$14,221,000	$0	$14,221,000
Westwego to Harvey Canal Modified to Include East of Harvey Canal (Recommended Plan)			
First Cost	$89,885,000	$134,249,000[2]	$224,134,000
Gross Investment	$191,190,000	$139,387,000[3]	$330,577,000
Avg. Annual Costs	$15,388,000	$11,856,000	$27,244,000
Equivalent Annual Benefits	$29,609,000	$47,769,000	$77,378,000
Net Benefits	$14,221,000	$35,913,000	$52,134,000

[1] The figures for the Westwego to Harvey Canal project were taken from the draft LMV Form 23B-R, dated June 16, 1994, and updated from 1989 to 1994 price levels.
[2] Project first costs do not include the mitigation costs ($484,000). These costs were added as a separate item and are included in the avg. annual costs.
[3] The gross investment has been reduced by $18,936,000 to account for deleting the floodwall feature of the Westwego to Harvey Canal project ($15,052,000) and the interest during construction ($3,884,000).

PLAN IMPLEMENTATION

INTRODUCTION

The purpose of this section is to present pertinent information concerning the Federal and non-Federal responsibilities regarding cost apportionment and the division of responsibilities for construction and subsequent operation and maintenance of the recommended project. Such cost apportionment is based on Federal legislative and administrative policies.

COST APPORTIONMENT

All costs associated with the construction and subsequent operation and maintenance of the recommended project will be allocated to hurricane protection. The Water Resources Development Act of 1986 requires the non-Federal interest to pay 35 percent of the first cost of construction for hurricane and storm damage reduction projects. In addition, all operations and maintenance costs are a non-Federal responsibility. Tables showing a breakdown of Federal and non-Federal expenditures by year are presented in Exhibit 2.

The West Jefferson Levee District, which has been granted authority to administer the project, has requested authorization for work-in-kind, see exhibit 1. The non-Federal share of the total project first cost is estimated at $41,888,000. The required lands, easements, rights-of-way, including suitable borrow and dredged or excavated material disposal areas necessary for construction are estimated to cost $22,527,000. The cost for all utility and facility alterations and relocations are estimated at $4,730,000. The non-Federal interests intend to perform work-in-kind to satisfy the remainder of the non-Federal share ($14,631,000). The proposed work includes the following: (1) Participation in design of the sector gate complex; (2) Design and construction of project features from Hero Pumping Station to the Algiers Lock, within Plaquemines and Orleans Parishes; (3) Design and construction of project features from Algiers Lock to the Hero Cut, within Plaquemines and Orleans Parishes; and (4) Design and construction of project features within Jefferson Parish, as needed, to accomplish satisfaction of the non-Federal cost share responsibility.

DIVISION OF RESPONSIBILITIES

Federal Responsibilities. The Federal government will be responsible for planning, engineering, design, and construction of the project in accordance with the provisions of PL 99-662 (WRDA of 1986).

Non-Federal Responsibilities. In accordance with Federal policy, non-Federal interests must, at the appropriate time, assure the Secretary of the Army that they will without cost to the United States:

a. Furnish all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas necessary for construction (including mitigation), operation, maintenance, repair, replacement, and rehabilitation of the project;

b. Accomplish or arrange for the accomplishment of all utility and facility alterations and relocations determined by the Secretary of the Army to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, except that, in the sole discretion of the Secretary of the Army, the United States may perform utility and facility alterations and relocations on Federal lands, using funds provided by non-Federal interests;

c. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, except for damages due to the fault or negligence of the United States or its contractors;

d. Provide for adjudication of all water rights claims resulting from construction, operation, maintenance, repair, replacement, and rehabilitation of the project, and hold and save the United states free from damages due to such claims;

e. Bear 35 percent of the total cost of project construction;

f. Operate, maintain, repair, replace, and rehabilitate as necessary all features of the project, at no cost to the Government, in accordance with regulations prescribed by the Secretary of the Army, including levees, floodwalls, floodgates and approach channels, drainage structures, drainage ditches or canals, and including all mitigation features;

g. Publicize floodplain information in the areas concerned and provide this

information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise development in the floodplain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility between future development and protection levels provided by the project;

h. Assure that construction, operation, maintenance, repair, replacement, and rehabilitation of any non-Federally constructed flood features do not diminish the hurricane protection provided by or jeopardize the structural integrity of the project;

i. Assure compliance with applicable Federal floodplain management and flood insurance programs;

j. Inform affected interests, at least annually, regarding the limitations of the protection afforded by the project;

k. Perform work-in-kind to satisfy the non-Federal share of the project costs;

l. Perform at the time of initiation of construction, and thereafter, any environmental investigations as determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675 on lands necessary for project construction, operation, maintenance, repair, replacement, and rehabilitation;

m. Assume complete financial responsibility for the cleanup of any hazardous materials located on project lands and regulated under CERCLA and be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner that will not cause liability to arise under CERCLA;

n. Comply with the applicable provisions of the Uniform Relocations and Real Property Acquisition Policies Act of 1970 (PL 91-646), as amended by Title IV of the Surface Transportation and Uniform Relocations Assistance Act of 1987 (PL 100-17);

o. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, approved December 31, 1970, which provides that the construction of any water resource project by the Corps of Engineers shall not be started until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project; and

p. Comply with 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.

SUMMARY OF COORDINATION

The New Orleans District, Corps of Engineers, had the responsibility for conducting and coordinating the study, consolidating information from other agencies and interested parties, formulating the alternative plans and associated recommendations, and preparing the report. During the course of this study, coordination was initiated and maintained with the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Naval Air Station (Alvin Callender Field), National Park Service, Louisiana Department of Transportation and Development, Louisiana Department of Environmental Quality, West Jefferson Levee District, Orleans Levee District, Plaquemines Parish Government, Jefferson Parish Citizens' Drainage Advisory Board, Algiers Drainage Committee, and other Federal, state, and local agencies.

Public meetings concerning the need for increased levels of hurricane protection for the west bank of the Mississippi River were held in 1966, 1972, 1984, 1986, 1989, and 1994. The earlier meetings held in 1966 and 1972 were broad in scope and were primarily concerned with protection of the multi-parish area. The meetings in 1984 and 1986 were concerned with the area between Westwego, Louisiana and the Harvey Canal. The final feasibility report for the West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana, study was issued in 1986. In addition to recommending a Standard Project Hurricane (SPH) level of protection, this report also recommended further studies east of the Harvey Canal.

The East of Harvey Canal study was initiated in 1988. Two public meetings were held in 1989 to discuss the preliminary findings of the study, including alternative alignments being considered. A preliminary draft of the feasibility study was submitted to higher authority for review in July 1992. A feasibility review conference was held in October 1992 to discuss comments on the preliminary draft report. Those Federal and state agencies involved in the study were invited to attend. The draft feasibility report and EIS were distributed to the public for review the week of June 6, 1994. A public meeting was held in July 1994 to discuss the recommendations presented in the report.

With portions of three parishes included in the study area, close coordination was maintained with the non-Federal sponsors. Several meetings were held with the Louisiana Department of Transportation and Development, West Jefferson Levee District, Orleans Levee District and Plaquemines Parish Government to discuss alternative plans, estimated

project costs and cost sharing responsibilities. Act 1012 of the 1993 Legislative Session named the Louisiana Department of Transportation and Development as the non-Federal sponsor for the construction of the Westwego to Harvey Canal Hurricane Protection Project and modifications which include East of Harvey Canal and Lake Cataouatche. Authority to administer the projects was granted to the West Jefferson Levee District in a letter dated November 5, 1993 (Exhibit 1).

Environmental considerations were an issue of concern, particularly with respect to the excavation of contaminated sediments in the Harvey Canal and the impacts to fish and wildlife resources. A notice of intent to prepare a draft Environmental Impact Statement (EIS) was published in the Federal Register on February 11, 1988. A scoping input request was issued on March 29, 1988. A scoping document that summarized all comments received during the scoping period was sent out October 29, 1988. A Fish and Wildlife Coordination Act Report, dated August 1994, was provided by the Fish and Wildlife Service and is included in Volume 2, Appendix D.

The draft report was transmitted to all agencies, groups, and individuals who normally review such documents, and to additional agencies, groups, and individuals who have expressed an interest in the project. A copy of all comments received along with responses, where appropriate, are provided in Volume 2, Appendix G. All comments received during the review process were considered in the preparation of the final report.

LOCAL COOPERATION

VIEWS OF LOCAL SPONSORS

The east of Harvey Canal study area, which is located on the west bank of the Mississippi River, includes portions of Jefferson, Orleans, and Plaquemines Parishes. The local agencies responsible for providing hurricane protection to the residents of these parishes are the West Jefferson Levee District, Orleans Levee District, and Plaquemines Parish Government. Close coordination has been maintained with these agencies throughout the planning process. The Louisiana Department of Transportation and Development has also been involved in the planning process. These agencies have all expressed their support for the project. A letter has been received from the Louisiana Department of Transportation and Development expressing their intent to provide the non-Federal share of the project costs. A copy of this letter is included in Exhibit 1.

PRELIMINARY FINANCING NEGOTIATIONS

Several meetings have been held between the Corps of Engineers, Louisiana Department of Transportation and Development, West Jefferson Levee District, Orleans Levee District and Plaquemines Parish Government. The purpose of these meetings was to discuss the recommended plan, estimated project cost, and cost sharing responsibilities. The Louisiana Department of Transportation and Development will serve as the non-Federal sponsor for the project. Secondary agreements between the Louisiana Department of Transportation and Development and the West Jefferson Levee District, Orleans Levee District, and Plaquemines Parish Government, will provide for the local assuring agencies to acquire the lands necessary for construction . A breakdown of the Federal and non-Federal expenditures by fiscal year, based on the fully funded cost estimate, has been prepared and is attached as Exhibit 2. A detailed breakdown of the project first cost by construction contract is attached as Exhibit 3.

ASSESSMENT OF FINANCIAL CAPABILITY

Act 1012 of the 1993 Legislative Session has named the Louisiana Department of Transportation and Development (DOTD) as the non-Federal sponsor for the recommended

plan of the West Bank - East of Harvey Canal project. Secondary agreements will be signed between DOTD and the West Jefferson Levee District (WJLD), the Orleans Levee District (OLD), and the Plaquemines Parish Government, concerning the acquisition of lands, easements, rights-of-way, relocations, and disposal areas (LERRDs). An agreement is currently being developed to outline the collective duties between DOTD and these entities. In the interim, the West Jefferson Levee District has been granted the authority by DOTD to administer the project. DOTD expects to fund the non-Federal cost share of the project through either the State General Fund or the State Bond Program. For the past five years, these two appropriations have averaged $4.3 billion and $100 million, respectively. The bonds of the state of Louisiana are currently rated A by Standard and Poor's, and Baa by Moody's.

A breakdown of the Federal and non-Federal share of the project cost is displayed by fiscal year in Exhibit 2. As shown in the exhibit, the largest non-Federal outlay for any year during the construction of the project is approximately $15.7 million in FY 2001. This amount is approximately 1% of the General Fund of the state, and is approximately 16% of the State Bond Program.

The Louisiana Department of Transportation and Development has been an active participant throughout the study. Its representatives have reviewed a preliminary draft of the local cost-sharing agreement, and have provided the Corps with a letter of intent indicating that the agency understands the responsibilities incumbent on the local sponsor. The agency intends to enter into a binding agreement with the Corps at the appropriate time. The letter of intent for participation in the recommended plan is contained in Exhibit 1.

ENVIRONMENTAL IMPACT STATEMENT

FINAL
ENVIRONMENTAL IMPACT STATEMENT
WEST BANK OF THE MISSISSIPPI RIVER
IN THE VICINITY OF NEW ORLEANS, LOUISIANA
EAST OF THE HARVEY CANAL

AUGUST 1994

Lead Agency: U.S. Army Corps of Engineers, New Orleans District
Cooperating Agency: Louisiana Department of Transportation and Development

ABSTRACT: The project area is adjacent to New Orleans and is bounded by the Mississippi River on the north and east, the Harvey Canal and Bayou Barataria on the west, and the Hero Canal on the south. This is an area of heavy residential, commercial, and light agricultural development. Although there are some sizeable forested tracts remaining in the project area, the total of which is approximately 11,300 acres, most of this acreage will be subject to development in the future, either with or without the proposed project. Due to low elevations in the study area, much being below sea level, and the inadequacy of existing levee systems, disastrous flooding can occur. Flooding was experienced in 1985 during Hurricane Juan, which was not classed as a major storm. The District studied five protection alignments and three levels of protection [100-year, 200-year, and standard project hurricane]. Plan 1 (with floodwalls along Harvey Canal), 100-year plan, would be the least damaging environmentally. The Recommended Plan is Plan 3B, SPH (floodgate in Harvey Canal, with floodwall/levee combination). This plan maximizes flood protection, results in little disruption to Harvey Canal businesses, maintains low costs, and results in a relatively minor increase in environmental damage over Plan 1. Environmental features of the plan include using existing alignments wherever possible, obtaining levee-building material from nonwetland areas if possible, and mitigating unavoidable losses of forested wetlands by acquiring and preserving 312 acres of high quality wooded wetlands in a nearby location.

Comments:
Please send your comments to the U.S. Army Corps of Engineers, Washington Level Review Center. Mail comments to Washington Level Review Center, 7701 Telegraph Rd, Alexandria, VA 22060 **to arrive within 30 days** of the Division Engineer's public notice. If you need further information on the Environmental Impact Statement, please contact Mr. Bill Wilson, U.S. Army Engineer District, New Orleans, Louisiana 70160. Commercial telephone: (504) 862-2527.

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

1. SUMMARY

1.1. CONCLUSIONS AND FINDINGS

1.1.1. Purpose and Alternatives. The purpose of this study is to determine the feasibility of providing hurricane surge protection for populated areas of the west bank of the Mississippi River, east of the Harvey Canal. The project area is bounded by the Mississippi River on the north and east, by the Harvey Canal and Bayou Barataria on the west, and by the Hero Canal on the south (see Plate 2). Two alternatives were studied in detail. Additionally, three levels of protection: 100-year, 200-year, and standard project hurricane (SPH) were analyzed for one alternative (see Feasibility Report). Hence, a total of five alternatives for accomplishing hurricane surge protection were addressed in detail. Several environmental features were also evaluated. These would serve to reduce or offset environmental losses that could result from using structural measures to provide hurricane protection.

1.1.2. Rationale For The Recommended Plan. Plan 3B, which has a floodgate in Harvey Canal just below Lapalco Boulevard at the SPH level of protection, is recommended. This plan, the least costly alignment that was acceptable to businesses along the Harvey Canal, would provide protection equal to or better than the other plans. The SPH level of protection corresponds to the level of protection already chosen for West Bank areas west of the Harvey Canal. Except for Plan 1, (floodwall/levee along Harvey Canal) Plan 3B, would result in no greater environmental damages than any of the other plans considered; however, Plan 1 is unacceptable to businesses operating along the Harvey Canal (see Feasibility Report).

1.1.3. Environmental Features. The project is designed to use existing rights-of-way and levees wherever possible to minimize environmental damage. Borrow material would be obtained from canals that must be excavated as part of the project plan and borrow sites located in non-wetland pasture. One end of the resulting borrow pond would be graded to 1.0 vertical on 2.0 horizontal for fisheries benefits. Silt curtains would be used during construction at the by-pass channel in the Harvey Canal. Contaminated sediments taken from the cofferdam and the ends of the bypass channel would be removed and hauled to an industrial landfill. The recommended mitigation plan for this project calls for the purchase and management of 312 acres of bottomland hardwoods (BLH) and swamp in the Bayou Bois Piquant finger-ridge area just south of U.S. Highway 90 near the Salvador Wildlife Management Area in St. Charles Parish. This acreage would be licensed to an appropriate agency such as the Louisiana Department of Wildlife and Fisheries (LDWF). Material for levee construction near Oakville would be obtained from the non-wetland pasture area. The existing dike near Oakville would be incorporated into the proposed levee design. Mitigation features would be implemented simultaneously with other project construction. The analyses

indicate that these mitigation measures would offset project-caused wildlife and fishery-related losses (see Mitigation Analysis / Incremental Analysis, Volume II, Appendix C, Section IV).

1.1.4. Environmental Impacts. The Recommended Plan would directly impact approximately 279 acres of wooded lands consisting of 233 acres of drained bottomland hardwoods and 46 acres of wooded swamp. The vast majority of lands that would be directly impacted by construction are already urbanized, agricultural, or have an existing levee on them. Almost all lands that would be enclosed by the proposed protection systems are already enclosed and have been under forced drainage for a number of years. Most of the drained land is urbanized and some is used for farming or grazing. It is assumed that undeveloped drained lands would be developed at a similar rate with or without the proposed protection system. Wooded wetlands would be directly impacted in the area of Hero Canal. Plans 1 and 3B would impact forested land along the Algiers and Harvey Canals. However, Plan 3B would impact a larger forested area along the Harvey Canal due to construction of the outfall channel and a stockpile area for dredged material for future lifts of the levee to bring it to the required grade. There would be temporary adverse impacts to aquatic resources in the area of the proposed floodgate and outfall/bypass channel in Harvey Canal (Plan 3B) during construction. Disturbance of sediments in the Harvey Canal, which is known to contain contaminants, would cause temporary water quality problems in the canals. Approximately 92 acres of non-wetland pasture would be destroyed to obtain borrow material (Plate 9 and 13). There are several structures along the Harvey Canal that may require relocation. Floodwalls and floodgates will be used to minimize relocations.

1.1.5. Threatened and Endangered Species. Based on a Biological Assessment prepared for the Recommended Plan, the U.S. Fish and Wildlife Service (USFWS) concurred with the findings that the proposed project would not affect bald eagles in the area. No other threatened or endangered species in southeast Louisiana would be adversely affected (Walther, personal communication, 1994).

1.1.6. Executive Order 11988. E.O. 11988, Floodplain Management, deals with minimizing or avoiding adverse impacts associated with the base floodplain unless there are no practicable alternatives. The proposed action would not accelerate development of the floodplain for the following two reasons. The action would consist of making an existing levee more substantial in the majority of the project reaches. Also extensive commercial and residential development has already occurred adjacent to the area where a levee does not currently exist. It is possible that the project would discourage development outside the protected area.

1.1.7. Executive Order 11990. E.O. 11990, Protection of Wetlands, has been extremely important in project planning. By following existing alignments and working in developed areas, there would be a very minimal impact to wetlands for a project of this magnitude. Development of wetlands outside the levee system would be less likely to occur. The acquisition, protection, and management of the 312-acre site would mitigate all lost habitat value.

1.1.8. Clean Water Act/Section 404(b)(1) Evaluation. Section 404(b)(1) guidelines were used to evaluate the discharge of dredged or fill material for adverse impacts to the aquatic ecosystem (see Appendix C, Section II). The presence of contaminants in sediments of the Harvey Canal at the site of the proposed floodgate presents the potential for redistribution of those contaminants. Excavation of the material at the ends of the bypass channel as well as excavation of the sediments from the floodgate site could result in significant impacts to the aquatic ecosystem. However, two actions would be taken to minimize the potential for contaminant redistribution. First, the top two feet of material from within the cofferdam and from the ends of the bypass channel would be removed and hauled to an industrial landfill. Second, the utilization of silt curtains around the excavation site at the ends of the bypass channel, as well as the best available technology while excavating the material, would greatly minimize the chances of any significant impacts on the aquatic ecosystem. Contaminated sediments removed from the Harvey Canal and from the ends of the bypass channel would not be deposited in waters of the United States including wetlands. Impacts to wetlands would be mitigated with the acquisition, preservation, and management of at least 70 acres of cypress-tupelo swamp of the 312-acre total wooded area as a component of the overall mitigation plan. The proposed project is specified as complying with the requirements of the guidelines. State Water Quality Certification for the Recommended Plan has been achieved.

1.1.9. Consistency with Coastal Zone Management (CZM) Program. The New Orleans District, U.S. Army Corps of Engineers, has determined that construction of required protective features in conjunction with the proposed West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana (East of Harvey Canal) project is consistent, to the maximum extent practicable, with the guidelines of the State of Louisiana's approved Coastal Zone Management Program. A CZM consistency statement was filed with the Louisiana Department of Natural Resources (see Appendix C). The Coastal Management Division of the Louisiana Department of Natural Resources has agreed with that determination.

1.2. AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

1.2.1. There has been considerable concern that the floodwall/levee along Harvey Canal (Plan 1) could actually increase flooding for businesses along the canal that would be outside of the floodwall. Also, it has been expressed that those businesses would be physically isolated by the floodwall during times of flooding. A floodgate at the southern end of Harvey Canal (Plan 2) would prevent flooding for all these businesses; however, the additional costs to construct such a floodgate and pumping station are much greater than the Plan 3B scenario and the benefits in reduced flood damage would be minimal. Therefore, Plan 2 was not chosen as the Recommended Plan.

1.2.2. Another concern centers on the quantity and quality of storm water pumped from the project area. It was suggested that any additional storm water be pumped to the Mississippi River. This is an issue of local and state concern that should be taken into account as the project area continues to be developed. However, this development would occur with or without the proposed project. Construction of the proposed project would not change the quantity or quality of pumped storm water but would only change the rate and area of discharge. Therefore, this matter should be discussed among the various communities involved and will not be addressed in this EIS. It should be noted that pumping storm water to the river would be a costly treatment of a symptom, not the solution of a problem. If the water is polluted, pumping it into the river only places the symptom elsewhere.

1.2.3. Another area of controversy was the inclusion of the towns of Lafitte and Barataria within a protection system. This alternative was examined initially and found to be economically infeasible and is not discussed in this report.

1.2.4. Early in the study some controversy arose regarding the proposed excavation of material from the Harvey Canal as required in Plan 3B. Testing of sediments in the Harvey Canal revealed contamination by various chemicals and metals. The methods and manner to minimize contaminant release during excavation and disposal was resolved through coordination with the Louisiana Department of Environmental Quality. The decision to relocate the top two feet of materials excavated from the cofferdam and the ends of the bypass channel to an industrial landfill was determined to be the satisfactory solution to both parties.

TABLE 1.3

ENVIRONMENTAL COMMITMENTS
FOR THE RECOMMENDED PLAN
WEST BANK OF THE MISSISSIPPI RIVER
IN THE VICINITY OF NEW ORLEANS, LOUISIANA
- EAST OF THE HARVEY CANAL [1]

APPLICABLE RESOURCE	CONCERN	COMMITMENT	LOCATION IN EIS
Bottomland Hardwood Forests & Wooded Swamp	Wildlife Habitat	Unavoidable habitat losses of these resources will be mitigated by the acquisition and management of about 312 acres of undrained bottomland hardwood and wooded swamp lands in the Bayou Bois Piquant area of St. Charles Parish.	4.3.3
HTRW	Environmental Contaminants	Contaminants will be confined by utilizing a cofferdam for construction of the floodgate in the Harvey Canal. After dewatering, the top two feet of sediments from within the cofferdam will be hauled to an industrial landfill. Also, during construction of the bypass channel, the top two feet of material from the ends of that channel adjacent to the Harvey Canal will be removed and hauled to an industrial landfill. Sediment screens will be utilized during excavation of the material at the ends of the bypass channel to minimize the distribution of contaminants in the water column and sediments in the Harvey Canal. Excavation of the material will be accomplished via mechanical dredge utilizing best management methods to minimize dispersal of particulates during excavation.	4.3.3 & 4.3.5 & 404(b)(1)

[1] Commitment to be met by inclusion in the plans and specifications with subsequent transmittal to the field.

2. TABLE OF CONTENTS

3. NEED FOR AND OBJECTIVES OF ACTION

3.1. STUDY AUTHORITY

The project was authorized by resolutions adopted November 10, 1965 and May 6, 1966 by the Committee on Public Works of the United States Senate, and by resolutions adopted May 5, 1966 and October 5, 1966 by the Committee on Public Works of the U.S. House of Representatives. The text of these resolutions is quoted in the Feasibility Report. The purpose of the study is to determine the feasibility of providing hurricane protection to that portion of the west bank of the Mississippi River east of the Harvey Canal.

3.2. PUBLIC CONCERNS

The public is concerned about the present inadequate hurricane surge protection in the project area. Local and Federal levees exist in the area, but they are deficient in grade and cross-section to the extent that flooding occurred in October - November, 1985, during minimal hurricane Juan. During the scoping process, governmental agencies, organizations, and private citizens expressed the desire that environmental impacts associated with increased hurricane protection be minimized. In addition, the Harvey Canal Industrial Association (HCIA) expressed the desire that access to their businesses not be blocked from the canal or land areas by the protection system.

3.3. PLANNING OBJECTIVES

The following planning objectives were established in response to the identified problems, needs, and opportunities. These include 1) provide adequate hurricane protection to that area of the West Bank of the Mississippi River in the vicinity of New Orleans east of the Harvey Canal; 2) maximize the project's contribution to the nation's economic development by reducing hurricane-related flood damages; and 3) minimize adverse impacts to the natural environment and to the social well-being of those individuals located in the project area.

4. ALTERNATIVES

4.1. PLANS ELIMINATED FROM FURTHER STUDY

4.1.1. The Feasibility Report presents a detailed description of the alternative plans considered and eliminated during the study. A brief description of those plans is presented in this section.

4.1.2. Two alternative alignments were considered parallel to Peters Road along Harvey Canal. One was a floodwall from Harvey Lock to Hero Pumping Station, while the other was a combination of floodwalls and levees (Plan 1). The complete floodwall plan was eliminated because of substantially greater costs with no added benefits.

4.1.3. Plan 2 requires a floodgate at the end of Harvey Canal along with a new pumping station (Plate 4). This plan was eliminated because of excessive costs for this alternative when compared to other alternatives and because it produced the greatest adverse environmental impacts except for Plan 3E.

4.1.4. Plan 3A, 3C, and 3D are almost identical to Plan 3B except for some minor alignment differences east of Harvey Canal and the proportion of levee to floodwall (see Feasibility Report). These alternatives add little or no benefits and would cost more than Plan 3B.

4.1.5. Plan 3E would have a floodgate at the end of Harvey Canal and an outfall canal from Cousins pumping station to the floodgate rather than a new pumping station as in Plan 2. Locating the structure at the end of Harvey Canal would increase costs considerably over other Plan 3 plans and would produce little increase in benefits. This alternative also resulted in the greatest environmental impacts.

4.1.6. Plan 4 consists of levee upgrading and construction of a floodgate structure in the Gulf Intracoastal Waterway (GIWW) below the junction of the Algiers and Harvey Canals (Plate 7). A large pumping station at the floodgate structure would be needed. The plan includes upgrading the existing Harvey Canal/Bayou Barataria Levee to the Estelle Pumping Station. This alternative was eliminated because of excessive costs of the structure in the GIWW.

4.2. FUTURE CONDITIONS WITH NO FEDERAL ACTION

4.2.1. Without implementation of the proposed project, it is probable that flooding as a result of inadequate hurricane protection would continue to occur, especially in the area immediately east of the Harvey Canal. Social and economic impacts would continue to involve individuals

affected directly by flooding and persons who pay higher flood insurance because of the inadequate protection system. With completion of the second expanse of the Crescent City Connection bridge, development of the West Bank project area may increase, thereby increasing the possibility of major flood damage resulting from a hurricane.

4.2.2. Most of the area would continue to be developed because it is leveed and under forced drainage. This would result in the development of wooded sites into cleared sites..

4.3. PLANS CONSIDERED IN DETAIL

4.3.1. For a detailed description of the alternatives, see the Feasibility Report.

4.3.2. Plan 1: Floodwall/Levee Parallel to Peters Road. A combination floodwall and levee would be constructed along Peters Road from the Harvey Lock to the Hero Pumping Station, with levee upgrading from the Hero Pumping Station to the Algiers Lock (Plate 3). From the Algiers Lock, levee upgrading would occur along the Algiers and Hero Canals to the vicinity of Highway 23 near Oakville (Plate 6). At end of the Hero Canal, a levee would be constructed. The new levee would connect with the existing Plaquemines Parish levee approximately 0.4 mile south of Hero Canal. Three levels of protection, Standard Project Hurricane (SPH), 200-year and 100-year were considered. This alternative encroaches on businesses along Peters Road, but it is one of the least expensive alternatives to construct. The alignment follows existing levees wherever possible. The majority of the material for the levees would be obtained from a borrow site near the Hero Canal which would consist of approximately 92 acres. Mitigation would be included.

4.3.3. Plan 3B: Floodgate in Harvey Canal. A navigable floodgate and outfall channel would be constructed in the Harvey Canal approximately 3,600 feet south of the Lapalco Boulevard Bridge (Plate 5 and Plate 6). It would connect to the levee on the west side of Harvey Canal and then to a proposed levee and floodwall on the east side. This would eliminate the need for a large portion of the proposed floodwall and/or levee along Harvey Canal in Plan 1. It would also eliminate the need for the previously authorized floodwall on the west side of Harvey Canal (Water Resources and Development Act of 1986). A new outfall channel would be excavated to connect the Cousins Pumping Station with the Harvey Canal, and the 1st Avenue drainage canal leading from the Harvey Pumping Station to the Cousins Pumping Station would be enlarged. Material for levee construction would come from a site near the west end of the Hero Canal. The material excavated for the construction of the temporary bypass channel will be utilized to construct the levee, but any excess will be stockpiled adjacent to the levee and utilized in the three planned lifts required for levee construction. The Cousins Pumping Station would be enlarged. The top two feet of material

from the Harvey Canal bottom and banks at each end of the bypass channel, as well as from within the cofferdam used for construction of the floodgate, would be excavated and hauled to an industrial landfill. All other features would remain the same as with Plan 1. Mitigation as described in paragraphs 4.3.5 and 4.3.6.11, as well as Appendix C, Section IV would be included.

4.3.4. Operation and Maintenance. Maintenance of any plan would consist of mowing levees and annual inspection and repair of the levees, floodgate, floodwalls, etc., along the entire alignment and any necessary vector control.

4.3.5. Mitigation. All existing levees have been incorporated into the design wherever possible. All borrow material would be obtained from non-wet pasture areas within existing levees as shown on Plate 9 and 13. One end of the resulting borrow area would be graded to 1.0 vertical on 2.0 horizontal for fisheries benefits. Silt curtains would be used in the Harvey Canal at each end of the bypass channel adjacent to the Harvey Canal during construction of Plan 3B. The plans described below were considered to compensate for unavoidable adverse impacts to fish and wildlife resources. Mitigation needs were determined by the Habitat Evaluation System (HES) and the Habitat Evaluation Procedures (HEP). A comprehensive analysis of the mitigation process including the basis for the determination of needs according to HES is presented in Appendix C, Section IV. The analysis process of the U.S. Fish and Wildlife Service is included in Appendix D, Fish and Wildlife Coordination Report.

4.3.6. Compensatory Mitigation Alternatives

4.3.6.1. Backfilling Canals

4.3.6.1.1. 404(c) Canals. This mitigation alternative consists of backfilling abandoned oil and gas canals in an area adjacent to the Gulf Intracoastal Waterway on the designated Environmental Protection Agency (EPA) 404(c) area (Plate 24). This is the 3,200-acre Bayou aux Carpes site located southwest of the study area where, with three exceptions, disposal of dredged or fill material is prohibited by the EPA. The disposal could be allowed on the 404(c) area under an EPA directive that states, "The third exception is discharges associated with projects with the sole purpose of habitat enhancement and specifically approved by EPA." These canals and their banks presently have moderate wetland and wildlife and fisheries habitat value. The value could be increased by degrading the spoil banks to create areas that would have the same surface elevation as surrounding wetlands. Up to about 12 acres of productive wetlands could be created in this way. This plan was derived only to compensate for habitat losses from construction of the Oakville levee.

4.3.6.1.2. Other Canals. There are several abandoned canals and slips that could be backfilled in the Barataria and West Barataria Oil and Gas Fields, located southwest of Oakville. These areas would not require approval from the EPA. Costs would be similar to the 404(c) plan, but the work would be done farther from the levee construction site. As with 4.3.6.1.1., this plan was derived only to compensate for habitat losses from construction of the Oakville levee.

4.3.6.2. Wetland Creation. This mitigation plan calls for canals to be filled with dredged material from an adjacent waterway to an elevation conducive to the growth of wooded swamp species. The same canals mentioned above for the backfilling plan would be used for this alternative. This plan was developed to mitigate for impacts to undrained swamp only.

4.3.6.3. Backfilling Canals and Wetland Restoration. This plan combines the backfilling and the wetland creation plans. The existing dredged material banks would be utilized as retaining dikes during dredging and disposal operations. After the dredging and disposal are completed, the existing levees would be degraded and the material would be added to the bank material deposited already in the canal.

4.3.6.4. Plantings on 404(c). Native vegetation such as baldcypress, Drummond red maple, etc., could be planted on specific sites of the EPA 404(c) area that have been damaged by disturbance (right-of-way (ROW) maintenance) in the past.

4.3.6.5. Bayou Bois Piquant Mitigation Plan. Bottomland hardwood (BLH) and swamp areas in the Bayou Bois Piquant finger-ridge area in St. Charles Parish would be purchased and licensed to the LDWF or other appropriate agency (Plate 25). The purchase of BLH in this same area was recommended in the West Bank of the Mississippi River, in the Vicinity of New Orleans, Louisiana, Feasibility Report and Environmental Impact Statement (1986) (Westwego to Harvey Canal) mitigation plan. The area has been identified for preservation by the Louisiana Nature Conservancy and other groups concerned with natural resources in Louisiana.

4.3.6.6. Plantings Along Canals. Trees could be planted along one side of Bayou Barataria and other larger bayous and canals draining into it. The planting would be limited to one or two rows of trees at best because of limited ROW.

4.3.6.7. Mitigation on Federal Lands. The U.S. Coast Guard and U.S. Naval Air Station facilities east of Algiers Canal were checked as possible mitigation areas. Officials at both facilities were not interested in mitigation being conducted on those lands.

4.3.6.8. Expanded Algiers Canal Levee Berm. Expanding one levee berm along Algiers Canal and planting trees was also investigated. Inadequate ROW and substantial increases in cost of levee construction made this plan impractical.

4.3.6.9. Bayou Barriere Mitigation Area. This plan consists of the purchase, and reforestation of 87 acres and management of 257 acres of BLH adjacent to the proposed borrow site (Plate 24). If the complete borrow site is not used, the remainder could be used for mitigation.

4.3.6.10. Bayou Segnette Mitigation Area. This plan involves the purchase and reforestation of land adjacent to the Bayou Segnette State Park (Plate 25). This area would be maintained as a buffer zone for the state park.

4.3.6.11. Compensatory Mitigation for the Recommended Plan. The purchase and conservation of undrained BLH and swamp (312 acres) in the Bayou Bois Piquant finger-ridge area is the recommended mitigation plan. This plan would completely mitigate the loss of 116 annualized habitat units of BLH and swamp as a result of project construction. It would maintain the entirety of a high-quality wetland area as some development is projected for the area without the proposed action which is based upon historical happenings in the area, there would be no net loss of wetland values and functions, and it meets the goal of being the most cost-effective mitigation plan.

4.3.7. Implementation Responsibility. The Federal Government would prepare detailed designs, plans, and specifications and bear 65 percent of the final cost. Non-Federal interests would provide lands, easements, and rights-of-way, accomplish all relocations, hold and save the U.S. free from damages, provide all interior drainage, and operate and maintain all features.

4.4. COMPARATIVE IMPACTS OF ALTERNATIVES

Table 4.4 describes in comparative form, the base conditions, the impacts of No Action and the detailed plans on significant resources, and plan economic characteristics. More detailed information on the impacts described in these tables is presented in Section 5, Environmental Effects.

TABLE 4.4
COMPARATIVE IMPACTS OF ALTERNATIVES

ALTERNATIVES	EFFECTS ON SIGNIFICANT RESOURCES			
	BOTTOMLAND HARDWOODS	SWAMP (UNDRAINED)	AQUATIC RESOURCES	T/E SPECIES
BASE CONDITION	Approximately 11,300 acres existed within the area afforded protection by the hurricane protection project in 1989. Acreage provides excellent habitat.	Approximately 124 acres of swamp are located in the area south of the Hero Canal. Unpermitted fill activities have destroyed much of the adjacent swamp.	Approximately 1,200 acres of open water are of low-to-moderate fishery value because of fair-to-poor water quality and low habitat diversity.	The bald eagle is the only T/E species occurring on or near the project area. Three nests are within 5-10 miles of the proposed work.
NO-ACTION	Losses of approximately -1.258% per year would occur due to development. Approximately 7,700 acres would remain in 2020 and 3,300 acres would remain in 2090. Decline in habitat acres would produce corresponding decline in wildlife populations.	Swamp would be lost by subsidence and saltwater intrusion. Implementation of proposed Hero Canal and authorized Davis Pond freshwater diversion projects would reduce the amount of swamp lost due to saltwater intrusion.	Average salinity in waters outside the levees would increase slowly over time resulting in a shift to greater dominance by estuarine species. Urban runoff would continue to be a detriment to water quality.	Eagles have increased in numbers in coastal Louisiana in recent years. Urban sprawl will extend into possible ranges of eagles in the future as populations of eagles and urban areas increase.
PLAN 1 100-yr	Same as No Action, but with 63 additional acres lost due to new levee construction and upgrade of existing levees. 25 AAHUs lost. Would be mitigated.	Approximately 44 acres of cypress swamp south of the Hero Canal would be lost over No Action. 21 AAHUs lost. Would be mitigated.	Similar to no action. Approximately 92 acres of open water would be created that would provide low to moderate quality habitat for fish.	USFWS agreed that there would be no effect upon the eagle provided that work is restricted in certain areas during the nesting season.
PLAN 1 200-yr	Same as No Action, but with 74 additional acres lost due to levee construction and upgrading. 30 AAHUs lost. Would be mitigated.	Approximately 45 acres of cypress swamp would be lost over No Action. 21 AAHUs lost. Would be mitigated.	Similar to Alt. 1 100-yr.	Same as Alt.1 100-yr.
PLAN 1 SPH	Same as No Action, but with 86 additional acres lost due to construction and levee upgrade. 35 AAHUs lost. Would be mitigated.	Approximately 46 acres of cypress swamp would be lost over No Action. 21 AAHUs lost. Would be mitigated.	Similar to Alt. 1 100-yr.	Same as Alt.1 100-yr.
PLAN 3B SPH	Same as No Action, but with 233 additional acres lost due to construction, levee upgrade, stockpile area, and Outfall Channel. 95 AAHUs lost. Would be mitigated.	Approximately 46 acres of cypress swamp would be lost over No Action. 21 AAHUs lost. Would be mitigated.	Similar to Alt. 1 SPH with disturbance to 2-3 acres in the Harvey Canal. Some amount of contaminant release and associated toxicities to aquatic organisms would occur with work in Harvey Canal. Silt curtains would be used to minimize impacts.	Same as Alt.1 100-yr.

TABLE 4.4 (continued)
COMPARATIVE IMPACTS OF ALTERNATIVES

ALTERNATIVES	EFFECTS ON SIGNIFICANT RESOURCES
	CULTURAL RESOURCES
BASE CONDITION	There are no National Register of Historic Places properties currently on record within the project area. Fifteen historic sites, three standing structures and two shell deposits have been recorded as a result of cultural resources investigations undertaken within the project area. Ten of the historic sites are located east of the Algiers Canal and are located along the Mississippi River. Five historic sites and 3 historic standing structures are west of the Algiers Canal, near the confluence of the Harvey Canal and the Mississippi River.
NO-ACTION	Unrecorded historic properties that may exist in the project area would continue to be adversely affected by present and future industrial expansion and urban developments. If population of the area increases, there is greater potential that historic properties would be vandalized or unknowingly destroyed. Natural forces, such as erosion, would continue to affect fragile historic properties.
PLAN 1 100-yr	Similar to Alt. 1 SPH, but with less impact because of decreased amount of acreage to be disturbed; less impact than Alt. 1 200-yr.
PLAN 1 200-yr	Similar to Alt. 1 SPH, but with less impact because of decreased amount of acreage to be disturbed; greater impact than Alt. 1 100-yr.
PLAN 1 SPH	The proposed Peters Road floodwall should have no effect on significant historic properties. The levee upgrade proposed along the Algiers Canal (GIWW alternate route) was previously surveyed in 1975. This canal lies away from any of the deltaic distributary ridges mapped in the project area. The Algiers Canal is an artificial channel dredged from the former freshwater swamp. Because of the absence of an associated natural channel, and because of the swampy environment of deposition, the occurrence of in situ archeological deposits within the proposed levee upgrade would be unusual. The proposed Oakville levee section should have no impact to significant cultural resources. Archeological investigations were undertaken within portions of the proposed borrow pit site; no evidence of in situ archeological deposits were encountered during the testing.
PLAN 3B SPH	Cultural resources investigations were recently completed as part of this study. These investigations focused on three features presented in the Recommended Plan. These sites include the Harvey Canal navigation bypass channel and control structure, the Oakville connecting levee, and a proposed borrow pit north of the Hero Canal. Archival research was incorporated with these investigations to develop land tenure histories and to aid in the interpretation and evaluation of identified historic archeological sites in each of these three areas. The navigation bypass channel and control structure feature will not impact significant cultural resources.

TABLE 4.4 (continued)
COMPARATIVE IMPACTS OF ALTERNATIVES

ALTERNATIVES	EFFECTS ON SIGNIFICANT RESOURCES		
	RECREATION	NOISE, AIR QUALITY, AND ESTHETICS	HTRW
BASE CONDITION	Primary public outdoor recreation areas in the vicinity include: Jean Lafitte National Historic Park and Preserve, Bayou Segnette State Park, and Salvador Wildlife Management Area (WMA). Passive or non-consumptive activities that occur in the area include levee walking, jogging, golfing, and nature study. Consumptive recreational activities are predominantly hunting, fishing, and crawfishing.	Noise in area is from land, waterborne, and aircraft traffic. Much aircraft noise emanates from the U.S. Naval Air Station. La DEQ 1987 info reported there were no violations of state air quality standards in New Orleans. Most of area is heavily developed but remaining forested areas as well as some waterways provide some amount of esthetics to the area.	Significance is from possible negative effects to the human environment and resulting in potential financial liability responsibility. Heavy industrial use of canals and surrounding area has resulted in concern.
NO-ACTION	Wetlands in Salvador WMA and other wetlands surrounding the project area would continue to be lost due to erosion and subsidence; thus, recreational opportunities, including hunting and fishing, would be reduced.	With growth an increase in noise is expected as well as some deterioration of air quality. Esthetic quality would be reduced with the development of forested areas.	Area would continue to be industrialized. More stringent regulations may result in cleaner environment. Substances in canals would continue to be moved by prop washes and wakes of moving vessels.
PLAN 1 100-yr	Limited short-term adverse impacts would occur to recreational use of the levee due to disruption caused by construction activities. Lost man-days of sport hunting will be replaced within or by the mitigation area. Construction of the floodwall would not affect recreational resources.	Construction would result in increased levels of noise caused by construction equipment during daylight hours. Noise would be annoying to nearby building occupants. Air quality standards should not be violated. Esthetic quality would be reduced over the short term but would be near the same over the long term. Enclosure of existing wooded lands would be replaced by expansiveness of levee.	Any contaminants attached to sediments or soil would be moved during construction. Floodwall construction would result in little effects regarding movement of any possible contaminants. Levee / floodwall routing through longer distance of heavy industrialized use would seem to result in increased chances of encountering contaminants than would other plans.
PLAN 1 200-yr	Similar to above.	Similar to above.	Similar to above.
PLAN 1 SPH	Similar to above.	Similar to above.	Similar to above.
PLAN 3B SPH	Similar to Plan 1 SPH, user-day losses would be greater with the additional loss of wooded lands	Similar to above, but would not extend to area above proposed floodgate. Noise around floodgate area would extend for longer duration.	Similar to above, other than the reduced area (of the floodwall,) but work around floodgate would move some contaminants in the canal. These are not at levels to be considered as hazardous wastes, but some of the material would be transported to an industrial landfill. Also, the reduced area for floodwall would result in a reduction of the likelihood of encountering any contaminants or HTRW.

TABLE 4.4 (Continued)

COMPARATIVE IMPACTS OF ALTERNATIVES

SOCIOECONOMIC IMPACT MATRIX

	Alternatives		
	No Action	1	3B
Land Use	+	+	+
Property Values	+	+	+
Business/Industrial Activity	+	+	+
Employment	+	+	+
Displacement of People 1/	-	+	+
Housing	+	+	+
Community Growth	+	+	+
Tax Revenues	+	+	+
Public Facilities & Services	+	+	+
Displacement of Farms	o	-	-
Noise	o	-	-
Esthetic Values	o	-	-
Community Cohesion	o	+	+
Regional Growth 2/	+	+	+

++ positive impact
+ slight positive impact
o no impact
- slight negative impact
-- negative impact

1/ Temporary displacements due to periodic flooding may occur, but permanent relocations are not anticipated.

2/ The New Orleans metropolitan area is expected to grow at the same rate with or without the project.

TABLE 4.4 (Continued)
COMPARATIVE IMPACTS OF ALTERNATIVES

ECONOMIC SUMMARY

Plan	Average Annual Benefit ($1,000)	Average Net Costs ($1,000)	Net Benefit ($1,000)	B/C Ratio
West of Algiers Canal				
1 100-yr	36,876	6,716	30,160	5.49
1 200-yr	37,893	8,447	29,449	4.49
1 SPH	37,970	9,205	28,764	4.12
3B SPH	41,245	10,370	30,875	3.98
East of Algiers Canal				
* 100-yr	2,476	745	1,730	3.32
* 200-yr	2,717	1,021	1,695	2.66
* SPH	2,718	1,417	1,301	1.92

* All alternatives follow the same alignment in this area.

5. AFFECTED ENVIRONMENT / ENVIRONMENTAL CONSEQUENCES

5.1. GENERAL ENVIRONMENTAL CONDITIONS

5.1.1. The study area (approximately 36,000 acres) lies within Jefferson, Orleans, and Plaquemines Parishes on the west bank of the Mississippi River. It is bounded by the Mississippi River to the north and east, by the Harvey Canal and Bayou Barataria on the west, and by the Hero Canal and the Plaquemines Parish levee on the south (Plate 2). Harvey, Algiers, and Hero Canals are included in the study area. Much of the area is highly urbanized and includes the U.S. Naval Air Station (Alvin Callender Field). Almost all land within the proposed hurricane protection system has some type of hurricane protection in place. Flooding from the Mississippi River is prevented by the mainline levee system.

5.1.2. The project site is located on the Mississippi River alluvial plain in the Barataria Basin. Elevations range from 10.0 to 15.0 feet National Geodetic Vertical Datum (NGVD) along the natural levee of the Mississippi River to several feet below sea level. Flooding occurs from water originating in the Gulf of Mexico that travels across marshes and the numerous natural and man-made channels south of the project area. Levees have been constructed in the area but are inadequate for many storm events. The area near the Harvey Canal has been especially prone to flooding. Most of the area within the existing levee system has already been developed, but there are still about 11,300 acres of forested areas remaining. Much of the forested area, although under pump, is still considered wetland. Aquatic sites offer low-to-moderate habitat value to fish and other aquatic organisms.

5.1.3. The study area represents an important portion of the New Orleans Metropolitan Statistical Area (MSA). The study area had a population of 127,436 compared to 1,288,816 in the MSA in 1990, or about ten percent of the total population. The main employers in the study area are the port and commercial and manufacturing industries.

5.1.4. The project impact area is defined as any lands that would be directly or indirectly changed by the proposed construction. The forthcoming sections describe the effects of no action and action alternatives on significant resources. A comparison of the impacts of the alternatives are given under each resource category.

5.1.5. Drainage of almost all of the New Orleans area is accomplished by pumps since a large portion of the area is below sea level. Since pumping has begun, the removal of water from the underlying subsurface has resulted in varying amounts of subsidence. Although pumping causes subsidence it is obvious that the adverse effects of flooding are considered to be more unacceptable to the great majority of New Orleanians than the adverse affects of

subsidence. An explanation of the effects of pumping on study area subsidence requires an understanding of water stages in the canals. The canals leading to the Cousins Pumping Station are very significant to the study area. Mr. Dan Modianos, an authority on pump designs, pumped drainage, and pumped drainage systems in the New Orleans area, is a consultant to the Jefferson Parish Department of Public Works (personal commuinication). Mr. Modianus explains that it is the intent that the drainage system be operated to try to maintain the level of the water in the canals that keeps subsidence at a minimum. Dry weather conditions are the primary factor that is used in determing the canal water levels. The drainage canals in the area of the Cousins Pumping Station are maintained from 10.0 to 10.5 feet Cairo Datum. This is equivalent to -10.0 to -10.5 ft. NGVD. This level is necessary to prevent dewatering of soils, to prevent earthen canal bank and concrete sloping failure, and to maintain the necessary relationship between the storm sewer system and the sanitary sewer system to prevent infiltration between the two systems. The two systems must be kept at very near the same levels to minimize problems. Thus, whatever pumping capacity that is utilized to evacuate stormwaters in hurricane and other storm periods has essentially nothing to do with the level of the canals in dry weather conditions. The non-flood water levels of those canals, in addition to the soils native to the area and the retained soil moisture, are the factors most consequential to subsidence in the New Orleans area.

5.2. SIGNIFICANT RESOURCES

5.2.1. Introduction. A resource is considered to be significant if it is identified in the laws, regulations, guidelines, or other institutional standards of national, regional, and local public agencies; or if specifically identified as a concern by local public interests; or if judged by the responsible Federal agency to be of sufficient importance to be designated as significant (Table 5.1). In addition, other specific statutes not listed in this table may be considered when establishing the institutional significance of some specific resources. This section contains a discussion of each resource determined to be significant and previously listed in Table 4.4.

5.2.2. Bottomland Hardwoods (BLH).

5.2.2.1. Significance. Bottomland hardwood forests are considered to be significant because of their economic value for forest products and their wildlife habitat value. Bottomland hardwood forests are considered to be the most productive wooded habitats of the nation. They are also considered to be significant because of their wetland characteristics. Bottomland hardwoods are productive ecosystems that are said by many authorities to depend upon water fluctuations for the maintenance of their structure and function (Wilkinson et al., 1987), and are said by others to be ecologically, recreationally, and aesthetically valuable

(EPA.1984). In the following list, the potential wetland functions exhibited by these resources are ranked in descending order of their probability and extent of occurrence on a nationwide scale (from Adamus and Stockwell, 1983).

1. Passive recreation and heritage value
2. Habitat for aquatic wildlife and fisheries
   Sediment trapping (short term)
   Ground water discharge
3. Nutrient retention (short term)
   Food chain support (nutrient export)
   Dissipation of erosive forces
   Active recreation potential
4. Flood desynchronization
   Food chain support (of clearly food-limited species of commercial sport value)
5. Nutrient retention / removal (long term)
6. Sediment trapping (long term)
   Shoreline anchoring
7. Ground water recharge

BLH occur to a limited extent in the area of the proposed levee south of Hero Canal, along the northern portion of the Algiers Canal, and at the location of the bypass/outfall canal along the Harvey Canal. There are small tracts located outside existing levee or dike systems that retain fairly natural drainage characteristics and exhibit more wetland characteristics than others in the study area. In 1989, there were approximately 11,300 acres of BLH in the study area. Almost all of the BLH have been leveed and pumped for a number of years and have lost much of their non-habitat wetland value and functions. However, some (approximately 39%) of the acreage is still classified as wetland under the three-parameter approach (Federal Interagency Committee for Wetland Delineation, 1989). This determination was reviewed using the 1987 parameters and there was no significant change in area. Also, a large portion of the remaining BLH has been segmented into parcels with reduced functional value. Of the 10 wetlands functions and values listed by Adamus et al. (1987), all have been reduced in their effectiveness because of levees and pumping, and some, such as groundwater recharge and discharge, have virtually been eliminated. The BLH areas become periodically saturated or flooded during heavy or extended rainfall events. However, the effects of pumping are demonstrated by deep subsidence (1-2 ft) around the bases of trees and the condition of leaf litter. Most of these woodlands are dominated by Drummond red maple, green ash, black willow, and sugar-berry, with occasional baldcypress, Nuttall oak, and American elm. The forested area west of the Harvey Canal is a drained cypress swamp under rapid transition to BLH. For this report, this area is considered to be BLH. Cattle grazing occurs on some of

TABLE 5-1
ATTRIBUTES OF SIGNIFICANT RESOURCES

RESOURCE	ECOLOGICAL ATTRIBUTES	CULTURAL ATTRIBUTES	AESTHETIC ATTRIBUTES
BOTTOMLAND HARDWOODS	Valuable habitat for wildlife including game and non-game species; provide several non-habitat wetland functions.	Supports the traditional extractive economy of the Barataria basin. Also protects archeological and historic sites located within these areas.	Provides escape from concrete and steel of urbanization.
SWAMPS	Valuable habitat for fish and wildlife, especially wading birds and furbearers. Nursery area for fish.	Supports the traditional extractive economy of the Barataria basin. Also protects archeological and historic sites located within these areas.	Typical Louisiana scenery includes moss-draped cypress.
AQUATIC RESOURCES	Numerous species of fish and shellfish utilize project area.	Supports traditional economy of Barataria Basin.	Esthetic values vary within project area.
WILDLIFE	Numerous species of wildlife utilize project area.	Furbearers and waterfowl provided both food and clothing to settlers of area.	Sightings provide interest to inhabitants of area.
ENDANGERED SPECIES	Indicators of man's impact upon environment.	N/A	Sightings are few and memorable.
RECREATION		Jean Lafitte National Historical Park; B. Segnette State Park; & Salvadore WMA nearby.	Pleasing environment, moss-draped trees in lowlands add to interest in this resource.
NATIONAL REGISTER OF HISTORIC PLACES	None	Serves as the Nations official list of properties worth of preservation for significance in American history, architecture, archeology, and culture.	National Register properties near study area.
HTRW	Presence of HTRW reflects negatively on many organisms. Existence is especially manifest through bioaccumulation.	Presence of HTRW reflects negatively on social well-being of area.	Presence of HTRW reflects negatively on perception of area.
SOCIO-ECONOMIC RESOURCES	N/A	Significant reasons for people inhabiting particular areas.	N/A

TABLE 5-2
RECOGNITION OF SIGNIFICANT RESOURCES

RESOURCE	INSTITUTIONAL RECOGNITION	TECHNICAL RECOGNITION	PUBLIC RECOGNITION
BOTTOMLAND HARDWOODS	Water Resources Development Act of 1986, Fish and Wildlife Coordination Act, EO 11990, EO 11988	Habitat for many wildlife species. Present area is small % of original area. Fairly rare in Barataria Basin.	Public strongly desires preservation of this resource.
SWAMPS	Coastal Zone Management Act of 1972, La State and Local Coastal Resources Mgmt. Act of 1978, EO 11990, EO 11988, Protection of Cypress Trees (La EO 1980-3)	Habitat for many wildlife species	Public strongly desires preservation of this resource.
AQUATIC RESOURCES	Clean Water Act of 1977, La. Water Control Law, Estuary Protection Act, Fish & Wildlife Coordination Act.	Nursery area.	
WILDLIFE	Fish and Wildlife Coordination Act	Ten species of special interest in project area.	Resource is of importance to consumptive and to non-consumptive users.
ENDANGERED SPECIES	Endangered Species Act, Bald Eagle Act	Bald eagle nest located near project area.	High degree of interest in resource.
RECREATION RESOURCES	Land and Water Conservation Fund Act of 1965	Various facilities exist which currently satisfy numerous user-days of recreation annually.	High demand for recreation in and near urban areas.
NATIONAL REGISTER OF HISTORIC PLACES	National Historic Preservation Act of 1966, as amended; the Reservoir Salvage Act of 1960, as amended; EO 11593; Archeological Resources Protection Act of 1979.		Public recognition and support of historic preservation is strong, reflecting national trends.
HTRW	RCRA, CERCLA, E.O. Order 12088, State of La. safety and health regulations (40 CFR 1920), OSHA stndrd 29 CFR 1910.120	Contaminants (not at HTRW levels) have been found in the area of the proposed action.	Public expects protection from hazardous materials.
SOCIO-ECONOMIC RESOURCES	River and Harbor Flood Control Act, National Environmental Policy Act.	Significant potential benefits to area residents.	Social concerns and items affecting area economy are of significant interest to community.

the BLH in the project area, reducing the habitat quality of these areas. Although previous discussion emphasizes that wetland values are significantly lost when these forests are drained, by no means does this mean that the wildlife habitat value becomes insignificant under these conditions. Predominant species utilizing the area may change somewhat; however, bottomland hardwood forests not receiving seasonal inundation still maintain a diversity of floral and faunal species. Habitat value for many species is actually increased because of the increased cover that is present in areas not receiving frequent inundation. A diversity of wildlife species are present within or adjacent to the study area and potential mitigation area. The bottomland hardwoods forests provide habitat for many game and non-game species such as deer, squirrel, rabbit, and song birds. The habitat value of these areas is reduced as they are parceled into smaller contiguous areas. Most of the land within the study area, and along the proposed alignments in particular, has lost value because of development, levees, and pumping. However, large tracts of woodlands are located on and near the U.S. Coast Guard Station at English Turn and the U.S. Naval Air Station at Belle Chasse (see Plate 23).

5.2.2.2. No Action. Calculations based on the loss rate of BLH from 1978-1989 give projections for future acreage of BLH (Table 5.2). The projections are calculated from a loss rate of -1.258 percent per year. U.S. Fish and Wildlife Service calculations from 1956-1978

TABLE 5.2
ESTIMATED ACREAGE OF BLH IN PROJECT AREA OVER PROJECT LIFE

Year	Acres	Gross Loss (Acres)
1989	11,320	NA
1994	10,760	560
2000	9,966	1,354
2020	7,717	3,603
2050	5,260	6,060
2095	2,959	8,361

photographs gave a similar loss rate for BLH. Demand for residential and commercial property will continue to deplete BLH in the study area, especially with completion of the new span of the Greater New Orleans Bridge. Public and private development in the area will occur because of its location and the existence of levees and pumps. Permitting requirements because of the presence of wetlands, should not change development trends in this area from the past, as almost any sizeable development in the New Orleans area, would

encounter wetlands. Health of the local economy and need for a particular project will be the driving forces behind development. Some of the BLH south of Hero Canal would likely be lost to an operating landfill/recycling plant. Remaining wooded lands will continue to be developed (e.g. English Turn), but fairly sizeable tracts of forested area should exist for at least another 50 years. The recently completed span of the Crescent City Connection will probably make the area attractive for development for some time in the future. Because some forested areas would continue to remain for the next 100 years, there always would be limited habitat for wildlife. The overall acreage of wildlife habitat would continue to decrease as would the quality as the remainder is segmented and parceled by development. It is estimated that forested areas will decrease about 70.0 percent from 1994-2094. The area of proposed levee construction near Oakville would continue to provide habitat for swamp rabbit, woodpecker, etc., unless possible development occurs there.

5.2.2.3. Plan 1 100-yr. It is estimated that 63 acres of BLH potentially would be lost directly to levee construction and upgrading with an associated 25 annualized habitat unit value (AHUV) above the losses that would occur with continued development and with no Federal action. Losses would occur along the Algiers and Harvey canals, and at the Oakville area (see Plates 3 and 6). The AHUV is a unit that expresses habitat value over a given analysis period and is a product of the Habitat Evalustion System (HES) developed by the Corps of Engineers and is readily accepted for use in the Lower Mississippi Valley. The USFWS Habitat Evaluation Procedures (HEP) were also utilized and the analysis is described in detail in Appendix D. All losses of habitat value would be mitigated.

5.2.2.4. Plan 1 200-yr. Same as 100-yr, except 74 acres with an associated estimated 30 AHUV would be lost to levee construction and upgrading. All losses of habitat value would be mitigated.

5.2.2.5. Plan 1 SPH. Same as 100-yr, except 86 acres with 35 AHUV's would be lost to levee construction and upgrading. All AHUV losses would be mitigated.

5.2.2.6. Plan 3B SPH (Recommended Plan). Same to Plan 1 SPH, but with additional losses where the outfall channel, stockpile area, and floodgate would be installed in the Harvey Canal. A total of 233 acres with 95 AHUVs would be lost. Losses due to levee upgrading within the existing right-of-way were accounted for in the Westwego to Harvey Canal project. All AHUV losses would be mitigated.

5.2.3. Swamp

5.2.3.1. Significance. Wooded swamps, in this region, derive their significance from non-habitat wetland values, as well as habitat values. Swamps contribute particularly significantly to fishery habitats, since inundation of sufficient duration to enable successful spawning is more likely to occur in swamps than in the other forest resource described in this document. Dissipation of erosion forces and shoreline anchoring are also primary reasons for significance of this resource in the project area. A swamp area of approximately 124 acres lies south of the Hero Canal and outside of the area potentially protected by the proposed project. The swamp's overstory is dominated by baldcypress and red maple. The understory contains palmetto, red maple, and waxmyrtle. A variety of birds utilize the swamp including great white egrets, little blue heron, snowy egrets, black-crowned night herons, and various song birds. Other wildlife such as otter, raccoon, and mink may inhabit the swamp. The swamp provides habitat for aquatic organisms such as crayfish and also exports detrital material into adjacent marshes, enhancing their productivity.

5.2.3.2. No Action. Over a period of years, subsidence and erosion would cause a reduction in the size of the swamp and a change in the community towards a saline influenced marsh community. The remaining swamp would continue to provide habitat for a variety of wetland organisms. Permitted and unpermitted fill activities and the upgrading of parish levees are both real possibilities that could impact the habitat quality of the swamp. Permitted fill activity in the swamp could occur, provided a need for the particular project is proven. Currently, an operating landfill/recycling plant is located in the Oakville levee vicinity.

5.2.3.3. All 100-yr Plans. Approximately 44 acres of swamp with an associated 21 AHUVs south of the Hero Canal would be impacted due to levee construction. Realignment of the levee and incorporation of a local levee avoided impacting an additional 46 acres. All AHUV losses would be mitigated.

5.2.3.4. All 200-yr Plans. Same as 100-year, except 45 acres of swamp with an associated 21 AHUVs would be impacted. All AHUV losses would be mitigated.

5.2.3.5. All SPH Plans. Same as 100-year, except 46 acres of swamp with an associated 21 AHUVs would be impacted. All AHUV losses would be mitigated.

5.2.4. Aquatic Resources

5.2.4.1. Significance. There are approximately 1,230 acres of canals, ponds, and bayous within the study area. Flow is sluggish to non-existent in many of the smaller canals except

during and shortly after a rain. Most of the water bodies are designed and function for human uses. Many of the smaller water bodies become choked with aquatic vegetation during the summer and some are subjected to large variations in flow because of their drainage function. The Harvey and Algiers Canals are used heavily for navigation and portions are heavily industrialized, leading to conditions of poor water quality. Navigation can lead to deleterious effects on larval fish (Pearson et al., 1989). These two canals receive almost all discharged stormwater for the entire project area, allowing pollutants in rainfall runoff to accumulate in these canals. The Louisiana Department of Environmental Quality (LDEQ) has identified high concentrations of several metals, polychlorinated (PCB's) biphenyls, and polynuclear aromatic hydrocarbons (PAH's) in the sediments of the Harvey Canal. There are some contaminants (e.g. mercury and nickel) that have been found in elutriate tests to be above EPA chronic toxicity criteria (EPA, 1986), and mercury has been detected in elutriate concentrations above EPA acute toxicity criteria (EPA, 1986) in the Harvey Canal and the Algiers Canal (see Appendix C, Sections I and VIII). Elutriate analyses done on samples taken in 1987 showed that mercury could pose the greatest problem when bottom sediments are dredged (Eisler, 1987) (see Appendix C, Sections I and VIII). Several forms of mercury can be expected to occur, from relatively inert inorganic mercury to the alkyl or methyl mercury, which is formed by microbes in aerobic conditions. The latter form is actively bioconcentrated by aquatic organisms and is particularly toxic to man (Peakell and Lovett, 1972). Mercury concentrations at three out of four stations where elutriate analyses were conducted (see Appendix C, Sections I and VIII) ranged from 3.72 to 6.35 parts per billion (ppb), which is well above the acute toxicity criterion of 2.4 ppb for the Algiers Canal set by EPA (USEPA, 1986). The fourth station nearest the Mississippi River had concentrations below the EPA acute criterion. The values were progressively higher in the direction of the Harvey Canal, indicating the probable source of the pollution. Water quality improves in the direction of the Mississippi River and the Gulf Intracoastal Waterway near its intersection with Hero Canal. Benthic organisms are probably dominated by species of midges and oligochaetes, which are adapted to the soft substrates and are often tolerant of pollutants. Fish are represented by a mixture of fresh and saltwater species, including gar, striped mullet, gizzard shad, and bay anchovy, depending on the water body. Numbers and biomass of fish are probably low because of pollutants and poor habitat. Fishery resources are minimal in this heavily industrialized area.

5.2.4.2. No Action. Physical conditions in the various canals within in the project area would change very little over the life of the project. Pollutants would continue to enter the aquatic system from surrounding residential/industrial areas, thereby causing on-going water quality problems. As residential/industrial development continues, there will probably be an increase in pollutant levels in the canals. Legislation requiring improvements in both point and nonpoint source discharges may alleviate some water quality problems. Contaminants in

the sediments of Harvey and Algiers Canals would remain indefinitely unless the sediments are disturbed or removed. Approval from the LDEQ to disturb these sediments would be required. The canals outside the levee system would have a slow rise in mean salinity so that brackish conditions would be more likely to occur in the next century. Species composition and number of organisms would be slowly changed with estuarine organisms becoming more dominant. Implementation of proposed freshwater diversion projects could limit or reduce this rise in mean salinity.

5.2.4.3. Plan 1 (All Levels). Original plans for constructing the levees included borrow material being taken from adjacent canals. Contaminants in the canal bottoms precluded the use of the canals as a source of borrow. Elimination of the canal bottoms as a borrow source has reduced adverse impacts to water quality. The excavation of borrow pits to obtain material for construction would result in creation of aquatic habitat. Even though the sides of these borrow pits would be sloped to increase its fishery value, these areas would have low to moderate habitat value for most fish species. Adverse impacts to water quality would occur when earthen fill runs off the construction site into adjacent waterbodies. This impact should be minor and short-term, depending on rainfall and local site conditions. Construction of the levee in the swamp near Oakville, if adjacent borrow is used, would adversely impact the water quality in the swamp. Suspension of organics, clays, and other earthen material during construction of the levee would increase turbidity, decrease dissolved oxygen levels, and result in other adverse impacts to water quality (see Appendix C, Water Quality). With the cessation of construction activities, water quality should return to ambient conditions. These impacts would occur with each of the three lifts required to construct the levee. Increasing hurricane protection may encourage residential or industrial development to give equal consideration to developing in areas with equal hurricane protection. Pollutants generated by new development would decrease stormwater quality in the project area, including the Harvey and Algiers Canals. Construction of any level of protection for Plan 1 would not directly cause a significant decrease in water quality in the project area.

5.2.4.4. Plan 3B SPH (Recommended Plan). Water quality impacts, due to construction of the Oakville levee and runoff from the levee as described in Plan 1, would occur with construction of this alternative also. However, borrow material would come from the open area site. A sheet pile cofferdam would be constructed around the proposed location of the floodgate so that excavation at the site would be done in the dry. Initial construction of the cofferdam would disturb some sediments in the canal bottom, but this should have a minimal adverse impact on aquatic resources. Water pumped from inside the cofferdam during construction would have a temporary adverse impact on water quality. The removal of the top 2 feet of material after construction from within the cofferdam area and transporting to an offsite industrial landfill would remove this material from future use by organisms within the

Harvey canal. Excavation of the bypass channel would release contaminants absorbed and adsorbed in the sediments. However, the silt curtains to be employed around the proposed work area in the Harvey Canal at each end of the bypass channel would limit the area of impact. Suspended sediments would be concentrated near the dredge. Fish and other aquatic organisms could succumb in the area near the dredge due to acute mercury poisoning if actual concentrations (as a result of construction activities) reach as high as in the elutriate tests. The potential release of additional toxic concentrations of cadmium, nickel, and lead, also exists. Construction by the use of mechanical rather than hydraulic dredge would minimize the dispersion of any contaminants. Relocation of the Cousins Pumping Station discharge canal would relocate impacts associated with the discharge of stormwater runoff. The increased rate of discharge of stormwater from the increase in size of that structure would result in some greater dispersal of pollutants into the Harvey Canal from urban runoff. The same impacts resulting from continued development in the project area as described for Plan 1 (all levels) would also occur for this alternative.

The Toxicity Characteristic Leaching Procedure (TCLP) was performed on sediment samples to assess the risk of contaminated leachates returning to the canal or into local storm water drainage systems from the excavated sediments. Results of the tests (see Appendix C, Section VIII) indicated that leachates from the material should not pose a danger to the environment.

5.2.5. Threatened and Endangered Species

5.2.5.1. Significance. Although the project area lies within the range of several endangered and threatened animal species (Florida panther, Eskimo curlew, Arctic peregrine falcon, Bachman's warbler, and ivory-billed woodpecker), the only species noted by the U.S. Fish and Wildlife Service during informal consultation as occurring on or near the project area was the bald eagle. There are three nests located 5-10 miles from the proposed work areas, and one located within one mile. Transient individuals may also occur in the study area. The American alligator also occurs in the study area, and is listed as threatened due to similarity of appearance. A regulated harvest of alligators is permitted in Louisiana. A recent (March, 1994) request to the USFWS, again in informal consultation, as to the original question of the presence of any species or critical habitat that may be affected by the proposed action resulted again in the affirmation that the bald eagle would be the only species that may be affected by the proposed action. (Walther, David, USFWS, personal communication, March 18, 1994)

5.2.5.2. No Action. The bald eagle has been increasing in numbers in recent years in coastal Louisiana due to increased public concern, successful nesting attempts of late caused by the

effectiveness of restrictions on pesticides usage, and protection provided by the Endangered Species Act. Development of urban areas will continue to spread into possible territories of eagles nesting near those areas. With a continued concern for locating future development with the eagle in mind, it is quite likely that eagle populations will continue to increase in coastal Louisiana.

5.2.5.3. All Plans. A letter from the U.S. Fish and Wildlife Service in April 1988 stated that there were bald eagle nests located within 10 miles of the projected work areas. A Biological Assessment was prepared by the COE that determined the project would not adversely impact bald eagles (see Appendix C, Section V). The U.S. Fish and Wildlife Service concurred with these findings by letter, dated October 6, 1988, and November 8, 1989, following some additional project modifications (Bettinger, Kim, 1989, personal communication). Subsequent to receiving these letters, a pair of bald eagles constructed a nest within approximately one mile of a portion of the project area planned for levee upgrading. Another Biological Assessment dated May 19, 1992, was sent to the USFWS addressing impacts to this new nest site. By letter dated June 11, 1992, USFWS concurred that no impact would occur to the nest provided no work would occur in this area during the nesting season. Copies of the Biological Assessment and USFWS correspondence are in Appendix C.

The proposed work would not impact populations of the American alligator in or near the project area.

5.2.6. Recreation

5.2.6.1. Significance. The land use of the area existing within the project boundaries is largely urban and industrial. Very little water-oriented recreation exists within the project zone of influence. Recreational activities within this urban setting can be categorized as non-consumptive or passive: walking, driving, and sightseeing. Pedestrian access to the levee in the vicinity of the Gulf Intracoastal Waterway and Hero Canal is extremely limited due to its isolation from roadways and areas of public access. Recreational sport fishing and boating are limited in the GIWW due to the existence of large vessel traffic and other more desirable fishing and boating areas in the vicinity.

Due to the open rural environment in the vicinity, outdoor recreational opportunities existing west of the Harvey Canal and adjacent to the project are predominantly fishing and hunting. Hiking, bird watching, and many other nature-oriented activities also occur. Three major recreational areas of significance exist on the west bank, including the Lake Salvador Wildlife Management Area, the Jean Lafitte National Historic Park, and the Bayou Segnette State Park.

5.2.6.2. No Action. Outdoor recreational opportunities in the project area would not increase in the future due to limited access and lack of existing recreational facilities. Recreational areas in the vicinity of the project area would experience increased use in the future and possibly some expansion of facilities.

5.2.6.3. Plan 1 100-yr. Limited adverse impacts would occur to the recreation environment due to the potential conversion of approximately 100 acres of bottomland hardwood and swamp land to project use. Use of pasture, bottomland hardwood forest, and wooded swamp, which serve as borrow areas, would impact recreation. Potential hunting use would be decreased by loss of land due to project implementation. Most of the work would be accomplished within the existing right-of-way, with the exception of the new levee at Oakville and the borrow areas. Short-term minimal impacts would be imposed on existing recreational activities occurring on the levees, such as walking, jogging, birdwatching, and nature study. There would be localized turbidity in the Intracoastal Waterway during work; however, sport fishing, which is limited in this corridor, would experience minimal impacts. Development of the floodwall would not affect recreational resources. The borrow area following project construction would provide limited fishery habitat. Fishing and other recreation opportunities (bird watching, photography) would be created by the construction of the borrow pit.

5.2.6.4. Plan 1 200-yr. Similar to above.

5.2.6.5. Plan 1 SPH. Similar to above.

5.2.6.6. Plan 3B SPH (Recommended Plan). Impacts imposed by this plan are similar to those of Plan 1; however, due to construction of the structure in Harvey Canal, approximately 47 additional acres of forested land would be transformed into project land. This additional acreage loss, combined with the impacts imposed within Plan 1 above, impact hunting use of the area. All other impacts including those affecting non-consumptive recreational use would be the same. Loss man-days of bird watching, nature study, and sport hunting, will be replaced within or by the mitigation area.

5.2.7. Cultural Resources.

5.2.7.1. Significance. There are no National Register of Historic Places properties currently on record within the project area. Fifteen historic sites, three standing structures and two shell deposits have been recorded as a result of cultural resources investigations undertaken within the project area. Ten of the historic sites are located east of the Algiers Canal and are located along the Mississippi River. Five historic sites and 3 historic standing structures are

west of the Algiers Canal, near the confluence of the Harvey Canal and the Mississippi River. The natural waterways situated within the project area were important to the region. Distributary channels formed important routes of transportation while the adjacent levees provided suitable landforms for settlements, fortifications and access to the area's abundant natural resources. Agricultural concessions were initially granted along the rivers. However, manmade waterways provided for important economic developments, such as sawmills and brick kilns, during the Plantation through Modern Industrial eras.

5.2.7.2. No Action. Unrecorded historic properties that may exist in the project area would continue to be adversely affected by present and future industrial expansion and urban developments. If population of the area increases, there is greater potential that historic properties would be vandalized or unknowingly destroyed. Natural forces, such as erosion, would continue to affect fragile historic properties.

5.2.7.3. Plan 1 100-year. This alternative would have less impact than the 200-year level alternative (see Section 5.2.7.5).

5.2.7.4. Plan 1 200-year. This alternative would have less impact than the SPH level; less acreage would be disturbed (see Section 5.2.7.5).

5.2.7.5. Plan 1 SPH. The proposed Peters Road floodwall should have no effect on significant historic properties. The Louisiana State Historic Preservation Officer (SHPO), in a letter dated 13 December 1988, concurred with the Corps of Engineers that a cultural resources survey would not be warranted prior to floodwall construction. In addition, construction monitoring is not required (see Appendix C, Section IX).

The levee upgrade proposed along the Algiers Canal (GIWW alternate route) was previously surveyed in 1975. This canal lies away from any of the deltaic distributary ridges mapped in the project area. Two sites, 16PL40 and 16PL41 were identified as a result of the 1975 survey. These sites were evaluated during the current feasibility study. Both 16PL40 and 16PL41 were demonstrated to represent modern shell deposits mixed with modern debris deposited as bankline protection following the construction of the waterway during the 1950s. Each site was assessed using National Register of Historic Places criteria [36 CFR 60.4 (a-d)]. Site 16PL40 and 16PL41 are considered ineligible for nomination on the National Register of Historic Places. The Algiers Canal is an artificial channel dredged from the former freshwater swamp. Because of the absence of an associated natural channel, and because of the swampy environment of deposition, the occurrence of in situ archeological deposits within the proposed levee upgrade would be unusual.

5.2.7.6 Plan 3B SPH (Recommended Plan). Cultural resources investigations were recently completed as part of this study. These investigations focused on three features presented in the Plan. These sites include the Harvey Canal navigation bypass channel and control structure, the Oakville connecting levee, and a proposed borrow pit north of the Hero Canal. Archival research was incorporated with these investigations to develop land tenure histories and to aid in the interpretation and evaluation of identified historic archeological sites in each of these three areas. No significant cultural resources were encountered during the investigation. No further work was recommended. The SHPO concurred with the recommendations by letter dated August 15, 1991 (see Appendix C, Section IX).

The Harvey Canal is an artificial channel dredged from what was formerly swamp. The canal was constructed between 1839 and 1845 by Nicholas Noel Destrehan. Destrehan's daughter, Louisa Destrehan Harvey, purchased the canal and property through a series of succession sales of her father's estate in 1848. Industrial developments along the canal included brick kilns and saw mills. These were located in close proximity to the Mississippi River. Further away from the river, the property along the canal was left undeveloped. In 1924, the Harvey descendants sold the canal to the Federal Government. The area along the canal has existed as a maintenance right-of-way, with restricted land use in anticipation of future canal development. Activities along the lower portion of the Harvey Canal appear to have been limited to fishing and trapping. The navigation bypass channel and control structure feature would not impact significant cultural resources.

The proposed new levee northwest of Oakville should have no effect on significant historic properties. A cultural resources survey and archival research was conducted to identify and evaluate cultural resources within the proposed alignment as part of this current feasibility study. The Oakville levee lies at the distal end of the Mississippi River natural levee. The project area crosses marshland that has been owned by a number of parties through the years but has seen little activity that would be reflected in the archeological record. The upriver portions of the site were part of New Hope/Cedar Grove Plantation. The plantation structures were located upriver from the proposed levee site, above the present-day Hero Canal. A portion of the site was planted in sugar cane, but much of the land remained pastureland and marshland. The cultivated area between the community of Cedar Grove and Oakville gave way to marshland over the years. The proposed Oakville levee section should have no impact on significant cultural resources.

The proposed borrow site situated north of Hero Canal consists of formerly forested swamp. Concession Bayou, which extends as a bifurcating drainage within the borrow area probably is one of several partially buried deltaic distributaries which may contain thick natural levee deposits. The earliest archeological deposits that could be present would be those of the

Tchefuncte or Marksville cultures. The proposed borrow pit was situated in a remote portion of a land grant made on August 12, 1789, by Estevan Miro, the Spanish governor of Louisiana, to Francisco Bouligny. The area appears to have remained undeveloped throughout most of its history due to marshy conditions. Cultural resources investigations were conducted within approximately 44 percent of the total borrow pit area during 1990. Six auger tests were excavated within the proposed borrow pit site to determine the stratigraphic nature of these deposits and whether evidence of buried archeological resources were present. No evidence of in situ archeological deposits were encountered during the testing.

5.2.8. Noise, Air Quality, and Esthetics

5.2.8.1. Significance. Noise in the study area is generated by various forms of traffic and industrial developments. The noise generated by planes going to and from the U.S. Naval Air Station impacts a large zone around the facility. Boat traffic in the Hero, Algiers, and Harvey Canals is an additional source of noise for areas adjacent to these canals. Noise probably varies between 50-80 decibels in most of the project area. Based upon ambient air quality data from 1987, collected by the Louisiana Department of Environmental Quality (1987), there were no violations of state air quality standards at monitoring stations in New Orleans, indicating that air quality in the study area is fairly good.

Most of the area is heavily developed and industrialized, but the remaining large forested tracts do retain a fairly high quality esthetic value. Esthetic conditions, predominately in the areas of the Algiers Lock and the Hero Canal, are enhanced by the vegetation enclosure created by numerous cypress, tallow, maple, and willow trees lining the bankline and paralleling the protected side of the levee. Individuals walking these levees have the opportunity to encounter a positive visual experience through the existence of various vegetation varieties. The opportunity exists to further enhance esthetic conditions through the occasional spotting of aquatic and terrestrial wildlife. Within the peaceful isolation of selected levee areas, the potential for viewing the movement of boat and barge traffic within the waterways enhances the esthetic experience.

5.2.8.2. No Action. With the anticipated residential and business growth that will occur in the project area, noise levels would increase slightly. Noise, primarily from aircraft from the U.S. Naval Air Station, would continue to occur. Air quality would worsen slightly as development continues, but violations of state air quality standards are not expected to occur. Forested areas would continue to be cut and developed (see Table 5.2), reducing the esthetic quality of the study area.

5.2.8.3. Plan 1 (All Levels). Noise levels would increase temporarily over the without-project conditions in the areas of construction. The number of residences and businesses impacted by construction at various noise levels are shown in Tables 5.3-5.7 for the alternatives at SPH level of protection. The other levels of protection would give very similar results. Construction workers would have protective hearing devices. Since construction would take place during daylight hours, sleep interference would be minimal. The noise could be annoying to workers and inhabitants in the identified buildings. Levee construction would result in higher dBA, but impacts would be of shorter duration than with floodwall construction. EPA has a limit of 85 dBA for eight hours of continuous exposure to protect against permanent hearing loss. Noise above this level would not occur for periods longer than eight hours. There would be temporary, minor adverse impacts to air quality near construction areas. Exhausts from construction equipment and dust from moving equipment would occur during construction. No violations of state air quality standards are expected to occur because of project work. Esthetics would be adversely impacted in the short-term due to the temporary loss of linear vegetation lining the bank line and land side of the levee. The feeling of enclosure created by bankline vegetation will diminish and the protection provided to wildlife will be lost, however, in time, volunteer vegetation will become established and return some of the lost habitat and visual quality. Temporary short-term impacts would also occur due to the presence of mud, machinery, and other equipment associated with construction.

TABLE 5.3

NOISE EXPOSURE (days) FOR PLAN 1 LEVEES

DISTANCE * (feet)	BUILDINGS (number)	DECIBELS			
		102-107	96-102	90-96	84-90
0-50	20	3.6	3.8	7.0	15.6
50-100	60	-	5.7	9.0	15.3
100-200	168	-	-	11.7	16.4
200-400	241	-	-	-	23.4

* Measured from the center of the levee/floodwall alignment not the noise source.

TABLE 5.4

NOISE EXPOSURE (days) FOR PLAN 1 FLOODWALLS

DISTANCE (feet)	BUILDINGS (number)	DECIBELS			
		95-105	89-95	83-89	77-83
0-50	45	6.7	6.7	13.5	26.8
50-100	104	-	10.1	16.0	27.5
100-200	100	-	-	20.8	32.0
200-400	129	-	-	-	41.6

TABLE 5.5

NOISE EXPOSURE (days) FOR PLAN 3B LEVEES

DISTANCE (feet)	BUILDINGS (number)	DECIBELS			
		102-107	96-102	90-96	84-90
0-50	20	3.6	3.8	7.0	15.6
50-100	60	-	5.7	9.0	15.3
100-200	168	-	-	11.7	16.4
200-400	241	-	-	-	23.4

TABLE 5.6

NOISE EXPOSURE (days) FOR PLAN 3B FLOODWALLS

DISTANCE (feet)	BUILDINGS (number)	DECIBELS			
		95-105	89-95	83-89	77-83
0-50	3	6.7	6.7	13.5	26.8
50-100	2	-	10.1	16.0	27.5
100-200	3	-	-	20.8	32.0
200-400	2	-	-	-	41.6

TABLE 5.7

NOISE EXPOSURE (days) FOR FLOODGATE CONSTRUCTION
(PLAN 3B)

DISTANCE (feet)	BUILDINGS (number)	DECIBELS			
		102-107	96-102	90-96	84-90
0-50	0	650	-	-	-
50-100	0	-	650	-	-
100-200	1	-	-	650	-
200-400	2	-	-	-	650

5.2.8.4. Plan 3B. Impacts to air quality and esthetics would be the same as described above for Plan 1. Noise impacts would also be similar. Construction of floodgates as proposed in Plan 3B would result in extended, localized noise impacts for a few businesses near the construction site (Table 5.7).

5.2.9. HTRW

5.2.9.1. Significance. HTRW is significant because of the possible negative effects upon the environment including the human environment. The ever-increasing knowledge and interest in knowledge of the adverse effects of man-made products upon the environment is of significant public concern. Far-reaching legislation has been promulgated that has had the effect of categorizing; significantly regulating; and establishing responsibility, including financial liability, for wastes. The area of both the Harvey and Algiers Canals is heavily industrialized and has been the object of concern regarding this issue.

5.2.9.2. Effects of No Action. The area would continue to be industrialized. Substances including those that are in concentrations sufficient to be regulated that are in the soils adjacent to the canals would leach through the soil and into groundwater as their characteristics and those of the soil particles dictate. Substances that are in the canal sediments would be disturbed by prop washes and wakes from boat traffic moving through the canals. These substances also would move through groundwater as their characteristics

dictate, however, most substances adhere to sediments. Digging would disturb the materials and would release them into adjacent and possibly other areas.

5.2.9.3. Effects of Plan 1 (all levels). Any substances contained within the soil of the area would be transported as that soil is moved to another location as required by levee construction. Movement of any soil containing these substances would spread the effects of the particular substance. Several permit violations and spills have been recorded by the Louisiana Department of Environmental Quality from industries between Lapalco Boulevard and the Harvey Lock. The construction of the project in this area would involve some amount of risk of encountering problems with contaminants and/or hazardous wastes. Simply because of the nature of the industries, i.e., barrel washing, barge cleaning and painting, etc., the chance of producing and, thus, encountering contaminants is high. However, movement of substances within the soils of the area would be minimal by construction of the floodwall since driving of floodwall sheetpiles would require a minimal amount of earth movement.

5.2.9.4. Effects of Plan 3B. The effects of this plan would be similar to the previous plan with the following exceptions or additions. Since no work would be done from the area of the proposed floodgate to the Harvey Lock, no impacts would occur by project construction in that area. The construction of the cofferdam for the floodgate within the canal would include excavating the top two feet of canal bottom after dewatering and transporting that material to an industrial landfill. The canal bottom and adjacent bank edge at each end of the bypass channel beside the floodgate would also be excavated similarly and would also be transported to an industrial landfill. Sampling of the Harvey Canal sediments have indicated that the sediments do not contain contaminants at the levels to be categorized as hazardous wastes. A bulk soil analysis was done for soil samples taken for the area of the bypass channel and levee adjacent to the floodgate as well as nearby areas for background comparison purposes. Analysis showed that none of the samples exceeded values that would categorize the material as hazardous wastes although all samples did contain some amount of contaminants. It was agreed in a March 16, 1994, meeting with representatives of the DEQ that the materials would be relocated to an industrial landfill. Even though the materials to be relocated are not categorized as hazardous wastes, special handling would be implemented to insure that no unnecessary contamination of the human environment occurs. The material would be hauled in accordance with all applicable regulations in effect at the time of hauling. Movement of the materials would result in some amount of release to the surrounding area, either through canal or ground water.

5.2.10. Socioeconomic Resources

5.2.10.1. Land Use

5.2.10.1.1. Significance. The lands considered for additional hurricane protection are within a 35,000-acre leveed area along the west bank of the Mississippi River, extending southward from a point near the Harvey Canal in Jefferson Parish, along the lower coast through Orleans Parish, to the Hero Canal below Belle Chasse in Plaquemines Parish. Jefferson, Orleans, and Plaquemines Parishes are part of the New Orleans Metropolitan Statistical Area (MSA), which also includes St. Bernard, St. Charles, St. John the Baptist, St. James, and St. Tammany Parishes. (Plaquemines and St. James Parishes were added to the MSA in 1993.) Most of the area's 22,000 acres of urban developments are above the Gulf Intracoastal Waterway (GIWW) alternative route. Most of the remaining 11,300 acres of forested or undeveloped lands are below the GIWW alternate route, along with an estimated 800 acres of agricultural land.

The area below the GIWW includes two large tracts of land currently used for a U.S. Coast Guard Reservation and a U.S. Naval Air Station (Alvin Callender Field), which also includes about 4,500 acres of undeveloped land. Residential communities include Harvey, Gretna, Algiers, Terrytown, and Algiers above the GIWW, and Belle Chasse below the GIWW.

The recently completed twin span of the Crescent City Connection bridge has created the potential for the future development of remaining vacant lands below the GIWW. Much of the land used for industrial development is located along the river. In 1990, the New Orleans Planning Commission approved a land-use plan for the lower coast of Algiers that allocated 1,000 acres to be developed as part of an upscale urban development called English Turn, and another 2,600 acres to become available for non-English Turn Development. The plan includes locations for major streets, sites for schools, fire stations, and district police headquarters, and industrial development that will border the Mississippi River at the Intracoastal Waterway Cutoff Canal. Eventually, 35,000 to 40,000 people are expected to live on the Lower Coast. A 900-acre golf course and recreation complex has already been completed, along with approximately $50 million in residential activity. Table 5.8 gives a breakdown of land usage by acres for 1989 in the project area.

5.2.10.1.2. No Action. Without Federal action, the general pattern of land use within the project area should continue. Recent improvements in the transportation network, the continuation of residential construction activity, and the performance of the local economy are the most important factors that will affect development in the study area. Between 1985 and

TABLE 5.8
LAND USAGE BY ACRES*
WESTBANK - EAST OF HARVEY CANAL
1989

Land Use	No. of Acres
Forested	11,324
Urban	22,550
Agricultural	811
Open Water	1,232
Total Study Area	35,917

* Note: The number of acres and its usage was estimated from infrared photography.

1990, approximately 700 forested acres were developed into urbanized areas. During this period, the Belle Chasse area (Reach F) population showed a slight increase despite the decline in the local economy. Also during this period, the area south of Lapalco Boulevard (Reach D) experienced a population increase of 68%. Construction continued in two upscale subdivisions: Stonebridge in Reach D, and English Turn in Reach E. Given these recent growth trends, it is reasonable to assume that development in the area will continue with or without the project, and not conflict with Principles and Guidelines 25 and Executive Order 11988.

5.2.10.1.3. All Plans. The alternative plans considered would provide hurricane surge protection for both developed and undeveloped areas of the study area. As indicated previously, some 22,000 acres, or more than 60 percent of the area has already been developed. Future residential and commercial development is expected to continue, with or without the project in place. In the economic analysis, future development projections are based on the continuation of past historical trends and land availability. Thus, while future development is expected to occur in the study area, it is based on non-project related growth.

5.2.10.2. Property Values and Housing

5.2.10.2.1. Significance. Table 5.9B shows the change in the total number of housing units for the three parishes that make up and surround the study area. Although housing prices in the metro area generally showed a downward trend during the mid to late 1980's, they have increased between 6% and 7% per year since 1990. According to the Real Estate Market

TABLE 5.9B
CHANGE IN HOUSING UNITS
JEFFERSON, ORLEANS, AND PLAQUEMINES PARISHES *
1980 TO 1990

PARISHES	1990 CENSUS HOUSING UNITS	1980 CENSUS HOUSING UNITS	HOUSING UNIT CHANGE
JEFFERSON	185,072	166,124	**18,948
ORLEANS	225,573	226,055	-482
PLAQUEMINES	9,432	9,490	-58
TOTAL	420,077	401,669	18,408

SOURCE: U.S. Department of Commerce, Bureau of the Census

* The 1990 Census estimate for vacant housing units in Jefferson and Orleans Parishes was 19,207 and 38,174, respectively. Estimates for Plaquemines Parish were not available.

** The growth in housing units mainly occurred on the East Bank of Jefferson Parish.

Analysis prepared by the University of New Orleans, the price of an average house in the metro area increased from a low of $82,613 in 1990 to an all time high of $98,789 in 1993. By national standards, however, the prices of homes in the New Orleans area still remain 20% or more below the national average. The highest average sales price in the metro area was recorded in the English Turn area. Housing sales in this community averaged $550,000 during the first nine months of 1993.

During the past year, there has been a shift in the real estate market throughout the area to purchases of larger homes. If the market continues its recovery and the demand for larger houses increases, there exists the potential for the average price of a house in the area to rise above $110,000. However, this price increase will only be sustained if employment gains occur in the metro area.

After nearly a decade of falling occupancy rates and rents, the apartment market has also stabilized and has begun to improve. The average occupancy rate in the metro area increased

from 90.3% in mid-1993 to almost 91.5% by the end of the year. Apartment occupancy ranged from 88.5% in Orleans Parish to 92.7% in Jefferson Parish. These rates are expected to continue rising if employment gains occur due to the construction and opening of a land-based casino. Table 5.10A shows the changes in housing prices during the past year in both the metro and project areas. A comparison of occupancy rates and rents in the apartment complexes of both the study area and the metro area is shown in Table 5.10B.

TABLE 5.10A
SINGLE FAMILY HOUSE PRICES
PRICES BY NEIGHBORHOOD
WESTBANK - EAST OF HARVEY CANAL
12/92 TO 12/93

AREA	AVG. PRICE 12/92	AVG. PRICE 12/93	PERCENT CHANGE
ORLEANS PARISH			
Algiers Point, McDonough	$49,438	$75,055	51.81%
Gen'l Meyer, Behrman	$45,338	$46,091	1.66%
Aurora, Brechtel, Huntlee Village	$85,854	$93,999	9.48%
Lower Algiers, Naval Air Station	$111,120	$88,581	-20.28%*
Lakewood	$135,281	$130,051	-3.86%
JEFFERSON PARISH			
Gretna	$49,428	$57,467	16.26%
Harvey East	$74,995	$83,360	11.15%
South Gretna	$67,338	$68,812	2.18%
Timberlane, Bellemeade, Terrytown	$69,927	$80,709	15.41%

METRO PARISHES	AVG. PRICE 12/92	AVG. PRICE 11/93	
Orleans, Jefferson, St. Bernard, St. Charles, St. John, St. Tammany	$94,879	$101,073	1.5%

SOURCE: Real Estate Market Analysis, University of New Orleans, Vol. XXI, Jan. 1993.

* The sharp change in the number of luxury homes in the English Turn development, being mixed in with the smaller, older houses in the surrounding areas of Lower Algiers.

TABLE 5.10B

COMPARISON OF OCCUPANCY RATES AND RENTS
IN APARTMENT COMPLEXES
WESTBANK - EAST OF HARVEY CANAL
1/93 - 6/93 VS 6/93 - 12/93

AREA	OCCUPANCY CURRENT	OCCUPANCY PRIOR	PERCENT CHANGE	AVG.RENT PRIOR	AVG.RENT CURRENT	PERCENT CHANGE
ORLEANS PARISH						
Algiers	84.60%	86.34%	-1.74	$372	$380	2.1
JEFFERSON PARISH						
Harvey Canal East	89.27%	89.93%	-0.66	$377	$376	-0.2
METRO AREA						
ALL	91.47%	90.26%	1.21	$429	$429	0.0

SOURCE: Real Estate Market Analysis, University of New Orleans, Vol. XXI, July 1993.

5.2.10.2.2. No Action. While the construction of housing in the affluent market, particularly English Turn, is an encouraging sign for the future, the stability of the overall housing market will depend on the economic vitality of the larger community, with or without the hurricane protection project in place. There are four main factors that will affect the future housing market. First, the continuation of lower interest rates and tax incentives for first time home owners will keep housing affordable. Second, the large number of vacant housing units created by shifts in the population could have an adverse affect on surrounding property values. The impact of this problem will be lessened if population trends change or if these structures are renovated similarly to many homes in the Algiers Point community. Third, the employment gains generated the advent of gaming in the metro area, and the potential employment gains generated by the passage of the North American Free Trade Agreement (NAFTA) could increase job growth and thereby increase the effective demand for housing. Finally, fluctuations in the national economy will have an effect on the local housing market.

5.2.10.2.3. All Plans. The project would provide hurricane surge protection to both existing residential communities and to future developments. The English Turn complex in Reach E should encourage future development in adjacent areas, without or with the project. The rural setting, as well as the improved access to vehicular traffic between the New Orleans Central

Business District (CBD) and the Lower Coast Algiers and Belle Chasse areas should be major factors promoting future growth.

5.2.10.3. Business/Industrial Activity and Regional Growth

5.2.10.3.1. Significance. The Westbank economy is largely centered around the port and related commercial and manufacturing activities; mineral production, particularly in Plaquemines Parish and, in recent years, growing tourist and health services industries. Most of the heavy industries in Jefferson Parish are located along the Harvey Canal of the Westbank. This industrial base has attracted retail sales and services to the area. In addition to shipbuilding, grain transport and storage, and other port activities, the Westbank and adjacent coastal areas have been major sources of natural gas, petroleum, sulfur, and salt, as well as fish and shellfish. Tables 5.11A, B, and C provide a breakdown of commercial occupancy rates by office, retail, and warehouse markets.

TABLE 5.11A
OFFICE BUILDING OCCUPANCY AND RENTS
WESTBANK
FALL 1992 TO FALL 1993

AREA	OCCUPANCY 11/92	OCCUPANCY 11/93	OCCUPANCY CHANGE	RENTS 11/92	RENTS 11/93	% CHANGE
ORLEANS PARISH						
Westbank	67.8%	70.9%	3.1%	$8.30	$8.43	1.6%
JEFFERSON PARISH						
Westbank	82.7%	74.5%	-8.2%	$9.73	$9.52	-2.2%

SOURCE: Real Estate Market Analysis, University of New Orleans, Vol. XXI, JAN 1994.

TABLE 5.11B
RETAIL OCCUPANCY
WESTBANK
NOVEMBER 1992 TO NOVEMBER 1993

AREA	OCCUPANCY 11/92	OCCUPANCY 11/93	OCCUPANCY CHANGE
ORLEANS PARISH			
WESTBANK	70.4	68.3%	-2.1%
JEFFERSON PARISH			
WESTBANK	90.0%	88.0%	-2.0%

SOURCE: Real Estate Market Analysis, University of New Orleans, Vol. XXI, Jan. 1994.

TABLE 5.11C
WAREHOUSE OCCUPANCY
WESTBANK
NOVEMBER 1992 AND OCTOBER 1993

AREA	OCCUPANCY 11/92	OCCUPANCY 11/93	OCCUPANCY CHANGE
ORLEANS PARISH			
WESTBANK	67.8%	64.3%	-3.5%
JEFFERSON PARISH			
WESTBANK	67.9%	80.9%	13.0%

SOURCE: Real Estate Market Analysis, University of New Orleans, Vol. XXI, July 1994.

The economic downturn of the past decade left a large surplus of commercial space. The absorption of this space increased during the first half of 1991 with the strengthening of the local economy. However, low occupancy rates and rents still characterize the office, retail, and warehouse markets on the Westbank, particularly in Algiers and Gretna. New and larger commercial construction will gain only at the expense of older and smaller buildings.

5.2.10.3.2. No Action. The opening of the twin span of the Crescent City Connection bridge and the completion of the elevated Westbank Expressway will continue to benefit commercial activity in the area. The Oakwood Shopping Center has undergone extensive renovation during the past few years, and this was highlighted by the opening of the new Maison Blanche store. This shopping mall currently has the most retail space of any shopping center in the New Orleans area.

The establishment of a more diversified economy to offset declines in the oil and gas industry is important for future economic growth. Port activity along the Harvey Canal and the expansion of the tourist and health services industries will be major factors in promoting future economic growth. Employment gains from improvements in the local economy could reduce the excess square footage that exists in the office, retail, and warehouse markets.

5.2.10.3.3. All Plans. Commercial growth is expected on the undeveloped land of the study area with the implementation of any action alternative, as well as, with the no-action alternative. As vacant land in the study area is converted to residential usage, commercial development in the adjacent areas will take place to support the population growth. Businesses and industries located along the Harvey Canal remain unprotected from hurricane surges under the parallel protection plan, Plan 1. Thus, no difference is expected regarding real estate values for a before and after condition. The structure in the canal alternative, Plan 3B, would have an advantage not provided to many industrial sites, protection from flooding, while maintaining waterway access.

5.2.10.4. Employment

5.2.10.4.1. Significance. The entire Westbank project area is part of the New Orleans metropolitan statistical area (MSA). According to a March 1994 report prepared by the Louisiana Department of Labor, the total nonagricultural employment in the New Orleans MSA was estimated to be 573,000 as of February 1994. This represents an increase of 11,600 jobs since February of 1993. The majority of this increase occurred in the health, amusement, and recreation segments of the services industry, which gained an additional 7,500 jobs. Manufacturing, mining, and wholesale and retail trade showed a slight decline. Even though the number of jobs increased during the period, the unemployment rate for the

New Orleans MSA rose from 6.6% in February 1993 to 7.0% in February 1994. The unemployment rate for the state of Louisiana increased from 7.7% to 8.0% during the same period. Table 5.12 provides a summary of the nonagricultural wage and salary employment in the New Orleans MSA.

Table 5.12
New Orleans Metropolitan Statistical Area
Nonagricultural Wage and Salary Employment
(In Thousands by Industry)

Nonagricultural Employment	Feb. 1994	Jan. 1994	Feb. 1993	Net Change from Jan. 1994	Net Change from Feb. 1993
TOTAL	573.0	569.7	561.4	+3.3	+11.6
Manufacturing	47.5	47.4	47.7	+0.1	-0.2
Mining	14.1	14.0	14.4	+0.1	-0.3
Construction	25.2	25.7	24.1	-0.5	+1.1
Transportation & Public Utilities	43.4	42.2	43.0	+1.2	+0.4
Wholesale & Retail Trade	139.0	138.0	139.2	+1.0	-0.2
Finance, Ins., & Real Estate	29.9	29.9	29.2	0	+0.7
Services	171.5	170.5	164.0	+1.0	+7.5
Government	102.4	102.0	99.8	+0.4	+2.6

Source: State of Louisiana, Department of Labor, "Louisiana Labor Market Information". March 25, 1994. Includes data for Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, and St. Tammany Parishes.

While the oil and gas industry is expected to remain stable, tourism and the health services industry are predicted to experience rapid growth during the next two years. Construction, retail trade, and state and local government are also expected to experience employment growth. Employment in the gaming industry will increase as the temporary land-based casino opens in mid-1994, and as more riverboat casinos begin operation.

5.2.10.4.2. No Action. The establishment of a more diversified economy, along with the continued expansion of tourism and health services, is important for future economic growth. With the collapse of the oil and gas industry and the continued decline in manufacturing, the area must create the climate for growth in other sectors of the economy. This growth should be separate from the potential job gains due to gaming construction and employment.

As the 21st century approaches, the unique geographical location of the New Orleans metro area could allow it to take advantage of the increased trade associated with the development of the North American Free Trade Agreement (NAFTA). With proper positioning, the New Orleans metro area could gain a share of the increased north/south commerce generated by the bill and expand its port activities. This could also create the potential for the development of satellite industries connected with the flow of trade.

The 1990 projections for the New Orleans MSA prepared by the Bureau of Economic Analysis (OBERS) were based on historical trends for population, per capita income, and employment. These projections, which are shown in Table 5.13, include only six parishes rather the expanded eight parish area. OBERS projects a compounded annual population growth rate of 0.03% during the 45-year period. The per capita income and employment were projected at 0.9% and -0.2%, respectively, during the same period.

5.2.10.4.3. All Plans. Construction of the hurricane protection levees would temporarily create additional jobs. Hurricane protection would also tend to provide an additional increment of employment stability over the long run. In any case, employment impacts are considered minor.

5.2.10.5. Population and Community, including Displacement of People.

5.2.10.5.1. Significance. Table 5.14 provides the 1980 and 1990 Census Bureau population estimates for the individual communities within the project area.

TABLE 5.13

NEW ORLEANS, LA (MSA)

Population, Per Capita Income, and Employment, 1973-1988, and Projected, 1995-2040

	1973	1979	1983	1988	1995	2000	2005	2010	2020	2040
Population as of July 1 (thousands)	1,1525	1,1238	1,320	1,307	1,304	1,306	1,307	1,312	1,333	1,322
Per capita personal income (1982 dollars)	9,242	11,050	11,373	11,272	12,509	13,383	14,116	14,772	15,862	18,750
	Thousands of Jobs									
Total employment	520.4	616.0	636.9	632.4	654.1	671.0	676.6	674.7	646.4	604.9
Farm	1.4	1.5	1.6	1.4	1.4	1.3	1.3	1.3	1.1	1.0
Nonfarm	518.9	614.5	635.3	630.9	652.7	669.7	675.3	673.4	645.2	603.9
Private	436.5	521.5	535.4	533.9	557.6	574.9	581.7	581.4	558.4	524.2
Agricultural services, forestry, fisheries,	2.1	2.4	2.7	(D)	3.9	4.3	4.6	4.7	4.8	4.7
Mining	(D)	(D)	22.0	(D)	16.4	16.0	15.5	14.9	13.6	11.9
Construction	35.1	45.5	42.7	30.5	29.6	29.2	28.6	27.9	25.9	23.3
Manufacturing	58.3	60.5	51.0	45.2	44.7	44.8	44.5	43.9	41.6	38.3
Nondurable goods	28.3	28.4	24.9	22.0	20.9	20.5	20.0	19.5	18.1	16.3
Durable foods	30.0	32.1	26.0	23.2	23.9	24.3	24.4	24.4	23.5	22.0
Transportation and public utilities	48.2	57.3	53.7	48.0	47.9	48.3	47.9	47.3	44.7	41.3
Wholesale trade	(D)	(D)	38.6	34.4	34.2	34.2	34.0	33.8	32.2	29.9
Retail trade	82.4	104.9	109.0	115.8	120.0	123.9	125.2	125.0	119.7	111.7
Finance, insurance, and real estate	33.8	43.4	46.5	50.0	51.5	52.8	53.2	53.0	50.7	47.6
Services	122.2	145.3	169.1	189.1	209.2	221.3	228.2	231.0	225.3	215.4
Government and government enterprises	82.4	92.9	99.9	97.0	95.1	94.8	93.6	92.0	86.67	79.7
Federal, civilian	33.8	43.4	46.5	50.0	51.5	52.8	53.2	53.0	50.7	47.6
Federal, military	8.6	8.5	9.2	10.1	10.1	10.1	10.1	10.1	10.1	10.1
State and local	60.6	68.9	75.8	71.0	69.4	69.2	68.3	67.0	62.8	57.0

Source: OBERS, Bureau of Economic Analysis, Regional Projections To 2040, Volume 2, 1990

Please Note: Not Revised to include 1990 Census Data and only includes Six Parishes as part of the N. O. Metro area: Jefferson, Orleans, St.Bernard, St. Charles, St. John the Baptist, and St. Tammany.

TABLE 5.14
TOTAL POPULATION BY COMMUNITY
WESTBANK - EAST OF HARVEY CANAL
CENSUS DATA - 1980 AND 1990

Area	Population		Change	
	1980	1990	Pop. #	%
Algiers	59,120	56,707	-2,413	- 4.0
Terrytown	23,548	23,787	+ 239	1.0
Gretna	20,615	17,208	-3,407	-16.5
Harvey	22,709	21,222	-1,487	- 6.5
Stonebridge/ Timberlane	8,638	14,524	+5,886	68.0
Belle Chasse Area	8,844	8,910	+ 66	0.1
Total Study Area	143,474	142,358	-1,116	-0.1

Source: U.S. Census Bureau

Note: A small portion of Harvey above the Westbank Expressway is on the west side of the Harvey Canal.

The upscale subdivisions, including Stonebridge and Timberlane, experienced rapid growth, while the lower income areas in Harvey, Gretna, and Algiers showed a decline in total population (Table 5.14). Population growth in the study area is expected to occur as more homes are constructed in existing subdivisions, and as residential development takes place in the vacant land east of the Algiers Canal. Table 5.15 summarizes the 1990 Census Bureau population count for the three parishes within the project area.

TABLE 5.15

WESTBANK EAST OF HARVEY CANAL
TOTAL POPULATION 1980, 1990, 1992, AND 1993

Change Area	1980	1990	1992	1993	% Change '80 - '90	% '92 - '93
New Orleans MSA	1,304,212	1,286,270	1,304,298	1,306,546	- 1.38	0.17
Plaquemines Parish	26,049	25,575	25,869	26,075	- 1.82	0.80
Jefferson Parish	454,593	448,306	456,389	457,069	- 1.38	0.15
Orleans Parish	557,515	496,938	495,116	493,021	- 10.87	- 0.42

Note: New Orleans Metropolitan Statistical Area (MSA) included population for Jefferson, Orleans, St. Bernard, St. Tammany, St. Charles, St. John the Baptist Parishes, Plaquemines, and St. James Parishes. Plaquemines and St. James Parishes were added to the New Orleans MSA per OMB Bulletin No. 93-50, December 28, 1992.

Sources: U.S. Census Bureau; and 1992 and 1993 figures are preliminary unpublished estimates provided by Louisiana Tech University, College of Administration and Business, Research Division.

The total population in the metropolitan area declined during the 1980's primarily due to the collapse of the oil and gas industry. A majority of this out-migration occurred on the East Bank of Orleans Parish. Preliminary population estimates prepared by Louisiana Tech University show that by 1993 the population in Jefferson and Plaquemines Parishes, as well as the entire New Orleans MSA, had surpassed the 1980 levels. Only the population of Orleans Parish continued in a downward trend.

5.2.10.5.2. No Action. Population growth is expected to continue paralleling the local economic activity. According to the University of New Orleans, continued employment gains in excess of 7,500 jobs per year will support a 1% population growth in the metro area. The exact location of the population growth will be influenced by many factors, including land availability, improvements to the transportation network, and improvements in the local economy.

5.2.10.5.3. All Plans. Population growth would continue as described above. Improved flood protection would have a qualitative impact on community development by increasing protection in specific neighborhoods. Further improvements in the infrastructure, especially in the Lower Coast Algiers area, may be necessary to attract population growth from other developing areas of the New Orleans MSA. Since residential relocations would not be

required by the project, there would be no displacement of people. As an indirect impact, however, inundation reduction resulting from the project would also reduce the potential for temporary displacement of people living in the path of a hurricane.

5.2.10.6. Public Facilities and Services and Tax Revenue

5.2.10.6.1. Significance. The types of public facilities and services that might be impacted by a hurricane surge are streets, drainage and sewerage systems, fire and police protection, schools, and local, state, and Federal emergency support systems. There are three large military installations in the project area: the Naval Support Activity located in Algiers, the U.S. Coast Guard Station located in Lower Coast Algiers, and the U.S. Air Station New Orleans (Alvin Callender Field) located in Belle Chasse of Plaquemines Parish (Reach F). Facilities of the Alvin Callender Air Station are used as an evacuation shelter for residents of Plaquemines Parish. Adequate drainage and flood control are necessary to sustain the continued maintenance and development of these public facilities and services.

5.2.10.6.2. No Action. Without additional hurricane protection, which the project would provide, additional tax revenues would be needed to mitigate the effects of periodic hurricane surges and flood damage in the study area. The growth, expected in the study area without the project, would require the normal expansion of public facilities and services and related tax revenues.

5.2.10.6.3. All Plans. Potential damage to public facilities and services would be reduced under with-project conditions. Local tax revenues would still be needed to maintain the normal expansion of public facilities and services needed for growth in the protected area. However, no additional tax revenues would be needed to reduce the effects of periodic hurricane surges.

5.2.10.7. Displacement of Farms

5.2.10.7.1. Significance. While most of the land in the study area is urbanized, a portion of the land below Belle Chasse. (Reach F), 811 acres, is agricultural. Historically, the pattern of urban expansion has resulted largely from the conversion of agricultural and forested land to urban land for residential, commercial, industrial, recreational, and institutional purposes. There is no prime and unique farmland in the project area (Appendix C, Section VI).

5.2.10.7.2. No Action. Under without-project conditions, this trend is expected to continue as the population grows and as changes continue in technology.

5.2.10.7.3. All Plans. There would be no displacement of farms as a result of the different alternative plans. Approximately 800 acres of farmland could be converted into residential land, with or without the project. Locating borrow areas in open fields and pastures would reduce the amount of farmland in the project area by a minimum of 92 acres.

5.2.10.8. Community Cohesion

5.2.10.8.1. Significance. Due to the vulnerability of the area to hurricanes, the consensus of community opinion strongly favors additional flood protection.

5.2.10.8.2. No Action. The community would continue to be strongly in favor of additional protection from periodic hurricane flooding.

5.2.10.8.3. All Plans. Most members of the community favor the flood protection provided by the alternative projects. The Harvey Canal Industrial Association, which represents some 200 business in the canal area (60 of them directly along the canal) and the West Jefferson Levee Board both favor Plan 3B. This alternative would protect 80 percent of the canal side businesses. There are 12 businesses along the canal that are not protected; however, due to the nature of their business, ship restoration and fabrication, waterway access to the Harvey Canal is a greater priority than flood protection. Waterway access to the Harvey Canal would be curtailed whenever the gates to the structure in the canal are closed, thus temporarily affecting navigation interests. The parallel protection plan, Plan 1, is opposed by the Harvey Canal Association because businesses along the Harvey Canal are not protected from hurricane stages.

5.3. CUMULATIVE IMPACTS

Development involving the clearing of wooded lands under the future without project condition would result in the loss of considerable forested lands over the entire west bank area since the demand for open land is so great. The projected development associated with the selected plan of the previously authorized Westwego to Harvey project would occur at a rate approximately 10 percent faster than without that project. Also, development of wooded lands associated with the related, but not authorized as yet, Post Authorization Change study pertaining to the nearby Lake Cataouatche area would increase by a projected 0.05 percent over the projected without project development rate of 0.56 percent if that study were to result in the change and subsequent implementation. However, the mitigation associated with the Westwego to Harvey project would result in the acquisition and thus preservation of approximately 1,024 acres in the Davis Pond area of the west bank. Also, any projected development to be caused by any subsequent actions resulting from the Lake Cataouatche study would be mitigated by actions to fully replace any lost habitat quality. The loss of swamp and BLH caused by the proposed action would be minimal when compared to the losses caused by development, subsidence, etc. The effect of the proposed action would result in losses of 233 acres of bottomland hardwood forests and 46 acres of wooded swamp with losses of 95 and 21, respectively, associated annualized habitat units according to HES. The mitigation plan would offset those project losses by conserving high quality wooded wetlands adjacent to the study area that could otherwise be subject to logging, development, or other disturbance. The project could result in a temporary increase in water quality problems for Harvey and Algiers Canals, both of which experience contamination from a variety of urban sources.

5.4. OPERATION AND MAINTENANCE

5.4.1. Operation and maintenance of the hurricane protection system would have minimal impact on the significant resources of the study area. The grass levees would be mowed periodically, which could cause minor disturbance to wildlife species that utilize the levees and adjacent areas. The floodwalls, floodgates, and levees would be subject to annual inspection and repair as necessary. Temporary and localized adverse impacts such as noise, esthetics, air quality, etc. are probable during repair work. Impacts should be minimal. Work on the mitigation area would consist of preservation and maintenance of habitat quality through stewardship of the land and forest.

6. LIST OF PREPARERS

The following people were primarily responsible for preparing this statement.

NAME	DISCIPLINE EXPERTISE	EXPERIENCE	ROLE IN PREPARATION
Mr. William Wilson	Wildlife Biology	6 Yrs, Ga DNR; 15 Yrs, USACE NOD	EIS Coordinator; Environmental Resources, Mitigation,
Mr. Brett Herr	Planner/ Civil Engineer	9 Yrs, USACE, NOD	Study Manager
Dr. William P. Klein	Forestry, Wildife Biology	2 Yrs Sul Ross State Univ, TX; 4 Mo, USACE NOD	404(b)(1) Evaluation (Ecological Components)
Mr. Michael Saucier	Marine Science	1 Yr, LDW&F, 2 Yrs USACE, NOD	HTRW Initial Assessment
Mr. Brian Maestri	Regional Economist	7 Yrs, USACE, NOD	Socioeconomics
Mrs. Lisa Leonard	Regional Economist	9 Yrs, USACE, NOD	Socioeconomics & Economic Review
Mr. Stephen Finnegan	Recreation	16 Yrs, Landscape Architect, USACE NOD	Effects on Recreation
Mr. James Wojtala	Archeology	16 Yrs, Archeologist, 2 Yrs USACE, NOD	Effects of Cultural Resources
Mr. Bill Hicks	Environmental Engineer / Water Quality	8 Yrs USACE, NOD	404(b)(1) (Physical Components) & Water Quality
Mr. Nicholas Constan	Economist	23 Yrs, Regional Economist, USACE NOD	Overall Economic Review
Mr. David Carney	Wildlife Biology	1 Yr, Biologist, USFWS 15 Yrs, Biologist, USACE NED & NOD	Overall Environmental Review

7. PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

7.1 PUBLIC INVOLVEMENT PROGRAM AND STUDY HISTORY

7.1.1. Public meetings were held in 1966, 1972, 1984, and 1986 regarding various proposals for hurricane protection on the West Bank of the Mississippi River. The proposals discussed at the 1966 and 1972 meetings were broad in scope and were primarily concerned with protection over the multi-Parish area. The 1984 and 1986 meetings were concerned with the area between Westwego, Louisiana, and the Harvey Canal.

7.1.2. In December 1986 a feasibility report and final EIS for the West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana, was completed and a final plan was approved by the New Orleans District in July 1988. The proposed project is a continuation of plans for adequate hurricane protection for the West Bank.

7.1.3. A notice of intent to prepare a draft EIS was published in the Federal Register on February 11, 1988, that explained the proposed project and scoping process for the draft EIS.

7.1.4. A scoping input request was issued March 29, 1988, to over 200 parties including individuals, libraries, and newspapers. A scoping document that summarized all comments received during the scoping period was sent out October 29, 1988. The major concerns were alternatives, potential impacts to fish and wildlife resources, and water quality.

7.1.5. A meeting at the New Orleans District office was held April 14, 1989 to present a tentatively selected plan and receive comments from elected local, state, and Federal officials, the Harvey Canal Industrial Association, and other interested parties. Because of these discussions, the Plan 3 plans emerged, with Plan 3B chosen as the Tentatively Selected Plan. In a later stage of the study this became the Recommended Plan.

7.1.6. During the course of this study, coordination was maintained with the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Park Service, Louisiana Department of Transportation and Development, Louisiana Department of Environmental Quality, Louisiana Department of Wildlife and Fisheries, Louisiana Department of Natural Resources, Jefferson Parish, Plaquemines Parish, Orleans Parish, West Jefferson Levee District, Harvey Canal Industrial Association, Jefferson Parish Citizens Drainage Advisory Board, and Sixth Ward Association for Progress.

7.1.7. The Notice of Availability of the Draft Feasibility Report and Draft EIS appeared in the Federal Register on June 17, 1994. The required 45-day review period began on that day.

Distribution of the document had been accomplished prior to that date. The review period ended on August 1, 1994.

7.1.8. A public meeting was held on July 21, 1994 at the Jefferson Parish School Board Media Center in Harvey, Louisiana, to provide additional opportunity for public input into the planning process. Eighteen individuals spoke in favor of the Tentatively Selected Plan. The route of the levee was the only design item of which there was not concensus. One speaker was in opposition to costs of the levee improvements along the Algiers Canal (Gulf Intercoastal Waterway) being a local responsibility.

7.2. STATEMENT RECIPIENTS

7.2.1. Draft Statement Recipients. All U.S. Senators and Congressmen representing Louisiana, Federal and state agencies, state officials, and interested groups and individuals were mailed copies of the draft EIS for their review and comments. Additionally, copies were furnished to the local libraries listed below. A complete list of those mailed a copy of the Feasibility Report and EIS is found in Appendix C.

LIBRARIES

Louisiana State University
University of New Orleans
Tulane University
Dillard University
Xavier University
Jefferson Parish Library
New Orleans Public Library
Plaquemines Parish Library
Loyola University Library
St. Charles Parish Library

7.2.2. Final Statement Recipients. Copies of the statement are being furnished to all Federal agencies having jurisdiction by law or special expertise with respect to any environmental impact involved and any Federal, State or local agency authorized to develop and enforce environmental standards. Copies of the statement are also being furnished to any person, organization, or agency which submitted substantive comments on the draft EIS.

7.3. ENVIRONMENTAL COMPLIANCE

Table 7.1 shows the various environmental laws that apply and the status of compliance.

TABLE 7.1
ENVIRONMENTAL COMPLIANCE

LEGISLATION	DOCUMENT	NOTE	LOCATION	STATUS
Bald Eagle Act	USFWS response to request			Full
Clean Air Act	EIS			Full
Clean Water Act	404(b)(1) Evaluation and State Water Quality Certification	*1	Appx C	Full
Coastal Zone Management Act	Consistency Determination & LDNR letter		Appx C	Full
Endangered Species Act	Biological Assessment, USFWS letter		Appx C	Full
Estuary Protection Act	EIS			Full
Farmland Protection Policy Act	EIS and Farmland Rating form		Appx C	Full
Fed. Water Project Recreation Act	EIS			Full
Fish and Wildlife Coordination Act	FWS Coordination Act Report		Appx D	Full
Land & Water Conservation Fund Act	EIS			Full
Marine Prot., Research and Sanctuary Act	EIS			Full
National Environmental Policy Act	EIS	*1		Partial
National Historic Preservation Act	EIS		Appx C	Full
Archeological & Historical Preservation Act	EIS		Appx C	Full
River and Harbor Act	EIS			Full
Wild and Scenic Rivers Act	EIS			Full
Water Resource Develop. Act of 1976	EIS			Full
Water Resource Develop. Act of 1986	EIS & Mitigation Report		Appx C	Full
E.O. 11988	EIS			Full
E.O. 11990	EIS			Full
Memo on Prime and Unique Farmlands	EIS & Farmland Rating form		Appx C	Full
La. Air Control Law	EIS			Full
La. Protection of Cypress Trees Act	EIS			Full
La. Coastal Zone Management Act	Consistency Determination & LDNR letter		Appx C	Full

*1 Receipt of State Water Quality Certificate resulted in full compliance.
*2 Signing of Record of Decision will achieve full compliance.

7.4 PUBLIC VIEWS AND RESPONSES

The views of the public were considered in great detail during the study and planning of the proposed project. The Recommended Plan minimizes environmental impacts and costs while maximizing protection benefits as much as possible. It achieves an excellent balance between these factors by using existing alignments wherever possible, transporting of contaminated excavated material from the Harvey Canal to an appropriate industrial landfill, completing SPH protection for the West Bank, providing mitigation for losses of wetlands and wildlife habitat, and utilizing the least costly alignment. Appendix G, Public Views and Responses, displays all substantitive letters of comment to the Draft Feasibility Report and DEIS as a result of the public review of the documents. The response of the District is included with each comment.

7.5 RECOMMENDATIONS OF THE U.S. FISH AND WILDLIFE SERVICE

7.5.1. Comment: The portion of the Plaquemines Parish levee tie-in extending perpendicular to Hero Canal and south of the industrial facility should be constructed on top, or immediately east, of the existing levee.

Response: The levee addressed in the comment is a minimal levee and canal; however, that levee would provide a base for a straddle enlargement. The levee also is non-wooded. That is, the use of the levee and the minimal canal landward of it would minimize the destruction of forested lands (some of which are wetlands) in the construction of the hurricane protection levee. The current design route of the levee is based upon recognition of the wetland value of the adjacent swamps and includes routing the levee approximately 1,000 feet east to preserve those wetland values. The location of the levee will include placement either on top, or landward, of the small levee rather than toward the unprotected side as long as possible future development on the landward side does not make that design cost-prohibitive.

7.5.2. Comment: The proposed 100-acre stockpile area on the west side of the Harvey Canal should be located and configured to avoid and minimize impacts to bottomland hardwood habitat.

Response: Hauling costs, both for the initial deposition of material and for obtaining material for each future lift, were a major consideration in locating the site for the stockpile area. Therefore, any offsite area was eliminated. The recommended mitigation plan will fully mitigate all unavoidable habitat losses caused by the deposition of material on the stockpile area.

7.5.3. Comment: A freshwater diversion structure (Louisiana Coastal Wetlands Conservation and Restoration Program project BA-13) in the vicinity of Hero Canal has been identified as a critical long-term wetland restoration project in the Barataria Basin feature of the Louisiana Coastal Restoration Plan, formulated in accordance with the Coastal Wetlands Planning, Protection, and Restoration Act (PL 101-646). That project has received strong endorsement from Jefferson and Plaquemines Parishes as a means to reduce or prevent the loss of low-salinity marshes south of Hero Canal. Therefore, detailed design of the Plaquemines Parish tie-in feature should be coordinated with the possible implementation of the proposed Hero Canal Freshwater Diversion project.

Response: The Recommended Plan would provide for enlarging the existing levee along the north bank of the Hero Canal. The protection would wrap around the head of the Hero Canal and continue west along the south bank of the canal. Upon approval of the Feasibility Report, preconstruction engineering and design will be initiated. This will include the preparation of Design Memorandums. A freshwater diversion structure in the vicinity of the Hero Canal could easily be incorporated into the design at that point.

7.5.4. Comment: Unavoidable project-related losses to fish and wildlife resources should be fully compensated by acquisition and management of 264 acres of forested wetlands, including not less than 190 acres of bottomland hardwood wetlands and 74 acres of forested swamp, within the Bayou Bois Piquant area of St. Charles Parish.

Response: The recommended mitigation plan consists of purchasing 312 acres of forested wetlands in the Bayou Bois Piquant area. The entire area is undrained, i.e., is not pumped, and can be categorized as bottomland hardwood / swamp that has functional wetland characteristics. Swamp habitat, i.e., functional wetlands, can be utilized, as noted both in Appendix C, Section IV and Appendix D, to mitigate drained bottomland hardwood in addition to swamp losses.

7.5.5. Comment: Mitigation lands should be acquired in fee simple; administration and management of those lands should be in accordance with the General Plan process contained in Section 3(b) of the Fish and Wildlife Coordination Act. Acquisition, operation, and management of mitigation lands should be at project expense.

Response: Concur.

7.5.6. Comment: Detailed design of the hurricane protection and mitigation features should be coordinated with the Service, the Louisiana Department of Wildlife and Fisheries, and other interested natural resource agencies.

Response: Concur.

7.5.7. Comment: Mitigation should be implemented simultaneously with other project features.

Response: Concur. This is required in Section 906(a)(1) of the Water Resources Development Act of 1986 (PL 99-662).

8. LITERATURE CITED

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CONCLUSION

I find that the recommended plan to provide hurricane surge protection to that portion of the west bank of the Mississippi River in the vicinity of New Orleans east of the Harvey Canal, as developed in this report, is based on a thorough analysis and evaluation of all practicable alternatives, in view of applicable economic, engineering, and environmental criteria. I have analyzed the data and concluded that the NED plan is a combination of Plan 3B, SPH protection west of the Algiers Canal, and 100-year protection east of the Algiers Canal.

I have given special consideration to the risks and uncertainties associated with the unpredictability of hurricanes, loss of evacuation routes, the potential for loss of life and property, the human suffering that hurricane surge flooding could cause in this particular area, and the unknown consequences of sea level rise, subsidence, and loss of coastal marsh which serves as a buffer against hurricanes. I have also considered the fact that the Lake Pontchartrain and Vicinity and the Westwego to Harvey Canal Hurricane Protection Projects have been authorized to provide SPH protection to the surrounding metropolitan area and the NED plan for the area west of the Algiers Canal would also provide SPH protection. The additional cost of providing SPH protection to the area east of the Algiers Canal is less than 1 percent of the total cost for the two previously authorized projects. Providing the NED level of protection would leave the area east of the Algiers Canal vulnerable to storms exceeding the 100-year event and would create a disparity in the level of protection.

There are a number of communities located along the Mississippi River south of the study area in lower Plaquemines Parish. Many of the 20,000 residents living within these communities typically evacuate to within the study area. A number of public shelters are located in the Belle Chasse area and also at Alvin Callender Field.. In addition to providing public shelter, Alvin Callender Field would also be utilized as a staging area for relief efforts after a hurricane had passed. Providing SPH protection would ensure a greater degree of safety to evacuees' and would minimize delays in the re-opening of Alvin Callender Field.

Implementing the recommended plan would provide protection to those areas east of the Harvey Canal and would tie the line of protection to the authorized Westwego to Harvey Canal project. These two projects combined would provide protection to over 190,000 west bank residents. Total project first costs for the recommended plan are

$99,665,000 west of the Algiers Canal and $20,016,000 east of the Algiers Canal. The area west of the Algiers Canal, with average annual costs of S9,779,000 and equivalent annual benefits of $44,549,000, would provide a benefit to cost ratio of 4.56 to 1.0. The benefit to cost ratio for the area east of the Algiers Canal, with average annual costs of $2,077,000 and equivalent annual benefits of $3,220,000, would be 1.55 to 1.0. The resulting annual net benefits are estimated at $34,770,000 for the area west of the Algiers Canal and $1,143,000 for the area east of the Algiers Canal.

The recommended plan would adversely impact approximately 279 acres of wildlife habitat as a direct result of levee and outfall channel construction, temporary stockpile area, and wooded borrow areas. These lands are predominantly bottomland hardwoods but also contain small areas of swamp. Mitigation of significant environmental losses would be accomplished by the acquisition of 312 acres of high quality wooded wetlands and implementation of measures designed primarily to improve fish and wildlife habitat.

I believe it is in the overall public interest to construct this project to the SPH level of protection. I have therefore determined that Plan 3B, west of Algiers Canal and the plan east of Algiers Canal, constructed to the SPH level of protection, is the best solution to provide additional flood protection to the study area.

Improvements for hurricane surge protection in the adjacent Westwego to Harvey Canal area were authorized by the Water Resources Development Act of 1986, Public Law 99-662, approved November 17, 1986. The recommended plan described in this report would modify the authorized project and would provide for a continuation of the protection east of the Harvey Canal.

RECOMMENDATIONS

As the District Engineer, I have considered the significant environmental, social, and economic effects, the engineering feasibility, and the input received from the public and have determined that the recommended plan presented in this report is in the overall public interest.

I recommend that the existing, West Bank Hurricane Protection Project, Jefferson Parish, Louisiana, authorized by the Water Resources Development Act of 1986, Public Law 99-662, approved November 17, 1986, be modified to provide additional hurricane protection to that portion of the west bank of the Mississippi River in the vicinity of New Orleans, east of the Harvey Canal. I also recommend that the level of protection for the area east of Algiers Canal deviate from the NED level of protection and provide protection for the Standard Project Hurricane (SPH). The recommended plan is a combination of Plan 3B, west of the Algiers Canal and the plan for east of the Algiers Canal, both providing SPH protection. This plan is being recommended with such modifications thereof as in the discretion of the Commander HQUSACE, may be necessary.

The total first cost of the recommended plan is $99,665,000 west of Algiers Canal and $20,016,000 east of Algiers Canal, based on October 1993 price levels and a project life of 100 years. Operation, maintenance, repair, replacement, and rehabilitation costs are estimated to be $240,000 annually. The recommended plan produces net excess benefits over costs and has a favorable benefit to cost ratio.

These recommendations are made with the provisions that prior to implementation, the non-Federal interests will agree to comply with the following requirements:

a. Furnish all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas necessary for construction (including mitigation), operation, maintenance, repair, replacement, and rehabilitation of the project;

b. Accomplish or arrange for the accomplishment of all utility and facility alterations and relocations determined by the Secretary of the Army to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, except that, in the sole discretion of the Secretary of the Army, the United States may perform utility and facility alterations and relocations on Federal lands, using funds provided by non-Federal interests;

c. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project, except for damages due to the fault or negligence of the United States or its contractors;

d. Provide for adjudication of all water rights claims resulting from construction, operation, maintenance, repair, replacement, and rehabilitation of the project, and hold and save the United States free from damages due to such claims;

e. Bear 35 percent of the total cost of project construction;

f. Operate, maintain, repair, replace, and rehabilitate as necessary all features of the project, at no cost to the Government, in accordance with regulations prescribed by the Secretary of the Army, including levees, floodwalls, floodgates and approach channels, drainage structures, drainage ditches or canals, and including all mitigation features;

g. Publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise development in the floodplain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility between future development and protection levels provided by the project;

h. Assure that construction, operation, maintenance, repair, replacement, and rehabilitation of any non-Federally constructed flood features do not diminish the hurricane protection provided by or jeopardize the structural integrity of the project;

i. Assure compliance with applicable Federal floodplain management and flood insurance programs;

j. Inform affected interests, at least annually, regarding the limitations of the protection afforded by the project;

k. Perform work-in-kind to satisfy the non-federal share of the project costs;

l. Perform at the time of initiation of construction, and thereafter, any environmental investigations as determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675 on lands necessary for

project construction, operation, maintenance, repair, replacement, and rehabilitation;

m. Assume complete financial responsibility for the cleanup of any hazardous materials located on project lands and regulated under CERCLA and be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner that will not cause liability to arise under CERCLA;

n. Comply with the applicable provisions of the Uniform Relocations and Real Property Acquisition Policies Act of 1970 (PL 91-646), as amended by Title IV of the Surface Transportation and Uniform Relocations Assistance Act of 1987 (PL 100-17);

o. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, approved December 31, 1970 which provides that the construction of any water resource project by the Corps of Engineers shall not be started until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project; and

p. Comply with 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.

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 authorization and implementation funding. However, prior to transmittal to the Congress, the State of Louisiana, the West Jefferson Levee District, the Orleans Levee District, Plaquemines Parish Government, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

KENNETH H. CLOW
Colonel, U. S. Army
District Engineer

CELMV-PE-F (CELMN-PD-F/26 Aug 94) (1105-2-10c) 1st End
Mr. Stuart/bab/5827
SUBJECT: West Bank of the Mississippi River in the Vicinity of New Orleans, Louisiana (East of Harvey Canal)

CDR, Lower Mississippi Valley Division, Vicksburg, MS 39181-0080
29 Aug 94

FOR Director, Washington Level Review Center, 7701 Telegraph Road, Alexandria, Virginia 22315-3861

1. I concur in the recommendations of the District Commander.

2. 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 authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

3 Encls
nc

EUGENE S. WITHERPSOON
Brigadier General, USA
Division Engineer

EXHIBIT 1

LETTERS FROM NON-FEDERAL SPONSOR

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

April 19, 1994

EDWIN W. EDWARDS
GOVERNOR

JUDE W. P. PATIN
SECRETARY

Colonel Kenneth H. Clow
District Engineer
New Orleans District,
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Clow:

This is in response to your recent letter, concerning the East of Harvey, Louisiana, Hurricane Protection Project.

Act 1012 of the 1993 Legislative Session named this Department the non-Federal sponsor for the hurricane protection works being developed and constructed by the Corps of Engineers in the area from Harahan to Belle Chase. Included in that legislation is the project named East of Harvey, Louisiana.

In response to that legislation, it is our intent to provide the non-Federal cost share of funds required for construction of this project through the State General Fund or the State's Bond Program, subject to legislative appropriations.

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

Sincerely,

Jude W. P. Patin
Secretary

pc: Mr. John Evanco
District Engineer Administrator,
District 02

WEST JEFFERSON LEVEE DISTRICT
BOARD OF COMMISSIONERS

7001 RIVER ROAD
P. O. BOX 608
MARRERO, LA 70072
TEL: (504) 340-0318
FAX: (504) 340-7801

May 24, 1994

Mr. Terral J. Broussard, Project Manager
Life Cycle Management Office
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160-0267

Re: Westbank of the Mississippi River in the vicinity of New Orleans
(East of Harvey Canal) Hurricane Protection Project

Dear Mr. Broussard:

Pursuant to our authority as administrator of the above referenced Project for the Louisiana Department of Transportation and Development, the non-Federal sponsor, we wish to advise our plan of participation relative to the Project. The non-Federal share of the Project is currently estimated at $56,000,000.

We understand that the non-Federal interests must furnish all lands, easements, and rights of way, including suitable borrow and dredged or excavated material disposal areas necessary for construction, including mitigation. The cost of land acquisition is estimated at $22,500,000.

We further understand that the non-Federal interests must accomplish or arrange for the accomplishment of all utility and facility alterations and relocations determined necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project. The cost of this activity is estimated at $5,500,000.

Finally, we also understand that the non-Federal interests must provide the balance of local share funding in cash, or in lieu of cash, by performing equivalent work. That amount is estimated at $28,000,000.

This letter is offered to advise our intention to provide for all land acquisition, accomplishment of all utility/facility alterations or relocations, and construction of Project features sufficient to accomplish satisfaction of the remaining local funding responsibility.

The following listed Project features are areas in which we believe non-Federal participation would aid our mutual goal of providing hurricane protection in an efficient, timely, and cost effective manner.

1. Participation in design of the sector gate complex.

2. Design and construction of Project features from Hero Pumping station to the Algiers Locks, within Plaquemines and Orleans Parish.

3. Design and construction of Project features from Algiers Locks to the Hero Cut, within Plaquemines and Orleans Parish.

4. Design and construction of Project features within Jefferson Parish, as needed, to accomplish satisfaction of the non-Federal cost share responsibility.

We offer these comments with the understanding that non-Federal participation will be provided in an amount needed to accomplish the non-Federal funding responsibilities. Our comments should in no way be interpreted as an agreement to provide funding in excess of the non-Federal share.

Should further discussion be required, please contact me or in my absence Mr. Jerry Spohrer, Executive Director at (504) 340-0318.

Sincerely,

Harry L. Cahill, III
President

xc: Luke Petrovich, Parish of Plaquemines
Robert Harvey, Orleans Levee District
Curtis Patterson, LA DOTD, Baton Rouge
Geneva P. Grille, LA DOTD, New Orleans

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

November 5, 1993

EDWIN W. EDWARDS
GOVERNOR

JUDE W. P. PATIN
SECRETARY

Mr. Harry L. Cahill, III
President
West Jefferson Levee District
Post Office Box 608
Marrero, Louisiana 70072

SUBJECT: WESTWEGO TO HARVEY CANAL HURRICANE PROTECTION PROJECT AND MODIFICATIONS

Dear Mr. Cahill:

Pursant to enactment of Chapter 2-B of Title 38 of the Louisiana Revised Statues (R.S.) of 1950, more specifically R.S. 38:100 through 104, by the Louisiana Regular Session of 1993, the Louisiana Department of Transportation and Development is directed to serve as non-Federal sponsor for the construction of the Westwego to Harvey Canal Hurricane Protection Project and modifications which include the Lake Cataouatche area and the East of Harvey Canal Hurricane Protection Project.

In a letter, dated May 5, 1993 promulgated by the Governor pursuant to R.S. 38:81 designating the Louisiana Department of Transportation and Development as non-Federal sponsor for the construction of the Westwego to Harvey Canal Hurricane Protection Project and modifications which include the Lake Cataouatche area and the East of Harvey Canal Hurricane Projection Project, the West Jefferson Levee District was named to administer the projects for the Department.

To properly define the responsibilities of the Louisiana Department of Transportation and Development and the West Jefferson Levee District and our individual and collective duties, an agreement of cooperation is currently being prepared by our office.

In the interim and until this agreement is prepared and executed by all concerned parties, the Louisiana Department of Transportation and Development, through its Secretary, hereby grants the West Jefferson Levee District the authority to administer the projects, including the authority to do whatever is necessary to carry them out in accordance with the local cooperation agreement between the U.S. Army Corps of Engineers and the West Jefferson Levee District, subject to review of the Department as a local funding agency.

We further understand that the levee district, as administrator, accepts responsibility for the development, location, design, and construction of the Westwego to Harvey Canal Hurricane Protection Project and modifications, and agrees to hold harmless and indemnify the Department against any loss or damage occasioned by its activities undertaken in pursuit of the projects, and to defend any suit brought against the Department relating to the projects.

This is to request that you sign and return the enclosed copy of this letter as an indication of the levee board's concurrence in these stipulations. In addition, by copy of this letter, we are notifying the New Orleans District, U.S. Army Corps of Engineers, of our interim agreement.

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

Sincerely,

Jude W. P. Patin
Secretary

Accepted this ____day of _____, 1993
West Jefferson Levee District

BY:_____
Harry L. Cahill, III, President

pc: Lieutenant General Arthur Williams,
Chief of Engineers
Brigadier General Eugene S. Whitherspoon,
Division Engineer, LMVD
Colonel Michael Diffley,
Commander, New Orleans District
Orleans Levee Board
Plaquemines Parish Council
Jefferson Parish Council
√Mr. Terral Broussard,
New Orleans District

EXHIBIT 2

FEDERAL AND NON-FEDERAL EXPENSES BY FISCAL YEAR

EAST OF HARVEY CANAL, LA
HURRICANE PROTECTION PROJECT
SCHEDULE OF ESTIMATED FEDERAL
AND NON-FEDERAL EXPENDITURES

AUG 94

FISCAL YEAR	TOTAL COST	FEDERAL COST 65%	NON-FEDERAL COST 35%	LANDS	RELOCATIONS	CONSTRUCTION CONTRIBUTIONS TOTAL	CONSTRUCTION CONTRIBUTIONS FEDERAL	CONSTRUCTION CONTRIBUTIONS NON-FED CASH/EQ WK
THRU 1995	$1,200,000	$780,000	$420,000			$1,200,000	$1,200,000	
1996	$3,300,000	$2,145,000	$1,155,000	$1,180,000	$160,000	$1,960,000	$1,289,697	$670,303
1997	$2,100,000	$1,365,000	$735,000	$390,000		$1,710,000	$1,347,273	$362,727
1998	$15,700,000	$10,205,000	$5,495,000	$9,810,000	$1,260,000	$4,630,000	$3,647,879	$982,121
1999	$32,800,000	$21,320,000	$11,480,000	$7,680,000	$3,100,000	$22,020,000	$17,349,091	$4,670,909
2000	$43,800,000	$28,470,000	$15,330,000	$1,520,000	$740,000	$41,540,000	$32,728,485	$8,811,515
2001	$44,800,000	$29,120,000	$15,680,000	$1,320,000	$240,000	$43,240,000	$34,067,879	$9,172,121
2002	$11,500,000	$7,475,000	$4,025,000			$11,500,000	$9,060,606	$2,439,394
2003	$100,000	$65,000	$35,000	$80,000		$20,000	$15,758	$4,242
2004	$400,000	$260,000	$140,000			$400,000	$315,152	$84,848
2005	$400,000	$260,000	$140,000	$230,000		$170,000	$133,939	$36,061
2006	$1,500,000	$975,000	$525,000			$1,500,000	$1,181,818	$318,182
2007	$0	$0	$0			$0	$0	$0
2008	$100,000	$65,000	$35,000	$90,000		$10,000	$7,879	$2,121
2009	$800,000	$520,000	$280,000	$200,000		$600,000	$472,727	$127,273
2010	$1,500,000	$975,000	$525,000			$1,500,000	$1,181,818	$318,182
TOTALS	$160,000,000	$104,000,000	$56,000,000	$22,500,000	$5,500,000	$132,000,000	$104,000,000	$28,000,000

NOTES:

1. COSTS INCLUDE ADJUSTMENTS FOR INFLATION.

2. PRECONSTRUCTION ENGINEERING AND DESIGN IS SCHEDULED TO BEGIN IN SEP 94. THIS WILL BE COST-SHARED; HOWEVER, LOCAL SPONSOR PAYMENTS ARE NOT REQUIRED UNTIL CONSTRUCTION BEGINS IN FY 96.

3. THE REQUIRED NON-FEDERAL CASH/EQUIVALENT WORK CONTRIBUTIONS ARE BASED ON THE PROPORTIONAL CASH PRINCIPLE OF ER 1165-2-131, PARA 9.A.(2). CASH CONTRIBUTIONS SHALL BE IN THE SAME PROPORTION TO FEDERAL AND TOTAL CONSTRUCTION OBLIGATIONS FROM YEAR TO YEAR. IF WORK-IN-KIND IS SPECIFICALLY AUTHORIZED FOR THE PROJECT, THE WORK-IN-KIND CAN SUBSTITUTE FOR CASH.

EAST OF HARVEY CANAL, LA, HURRICANE PROTECTION
OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION SCHEDULE
(NON-FEDERAL)

FISCAL YR	INCREMENTAL COST	INFLATION FACTOR	FULLY-FUNDED COST
2000	$1,000	1.198	$1,198
2001	$1,000	1.235	$1,235
2002	$120,000	1.273	$152,760
2003	$240,000	1.312	$314,880
2004	$240,000	1.353	$324,720
2005	$240,000	1.395	$334,800
2006	$240,000	1.438	$345,179
2007	$240,000	1.489	$357,260
2008	$240,000	1.541	$369,764
2009	$240,000	1.595	$382,706
2010	$240,000	1.650	$396,101
2011	$240,000	1.708	$409,964
2012	$240,000	1.768	$424,313
2013	$240,000	1.830	$439,164
2014	$240,000	1.894	$454,535
2015	$240,000	1.960	$470,443
2016	$240,000	2.029	$486,909
2017	$240,000	2.100	$503,951
2018	$240,000	2.173	$521,589
2019	$240,000	2.249	$539,844
2020	$240,000	2.328	$558,739

NOTES:

1. OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R) COSTS REMAIN THE RESPONSIBILITY OF THE LOCAL SPONSOR PAST THE YEAR 2020 AND ARE EXPECTED TO RISE DUE TO INFLATION IN A PATTERN SIMILAR TO THAT SHOWN ABOVE.

2. MAJOR REPLACEMENT COSTS (ABOUT $2.0 MILLION (OCT 93 PRICE LEVEL)) FOR HARVEY CANAL FLOODGATE MACHINERY ARE EXPECTED TO RECUR AT ABOUT 50-YEAR INTERVALS.

EXHIBIT 3

COST ESTIMATE FOR RECOMMENDED PLAN

EAST OF HARVEY CANAL, LA HPP INCREMENTAL COST SCHEDULE

AUG 94

Contr #		FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	TOTAL
	SECTOR GATE COMPLEX																	
	FDM	463	473	164														
1	P&S Sector Gate, Bypass Channel			863	1726													1100
	Const. Sector Gate, Bypass Channe					8997	8996	8997										2589
	Construction Management #1					1035	1036	1036										26990
	Lands & Damages #1				2665													3107
2	P&S 2nd Lift Discharge Chan Levee											31						2665
	Const 2nd Lift Discharge Ch Levee												246					31
	Construction Management #2												27					246
	Lands & Damages #2											75						27
3	P&S 3rd Lift Discharge Chan Levee															15	14	75
	Const 3rd Lift Discharge Ch Levee																234	29
	Construction Management #3																26	234
	Lands & Damages #3															71		26
4	P&S Cousins Pump Station				1140	570												71
	Const Cousins Pump Station					3312	6624	6625										1710
	Relocations, Cousins Pump Station				1118													16561
	Construction Management #4					411	820	820										1118
	Lands & Damages #4				851													2051
5	P&S Lev & FW East Side of HC				484	969												851
	Const Lev & FW East Side of HC						5522	5522										1453
	Relocations Lev & FW East Side HC					1528												11044
	Construction Management #5						606	606										1528
	Lands # Damages #5					5248												1212
	Temporary Stockpile - Jeff Parish				4052													5248
6	P&S 2nd Lift East Side of HC											76						4052
	Const 2nd Lift East Side of HC												689					76
	Construction Management #6												63					689
	Lands & Damages #6											153						63
7	P&S 3rd Lift East Side of HC															31	30	153
	Const 3rd Lift East Side of HC																552	61
	Construction Management #7																51	552
	Lands & Damages #7															153		51
																		153
	WEST OF ALGIERS																	
	FDM	300	400	165														
8	P&S Hero PS to Belle Chasse Hwy					1114	650											865
	Const Hero PS to Belle Chasse Hwy						3566	7131	3565									1764
	Relocations, Hero PS to Belle Chas					620	571											14262
	Construction Management #8						368	736	368									1191
	Lands & Damages #8					2435												1472
9	P&S Belle Chase Hwy to Algiers Lo						300	175										2435
	Const Belle Chasse Hwy to Algiers							1360	2710									475
	Relocations, Belle Chasse to Algier						50	49										4070
	Construction Management #9							132	264									99
	Lands & Damages #9						1524											396
																		1524
	TOTAL: West of Algiers	763	873	1192	12036	26239	30633	33189	6907	0	0	335	1025	0	0	270	907	114369

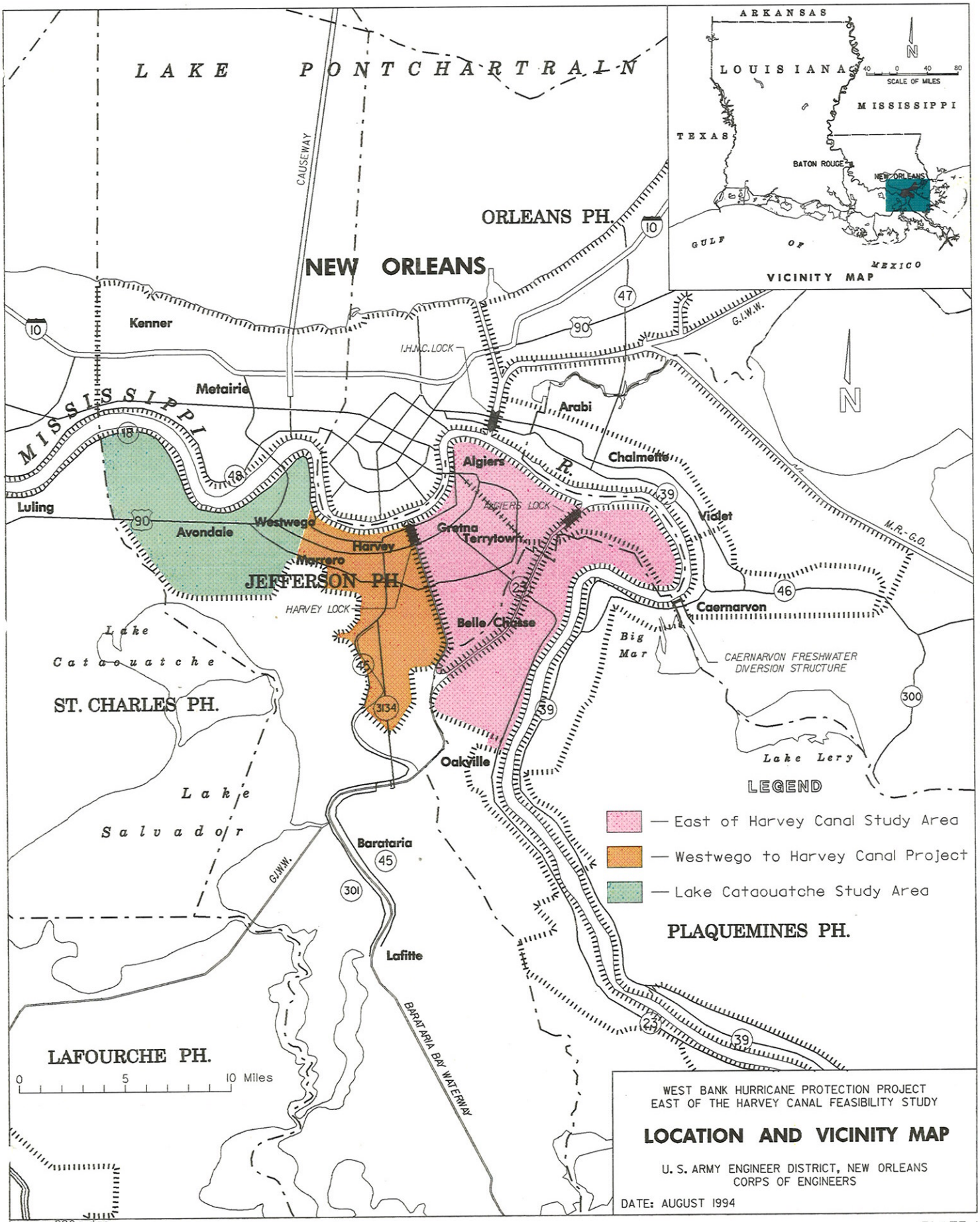
EAST OF HARVEY CANAL, LA HPP INCREMENTAL COST SCHEDULE

AUG 94

Contr #		FY 95	FY 96	FY 97	FY 98	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	TOTAL
	EAST OF ALGIERS																	
	HC Soil Report and P&S Oakville Le	280	180															460
10	Const Oakville Levee		460	230														690
	Relocations, Oakville Levee		148															148
	Construction Management #10		33	17														50
	Lands & Damages #10		668															668
	Borrow Pit - Plaquemines Parish		514															514
13	P&S Second Lift Oakville Levee									21	21							42
	Const 2nd Lift Oakville Levee										249							249
	Construction Management #13										34							34
	Lands & Damages #13									78								78
14	P&S 3rd Lift Oakville Levee														25	12		37
	Const 3rd Lift Oakville Levee															297		297
	Construction Management #14															31		31
	Lands & Damages #14														90			90
	FDM	150	300	100														550
11	P&S Plaquemines Parish				526	526												1052
	Const Plaquimines Parish					1284	5134	1284										7702
	Relocations, Plaquimines Parish					522												522
	Construction Management #11					146	583	146										875
	Lands & Damages #11				2238													2238
12	P&S Orleans Parish							185	61									246
	Const Orleans Parish								1660									1660
	Relocations, Orleans Parish							124										124
	Construction Management #12								204									204
	Lands & Damages #12							1319										1319
	TOTAL: East of Algiers	430	2303	347	2764	2478	5717	3058	1925	99	304	0	0	0	115	340	0	19880
	Mitigation			484														484
	TOTAL PROJECT	1193	3176	2023	14800	28717	36350	36247	8832	99	304	335	1025	0	115	610	907	134733

NOTE: COSTS ARE IN $THOUSANDS (OCT 93 PRICE LEVEL).

PLATES



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

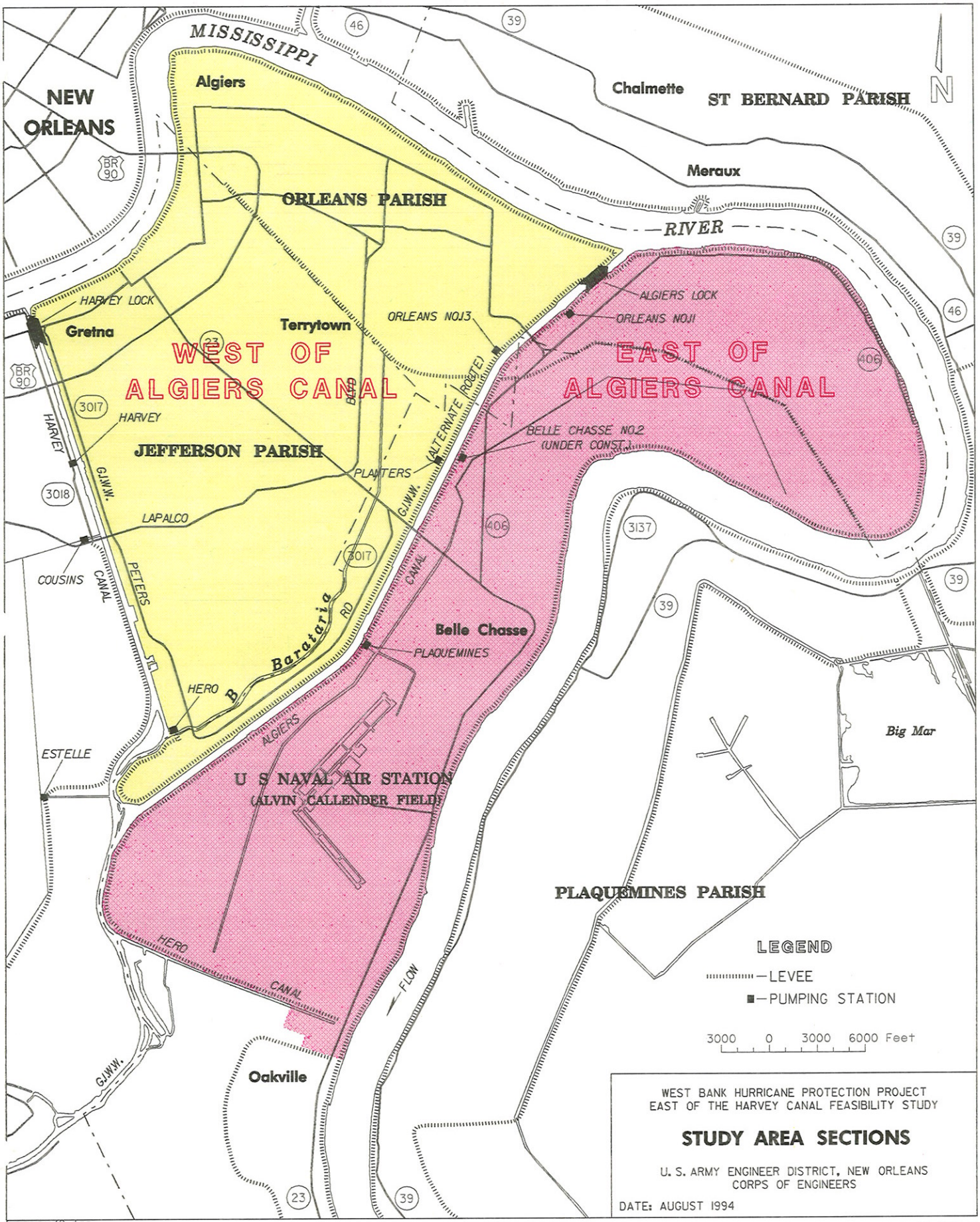
LOCATION AND VICINITY MAP

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

DATE: AUGUST 1994

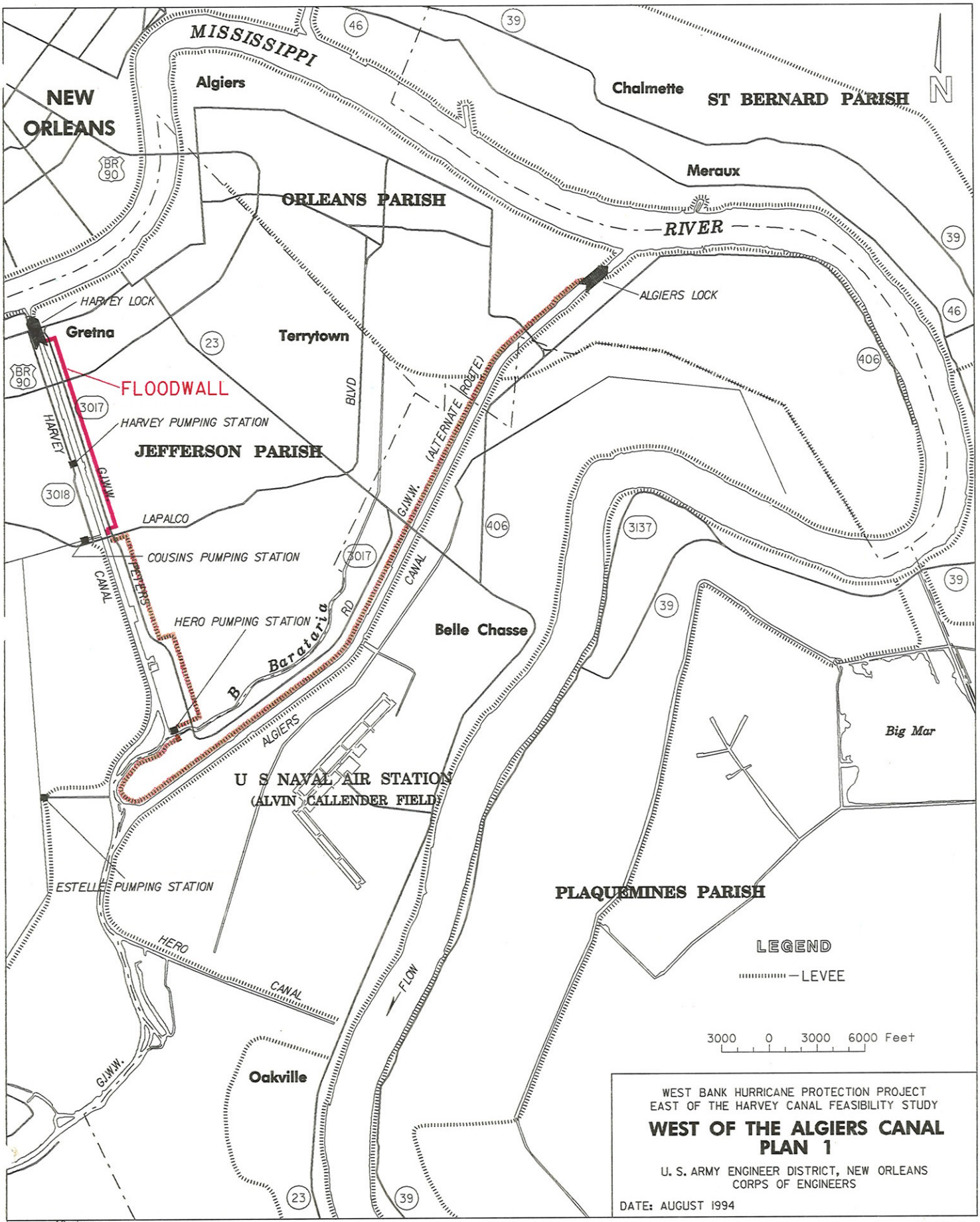
harvey220a.dgn

PLATE I



harvey30.dgn

PLATE 2



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

WEST OF THE ALGIERS CANAL PLAN 1

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

DATE: AUGUST 1994

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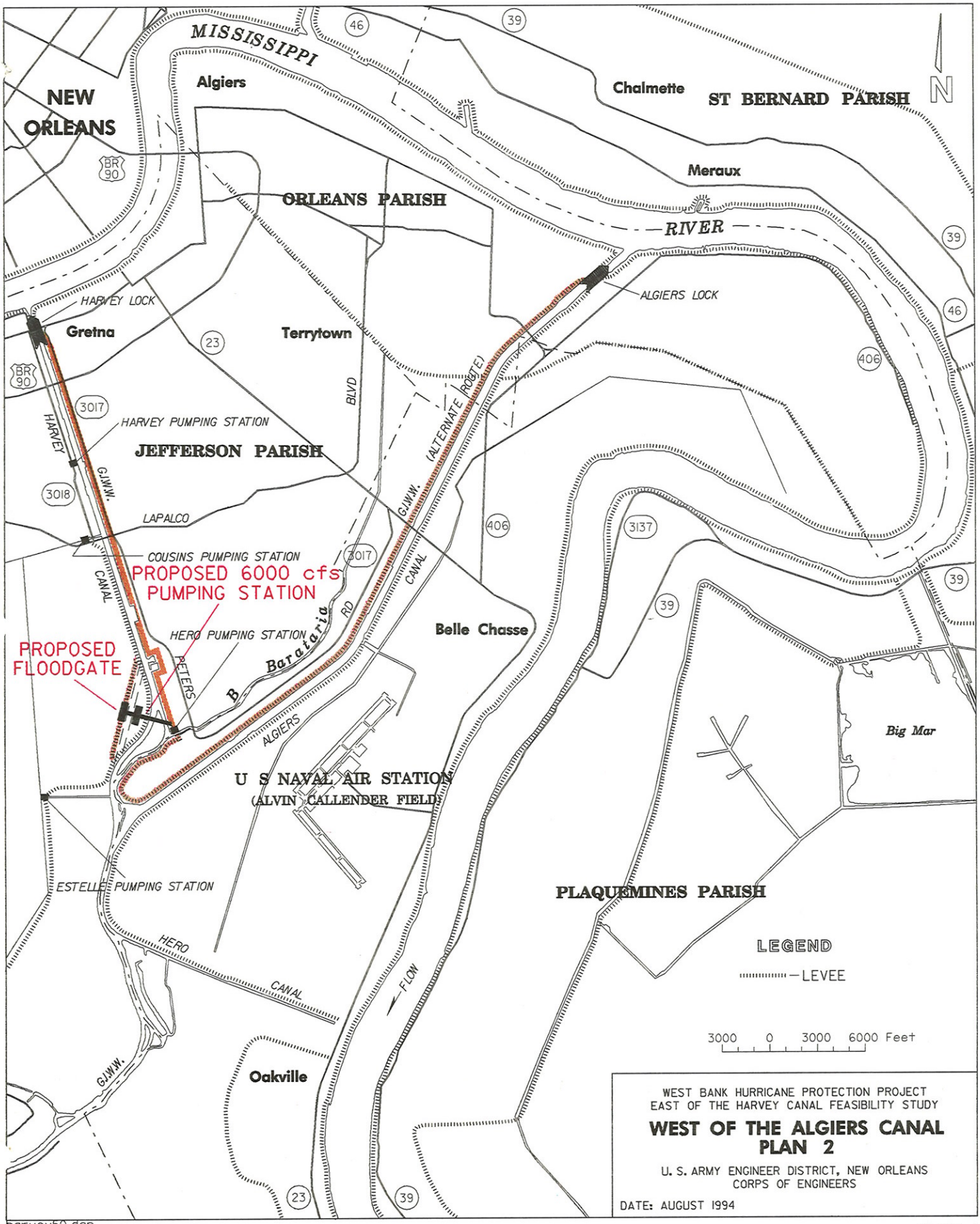
PLATE 3



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

WEST OF THE ALGIERS CANAL PLAN 2

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

DATE: AUGUST 1994

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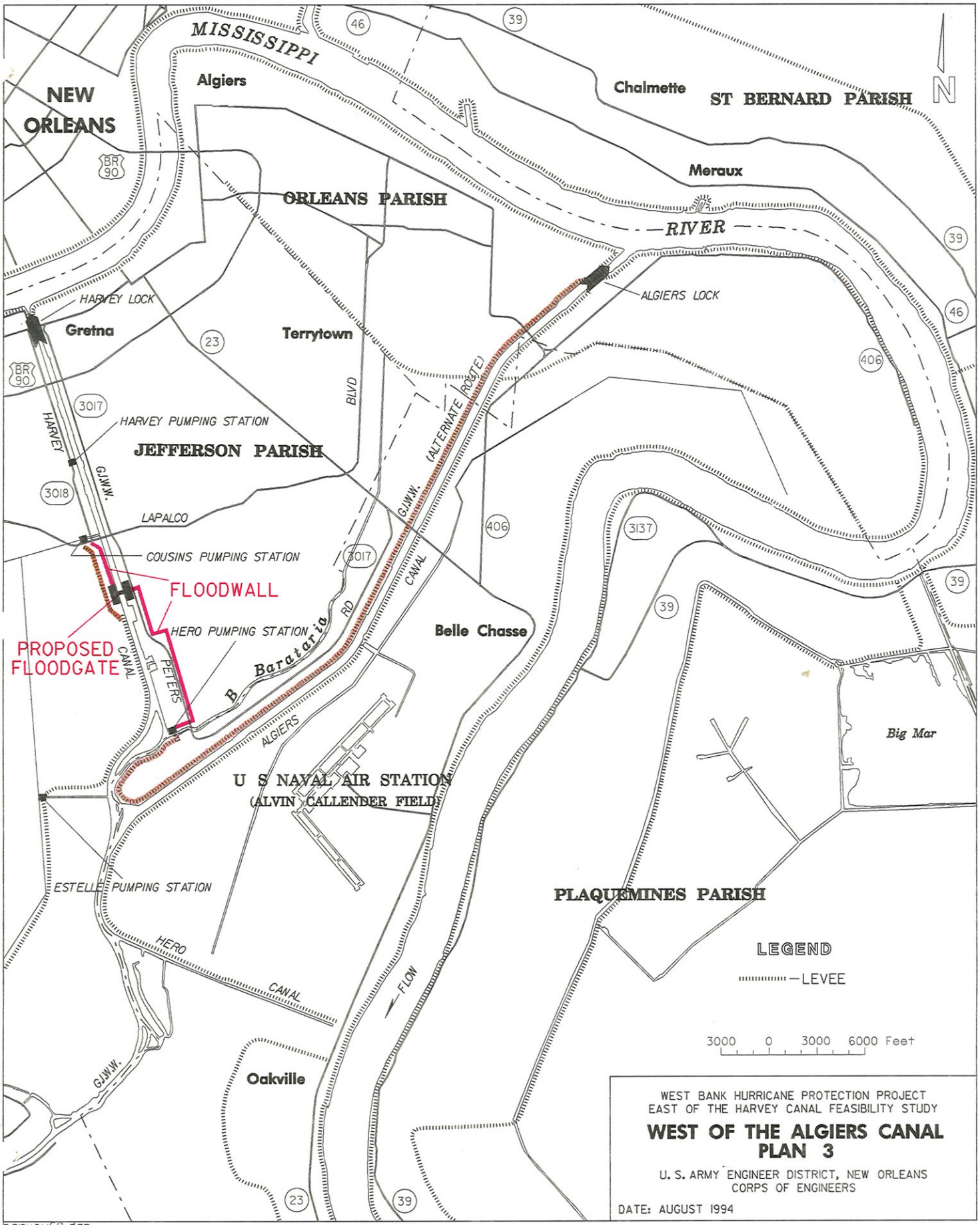
PLATE 4



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

WEST OF THE ALGIERS CANAL PLAN 3

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

DATE: AUGUST 1994

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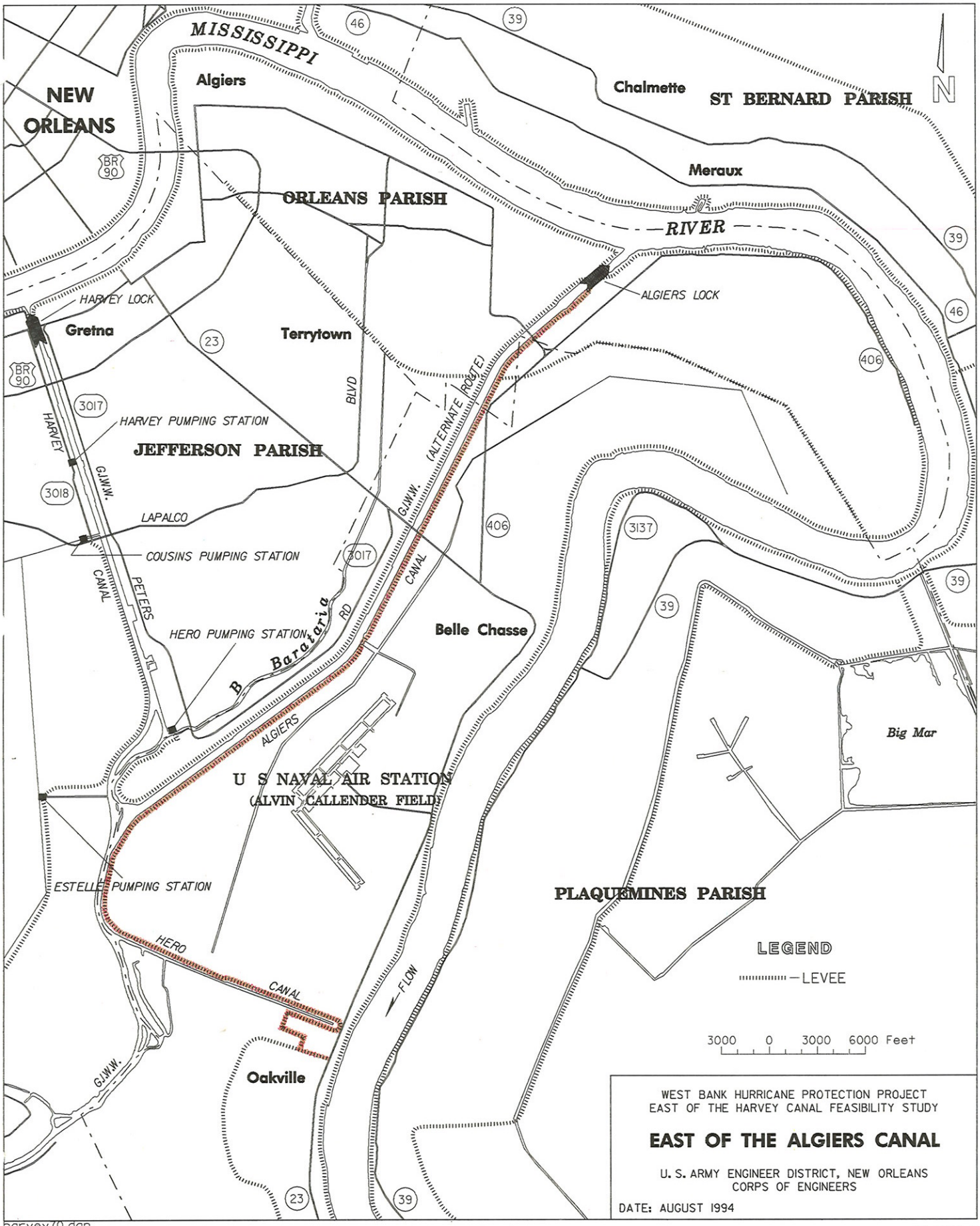
PLATE 5



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

EAST OF THE ALGIERS CANAL

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

DATE: AUGUST 1994

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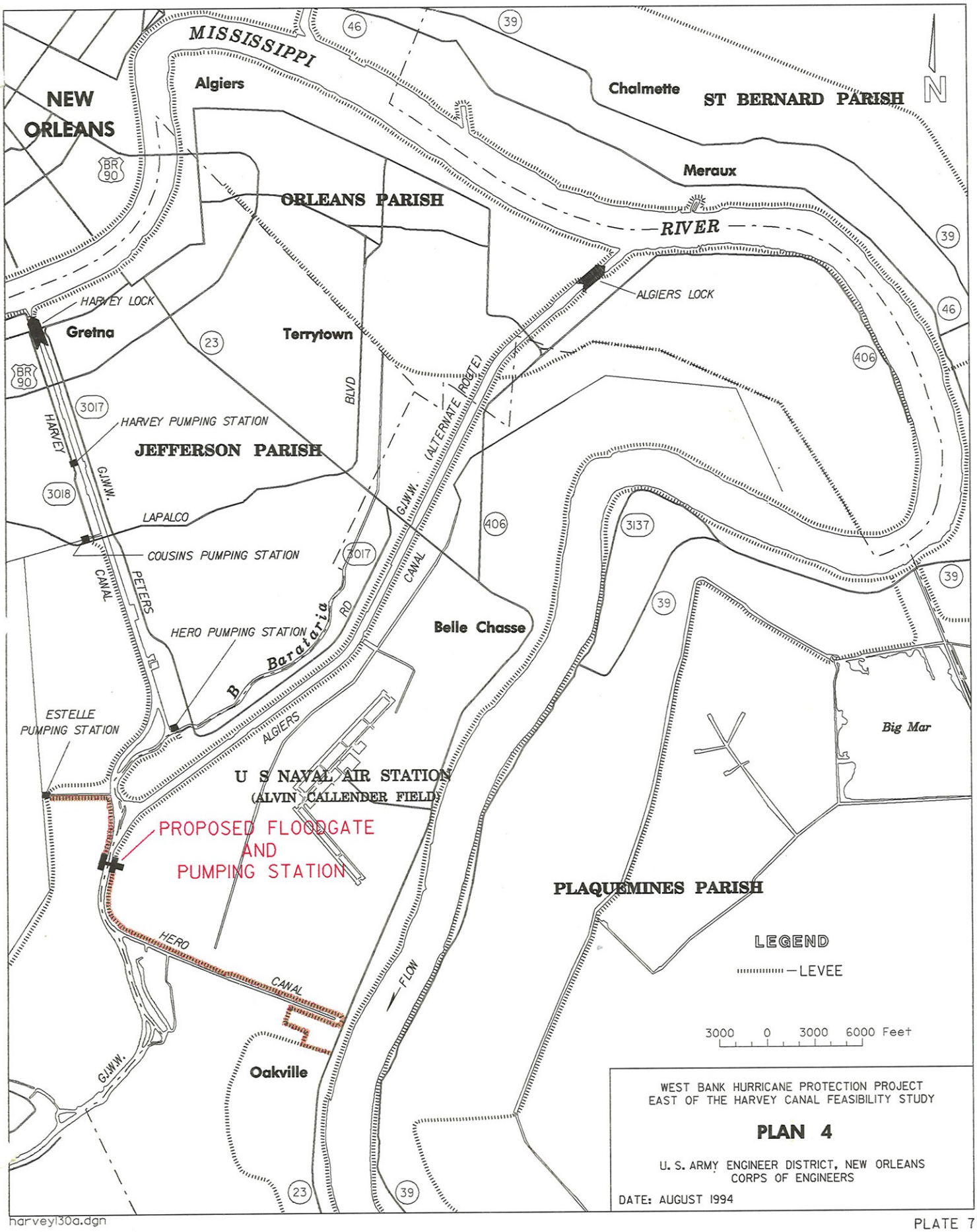
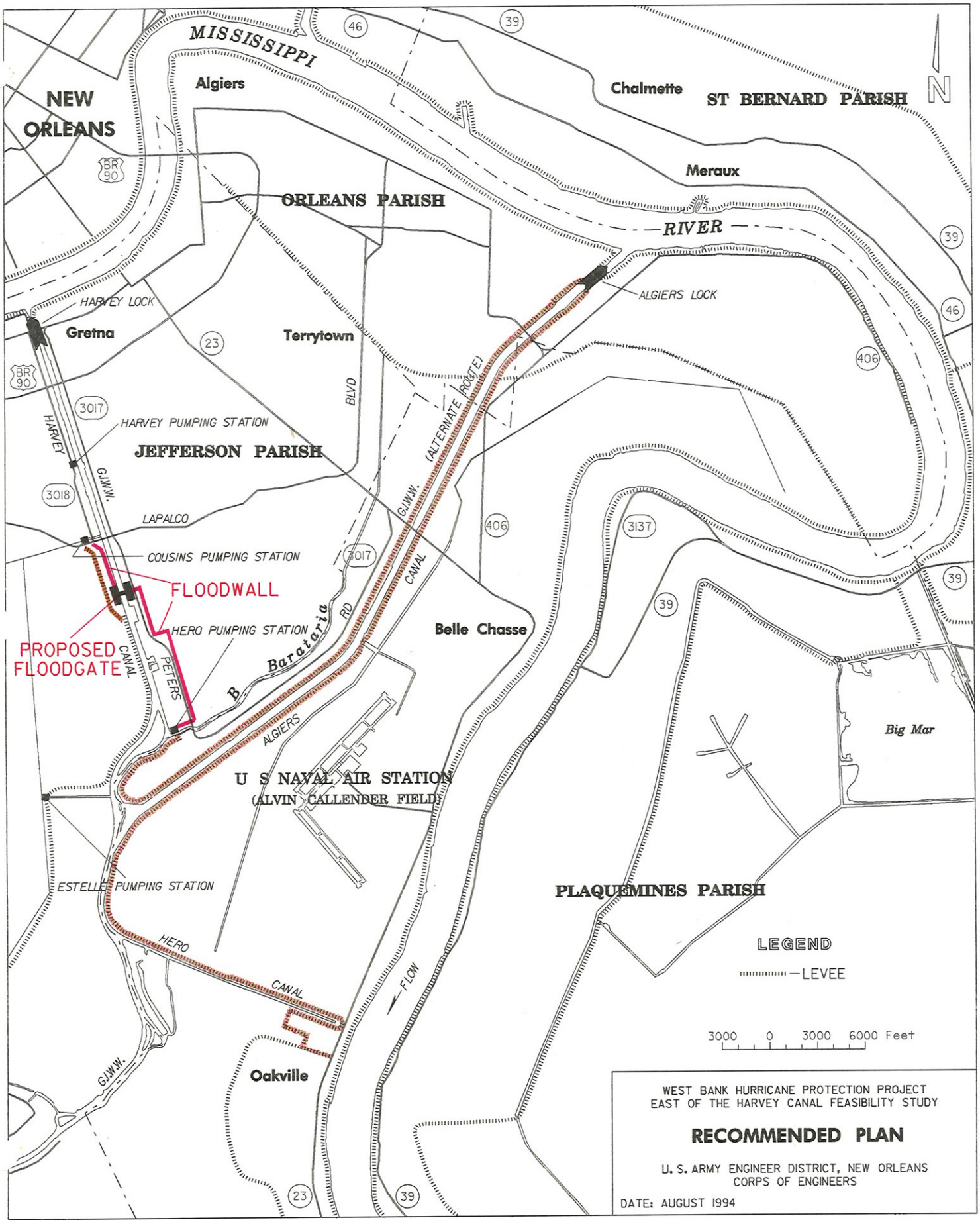
PLATE 6



harvey130a.dgn

PLATE 7



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

RECOMMENDED PLAN

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

DATE: AUGUST 1994

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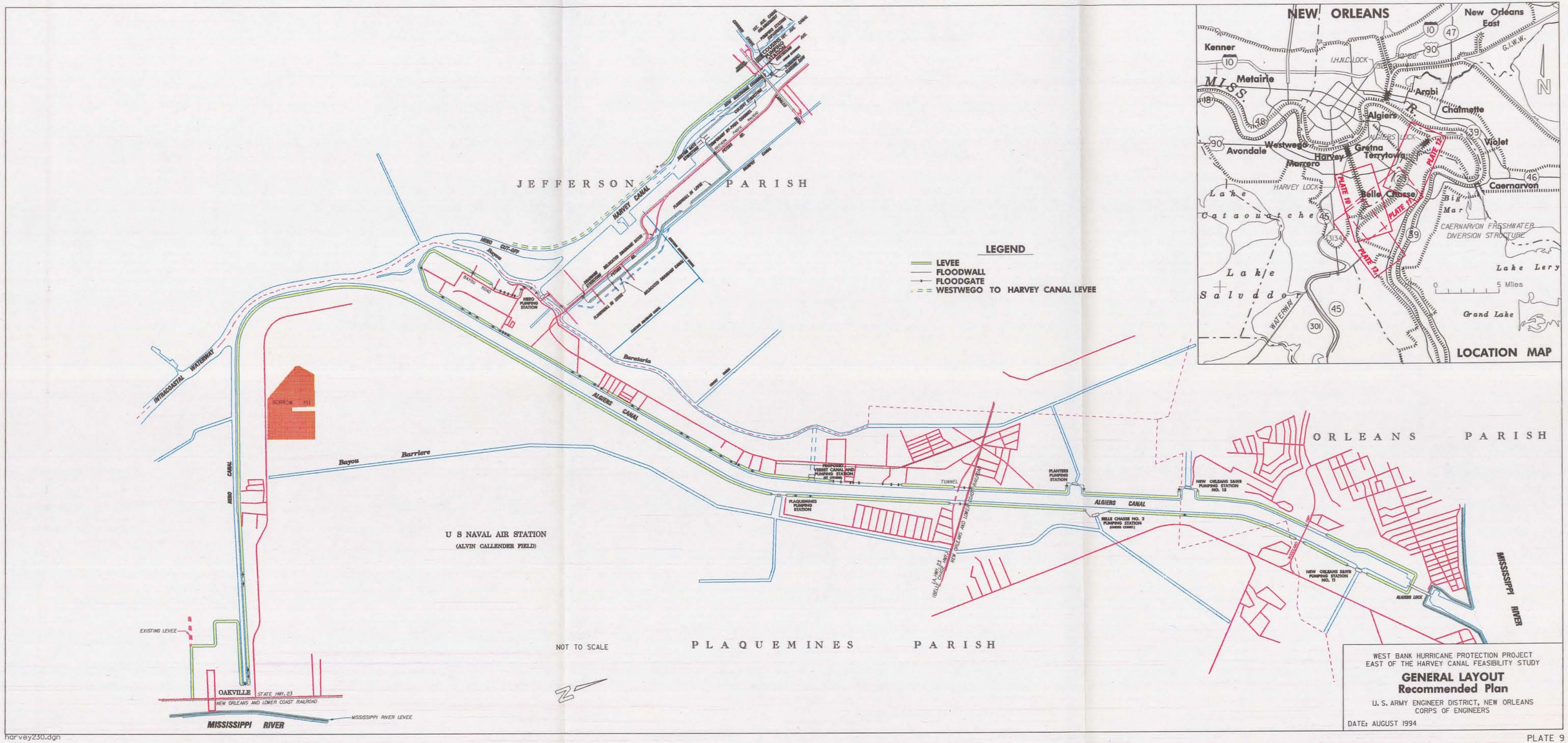
PLATE 8



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

GENERAL LAYOUT
Recommended Plan

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

DATE: AUGUST 1994

harvey230.dgn

EXISTING DRAINAGE CANAL

EXISTING DRAINAGE CANAL

RELOCATED DRAINAGE CANAL

FLOODWALL IN LEVEE

MURPHY CANAL

BLVD.

LAPALCO

PETERS RD.

SOUTHERN PACIFIC RAILROAD

FLOODWALL IN LEVEE

RELOCATED DRAINAGE DITCH

DRAINAGE STRUCTURE

PETERS RD.

TEMPORARY BY-PASS CHANNEL

CLOSURE DAM

FLOODWALL

CULVERT STRUCTURE

SECTOR GATE STRUCTURE

HARVEY CANAL

BRIDGE EXTENSION

NEW DISCHARGE CHANNEL

DESTREHAN AVE.

COUSINS PUMPING STATION

1ST. AVE. CANAL

FRONTING PROTECTION

PUMPING STATION EXPANSION

1ST. AVE. CANAL ENLARGEMENT

TO HARVEY PUMPING STATION

COUSINS CANAL

JEFFERSON PARISH

NOT TO SCALE

N

HERO PUMPING STATION

Bayou

HERO CUT-OFF

Barataria

BAYOU ROAD

ALGIERS CANAL

PLAQUEMINES PARISH

LEGEND

- LEVEE
- FLOODWALL
- FLOODGATE
- WESTWEGO TO HARVEY CANAL LEVEE

WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

Recommended Plan – Along Harvey Canal

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

DATE: AUGUST 1994

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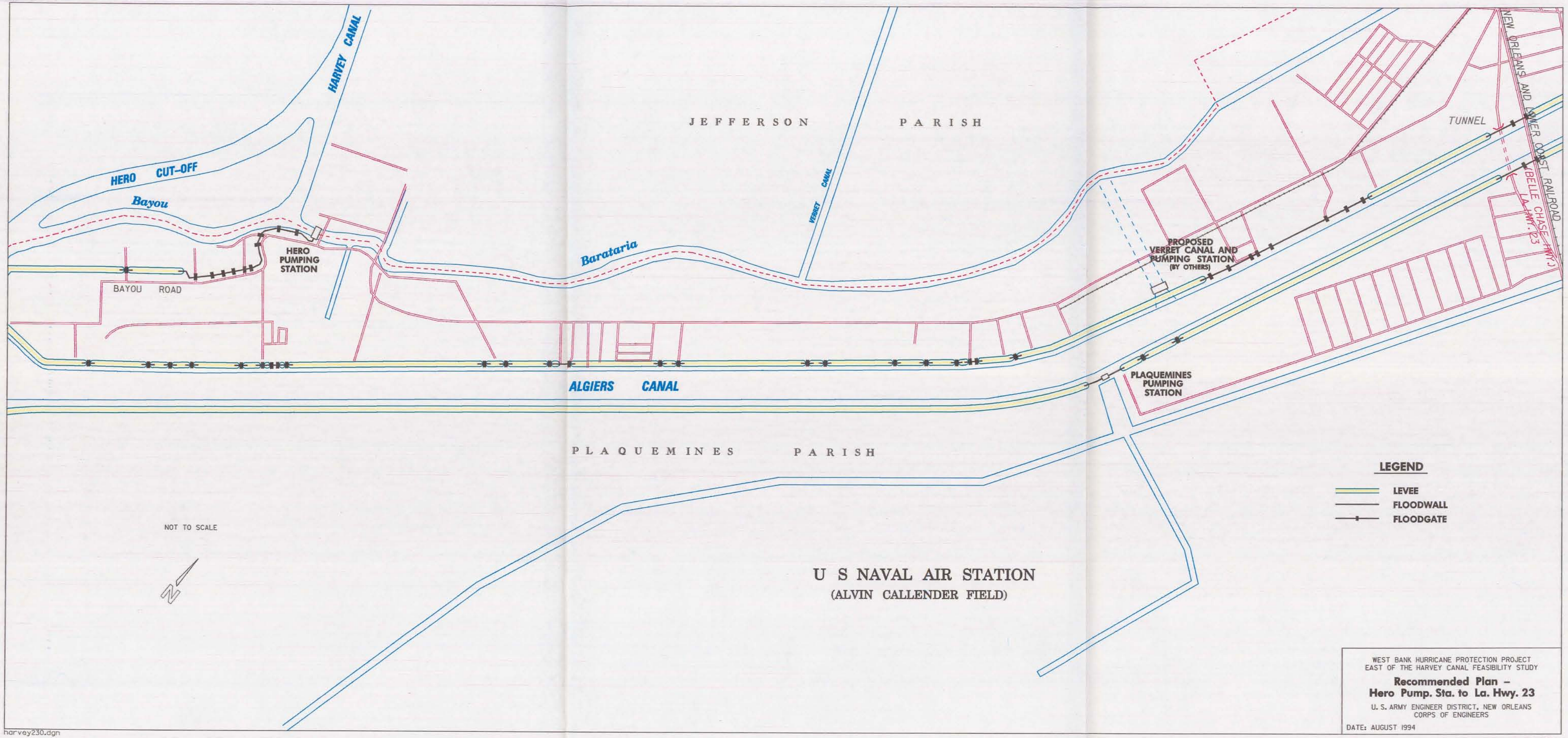
PLATE 10



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

Recommended Plan –
Hero Pump. Sta. to La. Hwy. 23

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

DATE: AUGUST 1994

harvey230.dgn

PLATE II

JEFFERSON PARISH

ORLEANS PARISH

PLAQUEMINES PARISH

LEGEND

- LEVEE
- FLOODWALL
- FLOODGATE

PLANTERS PUMPING STATION

TUNNEL

ALGIERS CANAL

NEW ORLEANS S&WB PUMPING STATION NO. 13

BELLE CHASSE NO. 2 PUMPING STATION (UNDER CONST.)

LA. HWY. 23

NEW ORLEANS AND LOWER COAST RAILROAD

WOODLAND HWY.

NEW ORLEANS S&WB PUMPING STATION NO. 11

ALGIERS LOCK

MISSISSIPPI RIVER

NOT TO SCALE

WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

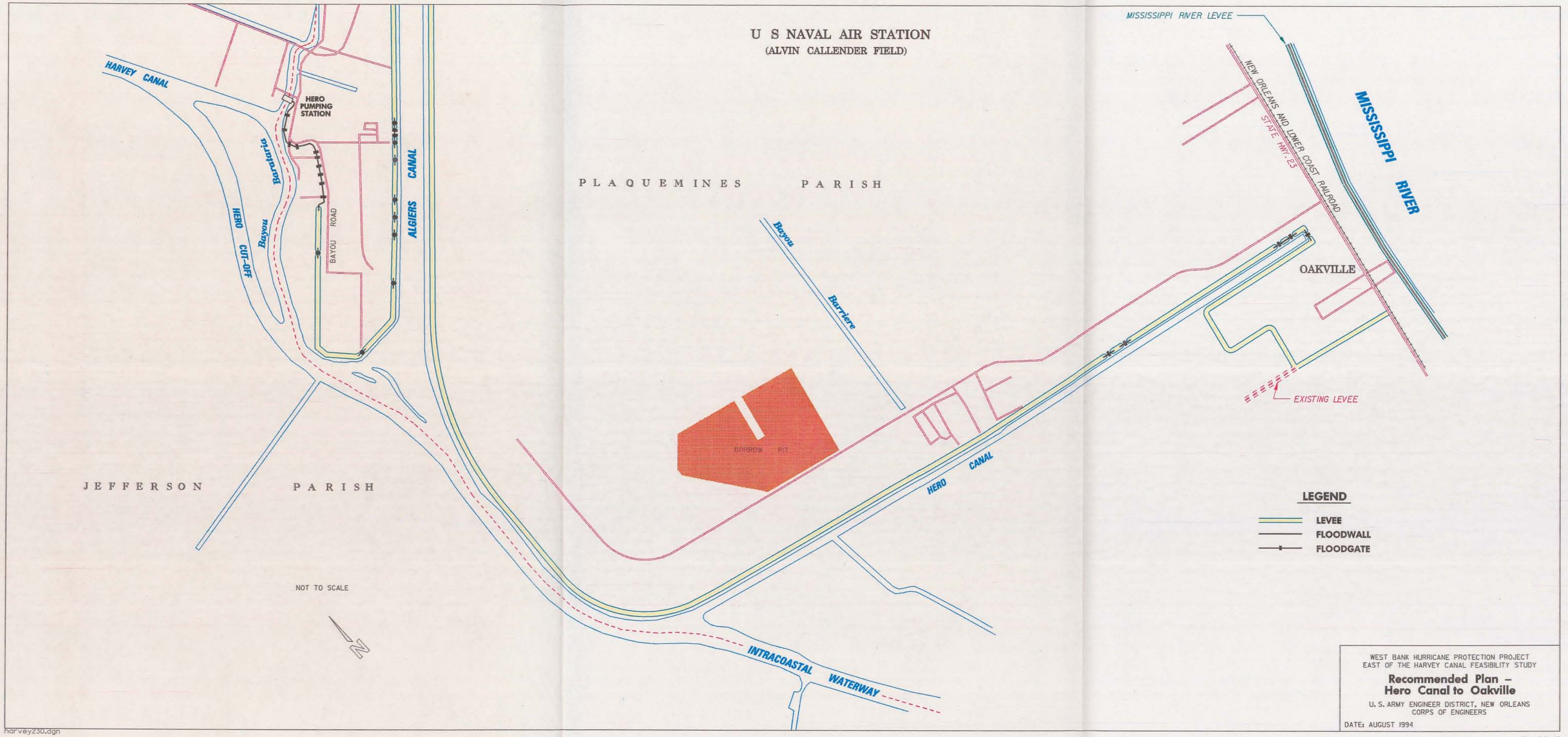
**Recommended Plan –
La. Hwy. 23 to Algiers Lock**

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

DATE: AUGUST 1994

harvey230.dgn

PLATE 12



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

Recommended Plan –
Hero Canal to Oakville

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

DATE: AUGUST 1994

harvey230.dgn

PLATE 13

LAPALCO BLVD.

PROTECTED SIDE

FLOODWALL & LEVEE

FLOOD SIDE

30' HIGHWAY SWING GATE

PETERS ROAD

SOUTHERN PACIFIC RAILROAD

30' RAILROAD SWING GATE

LAPALCO BLVD. BRIDGE (EXISTING)

TEMPORARY BY-PASS CHANNEL

℄ BRIDGE OPENING

190'±

℄ STRUCTURE

SECTOR GATE STRUCTURE

CLOSURE DAM

HARVEY CANAL

CULVERT STRUCTURE

FLOODWALL

FLOOD SIDE

FLOODWALL

BRIDGE EXTENSION

NEW DISCHARGE CHANNEL

DESTREHAN AVE.

LEVEE

30' HIGHWAY BOTTOM ROLLER GATE

PROTECTED SIDE

COUSINS PUMPING STATION

FRONTING PROTECTION

15TH AVE CANAL

PUMPING STATION EXPANSION

15TH AVE CANAL ENLARGEMENT

COUSINS CANAL

SCALE: 1" = 200'

200' 0 200' 400' 600' 800'

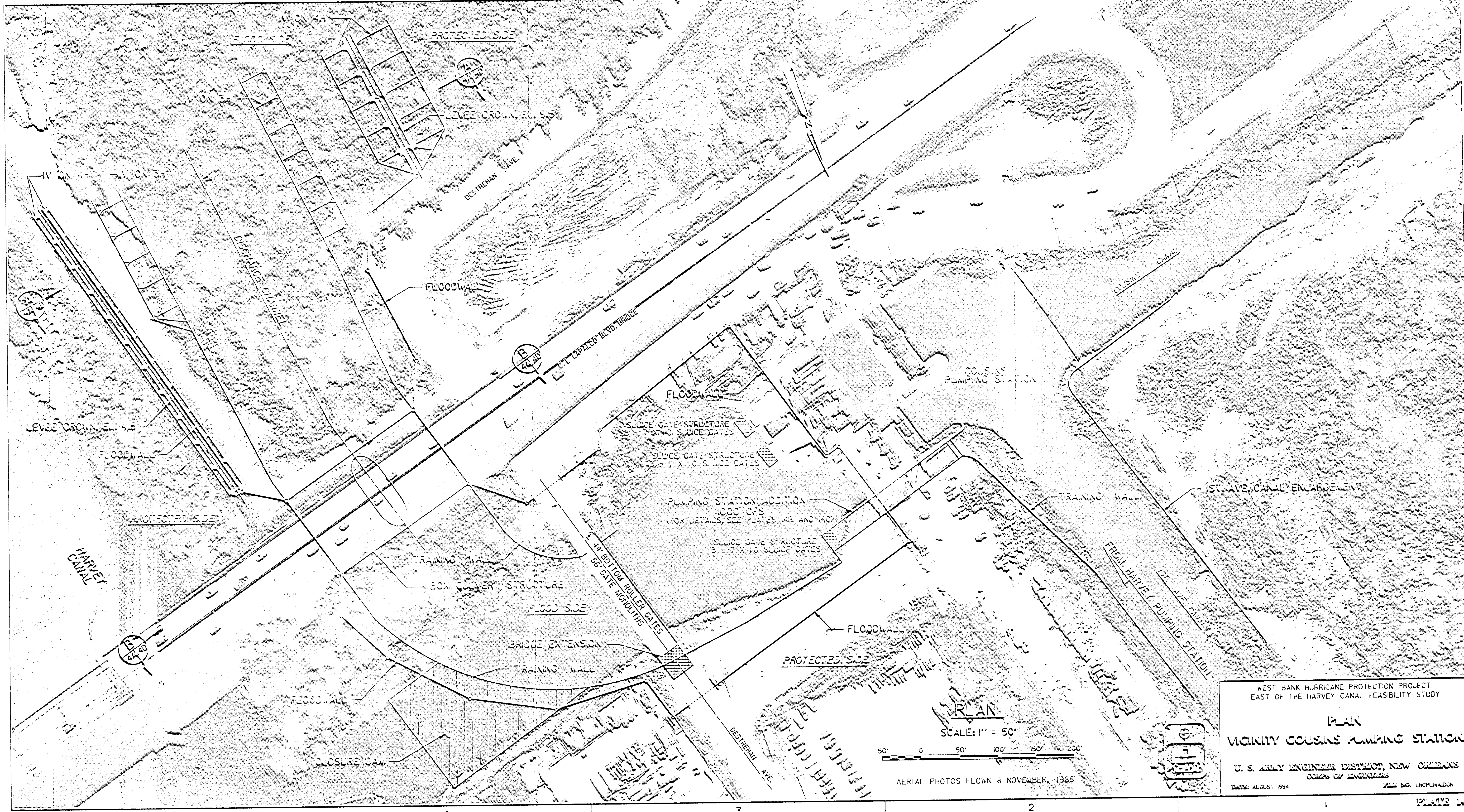
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

GENERAL PLAN
VICINITY SECTOR GATE STRUCTURE

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

DATE: AUGUST 1994 FILE NO. EHCPL14.DGN

PLATE 14

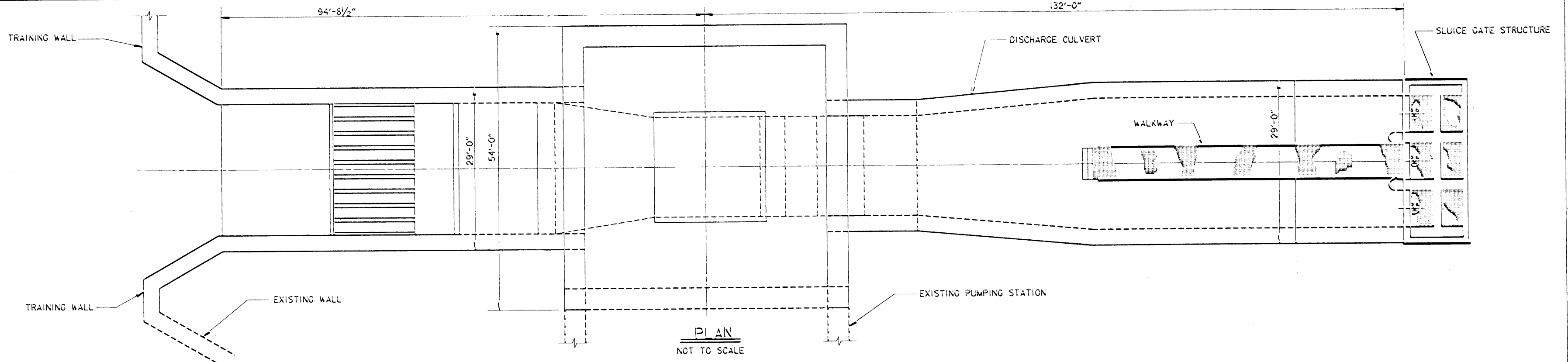

PROTECTED SIDE
FLOOD SIDE
LEVEE CROWN EL. 9.5
DESTREHAN AVE.
DISCHARGE CHANNEL
FLOODWALL
C/L LAPALCO BLVD. BRIDGE
COUSINS CANAL
COUSINS PUMPING STATION
LEVEE CROWN EL. 4.5
FLOODWALL
SLUICE GATE STRUCTURE
SLUICE GATE STRUCTURE
PUMPING STATION ADDITION
1000 CFS
(FOR DETAILS, SEE PLATES 1B AND 1C)
SLUICE GATE STRUCTURE
TRAINING WALL
1ST AVE. CANAL ENLARGEMENT
PROTECTED SIDE
HARVEY CANAL
TRAINING WALL
BOX CULVERT STRUCTURE
44' BOTTOM ROLLER GATES
56' GATE MONOLITHS
FLOOD SIDE
FLOODWALL
FROM HARVEY PUMPING STATION
1ST AVE. CANAL
BRIDGE EXTENSION
TRAINING WALL
PROTECTED SIDE
FLOODWALL
CLOSURE DAM
DESTREHAN AVE.
PLAN
SCALE: 1" = 50'
50' 0 50' 100' 150' 200'
AERIAL PHOTOS FLOWN 8 NOVEMBER, 1985

WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

PLAN
VICINITY COUSINS PUMPING STATION

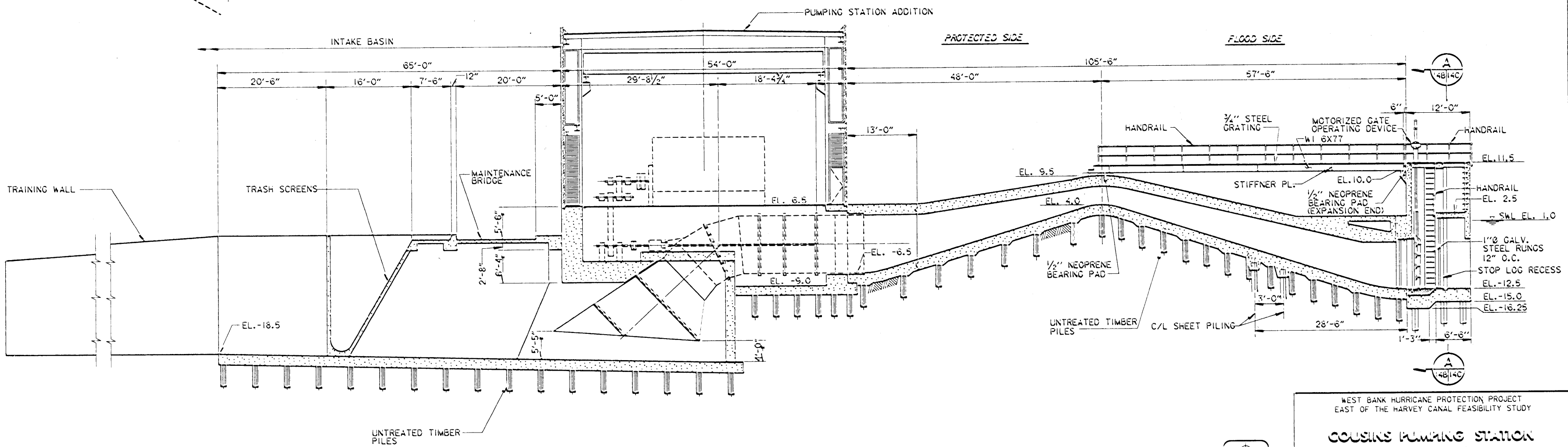
U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE: AUGUST 1994 FILE NO. EHCPL1A.DGN



PLAN

NOT TO SCALE



CROSS SECTION OF 1000 CFS PUMP ADDITION

NOT TO SCALE

SCALE: 1/8" = 1'- 0"

0 5' 10' 15' 20' 25'

C-A-D

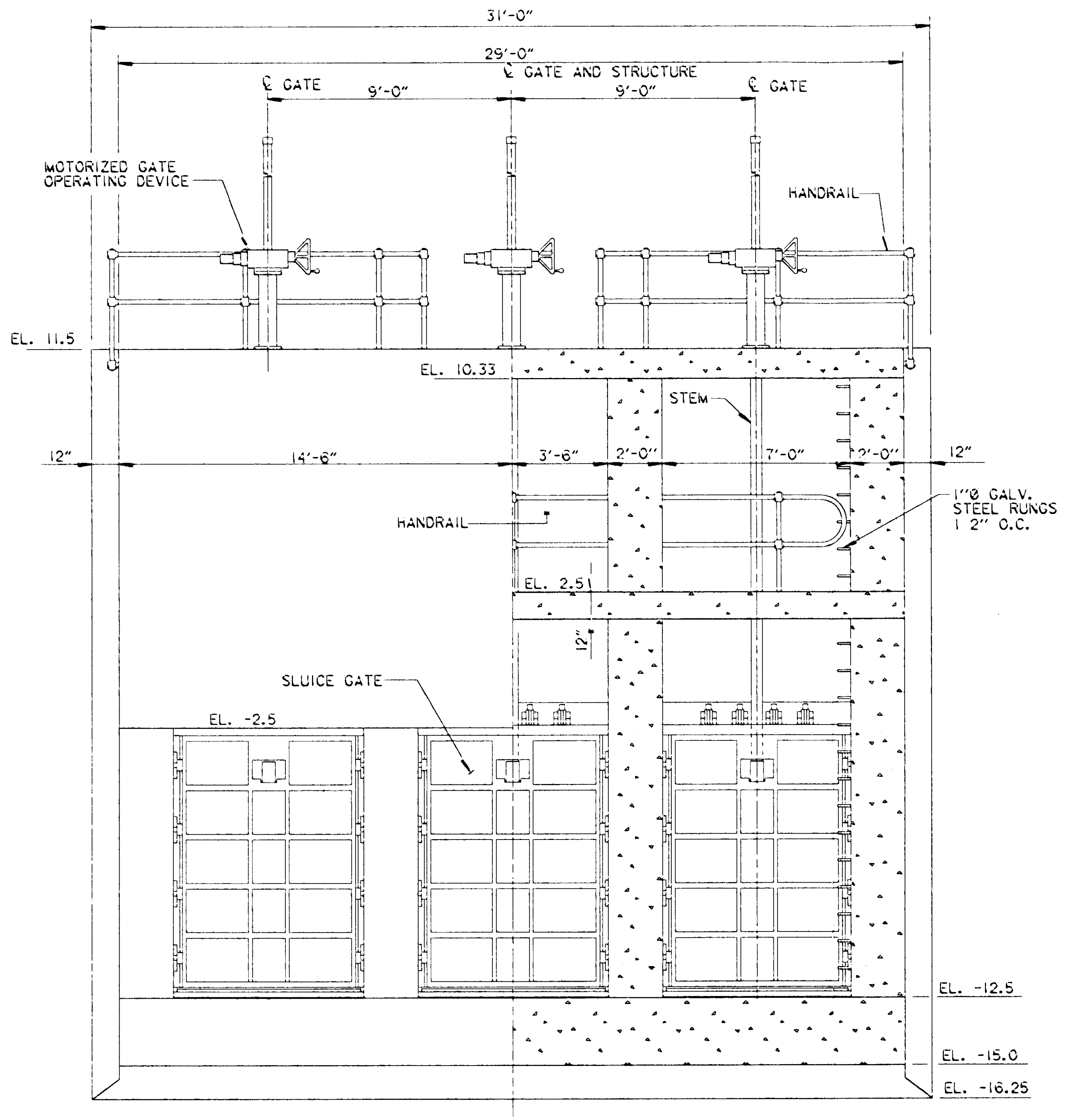
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

COUSINS PUMPING STATION ADDITION PLAN AND SECTION

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

DATE: AUGUST 1994 FILE NO. ENOPL148.DGN

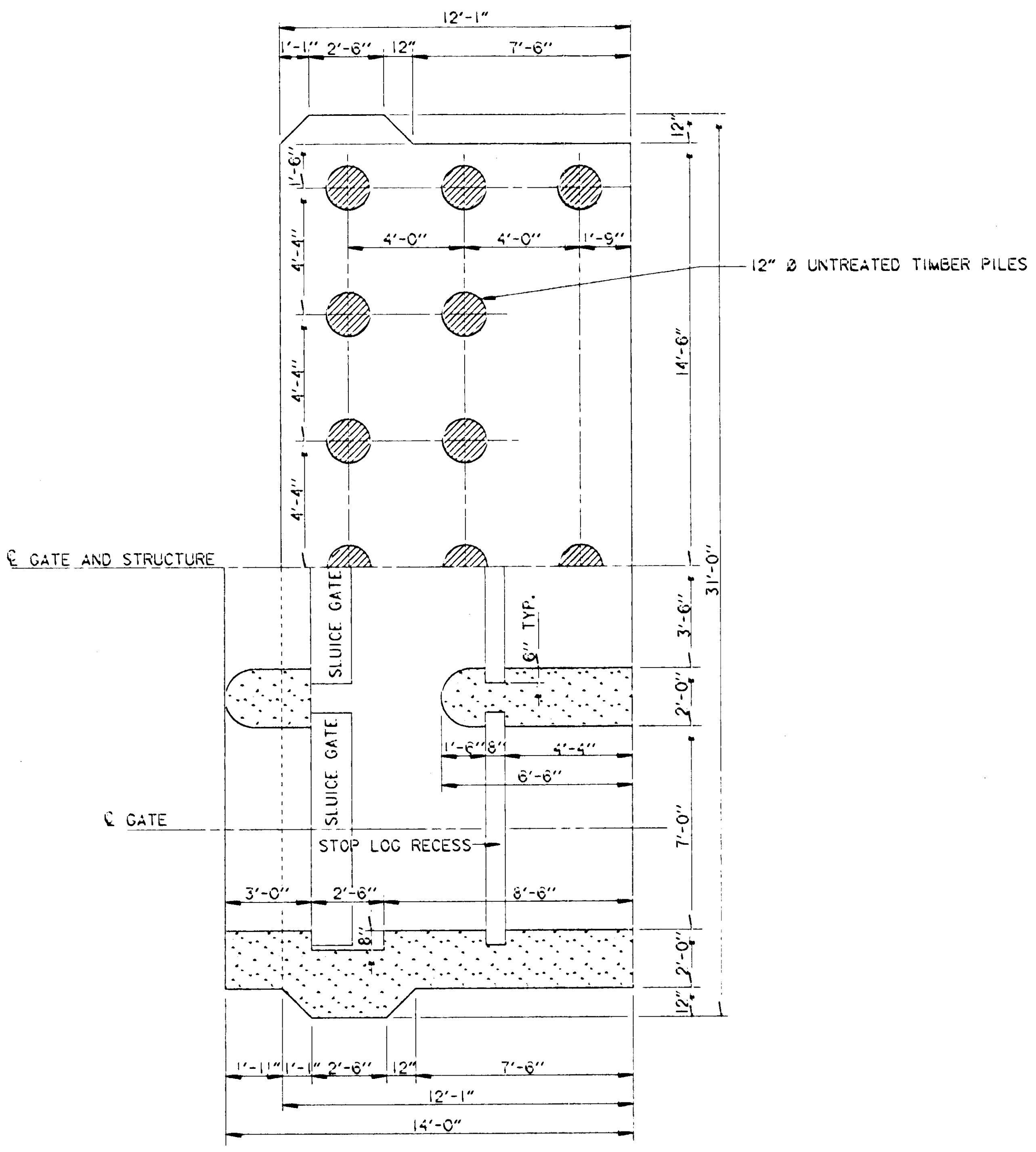
PLATE 148



SLUICE GATE STRUCTURE

SECTIONAL ELEVATION (A / 4B|14C)

SCALE: 3/8" = 1'- 0"



SLUICE GATE STRUCTURE

PLAN AND PILE LAYOUT

SCALE: 3/8" = 1'- 0"

SCALE: 3/8" = 1'- 0"

12" 0 2' 4' 6' 8' 10'

WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

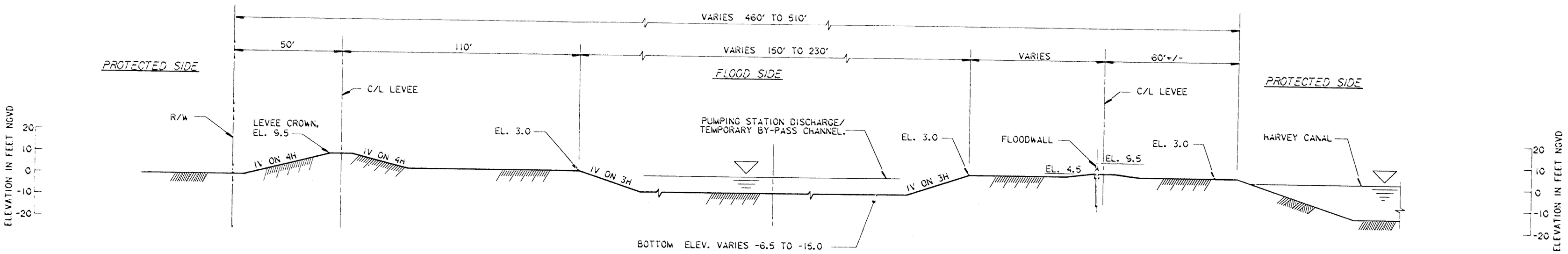
COUSINS PUMPING STATION MODIFICATION

SLUICE GATES AND DETAILS

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

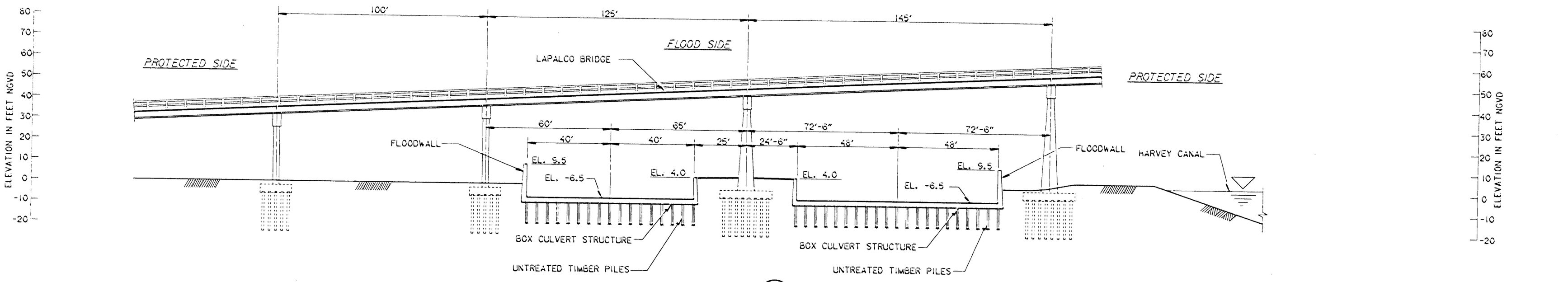
DATE: AUGUST 1994 FILE NO. EHCPL14C.DGN

PLATE 14C



SECTION A (14A|14D)

SCALE: 1"=20'-0"



SECTION B (14A|14D)

SCALE: 1"=20'-0"

SCALE: 1" = 20'

20' 0 20' 40' 60' 80'

D-A-D

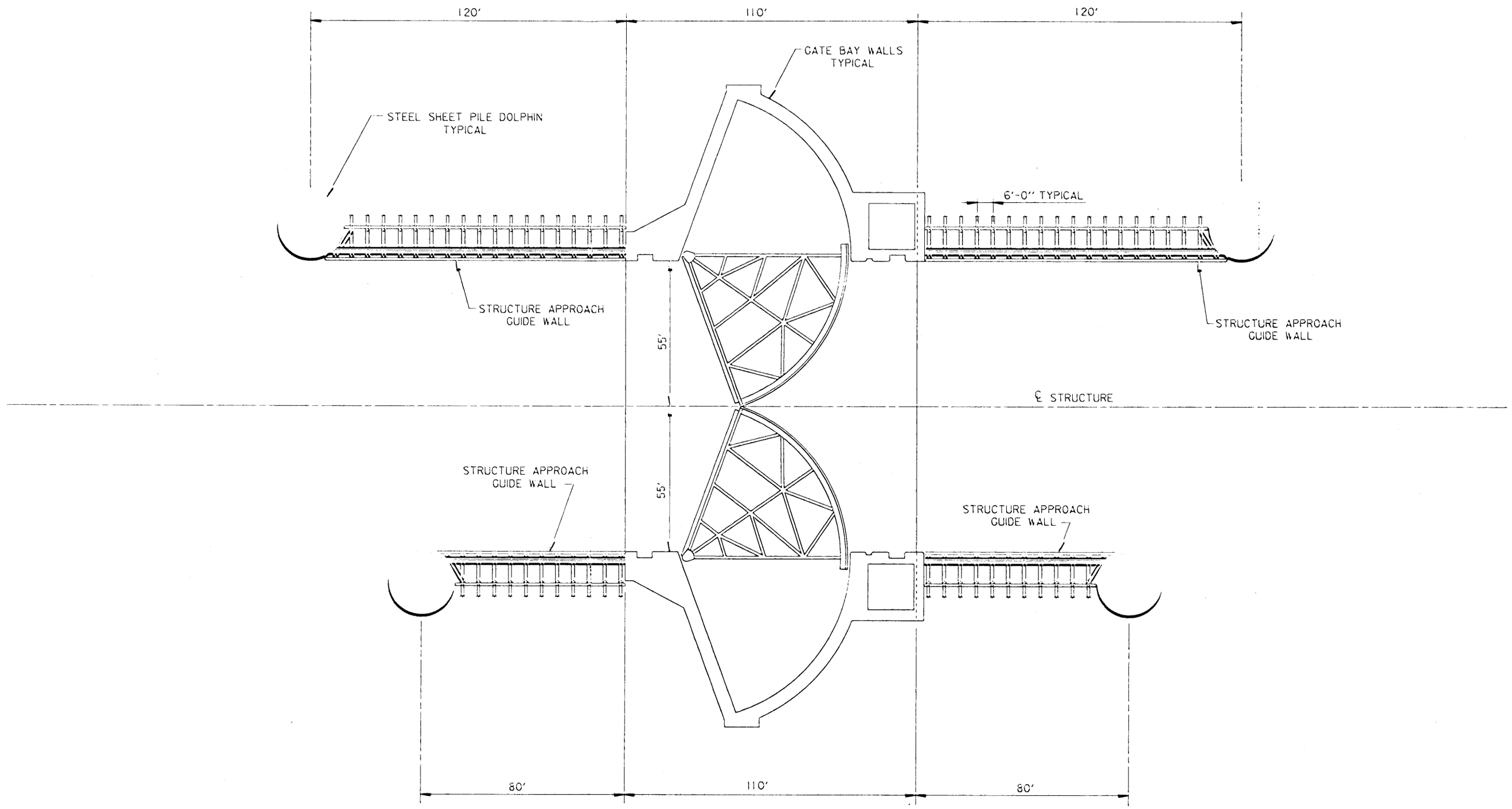
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

COUSINS PUMPING STATION ADDITION
DISCHARGE CHANNEL SECTIONS

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

DATE: AUGUST 1994 FILE NO. EHCPL14D.DGN

PLATE 14D



GENERAL PLAN

SCALE: 1" = 20'

SCALE: 1" = 20'

20' 0 20' 40' 60' 80'

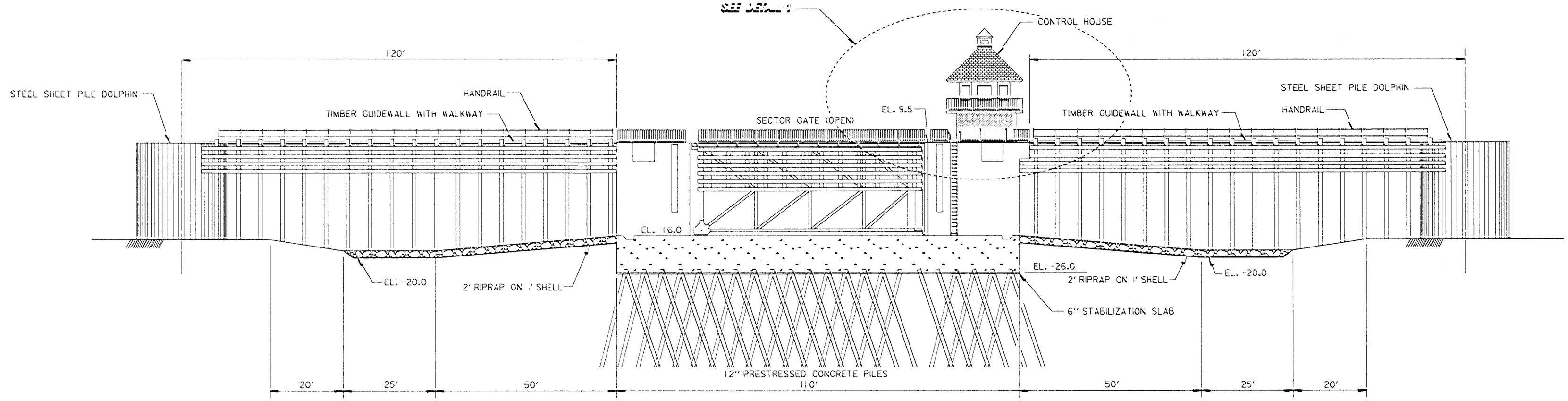
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

SECTOR GATE STRUCTURE GENERAL PLAN

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

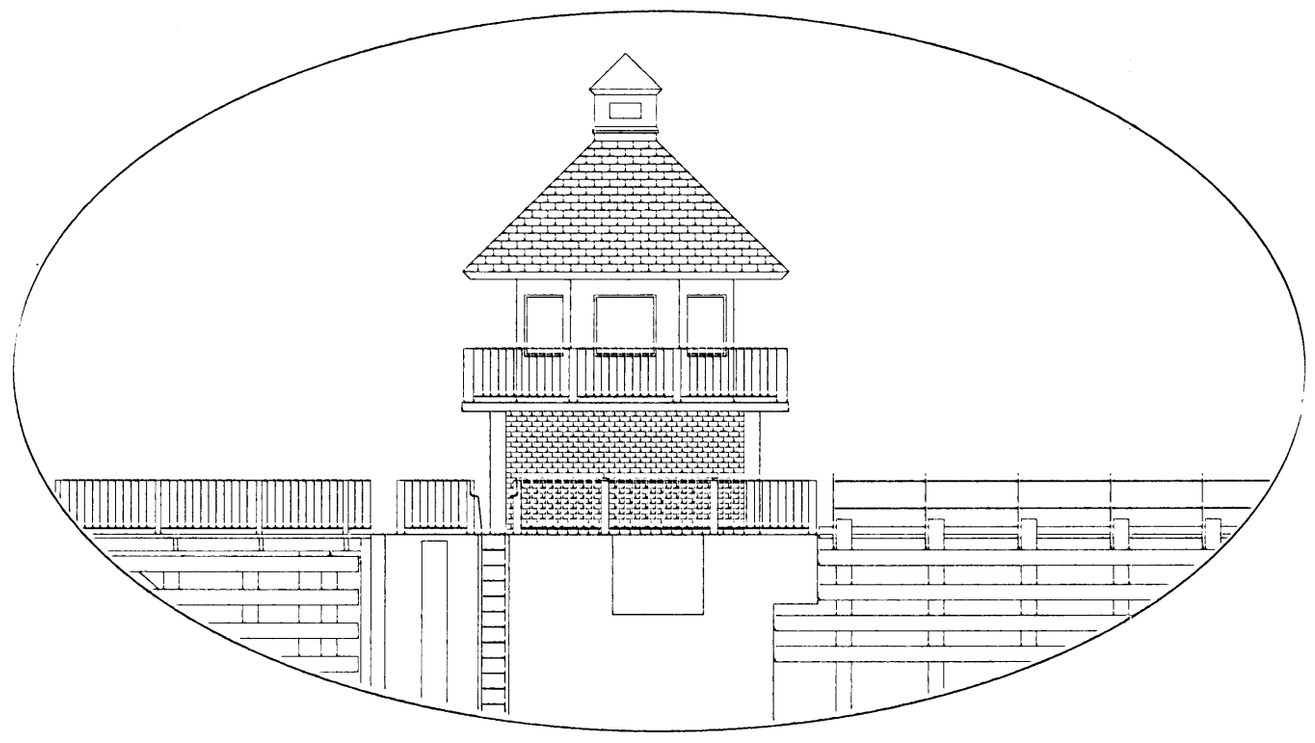
DATE: AUGUST 1994 FILE NO. EBMCPLIS.DGN

PLATE 15



LONGITUDINAL ELEVATION

SCALE: 1" = 12'



DETAIL 1

SCALE: 1" = 12'

12' 0 12' 24' 36' 48' 60'

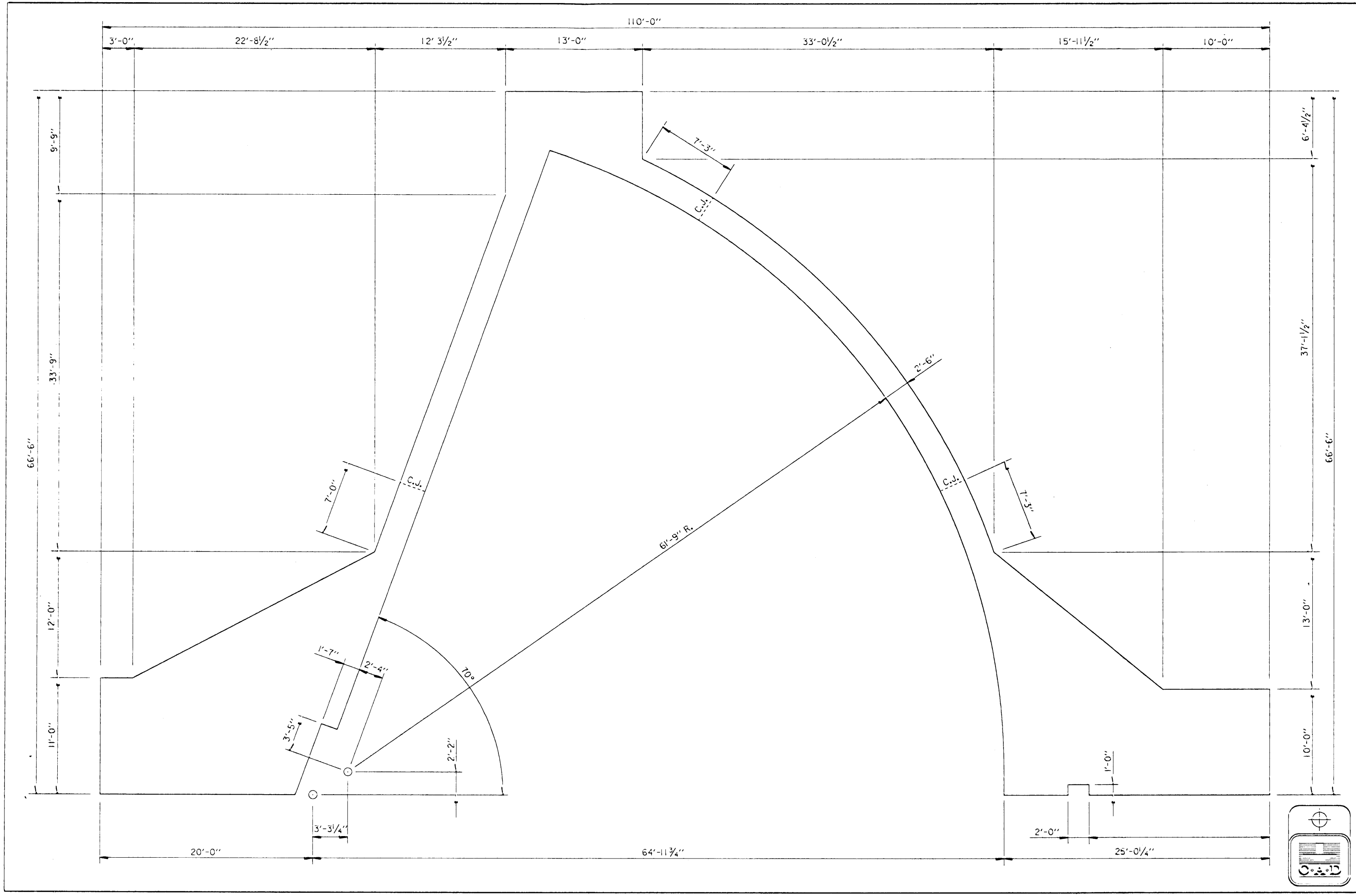
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

SECTOR GATE STRUCTURE LONGITUDINAL ELEVATION

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

DATE: AUGUST 1994 FILE NO. EHCPLI6.DGN

PLATE 16



GATE BAY WALL

SCALE: ¼" = 1'- 0"

SCALE: ¼" = 1'- 0"

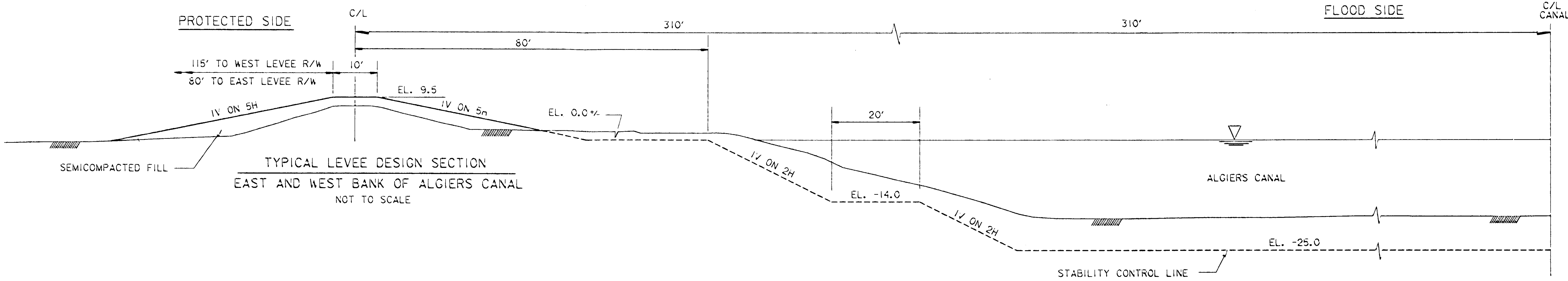
12" 0 5' 10' 15' 20'

SECTOR GATE STRUCTURE
GATE BAY
CONCRETE DIMENSIONS

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

DATE: AUGUST 1994 FILE NO: EHDPL17.DGN

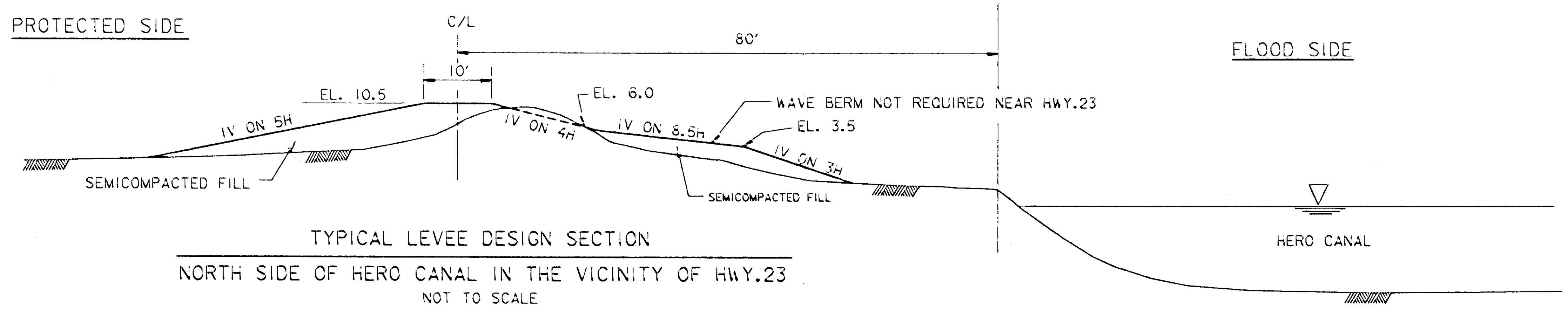
PLATE 17



TYPICAL LEVEE DESIGN SECTION

EAST AND WEST BANK OF ALGIERS CANAL

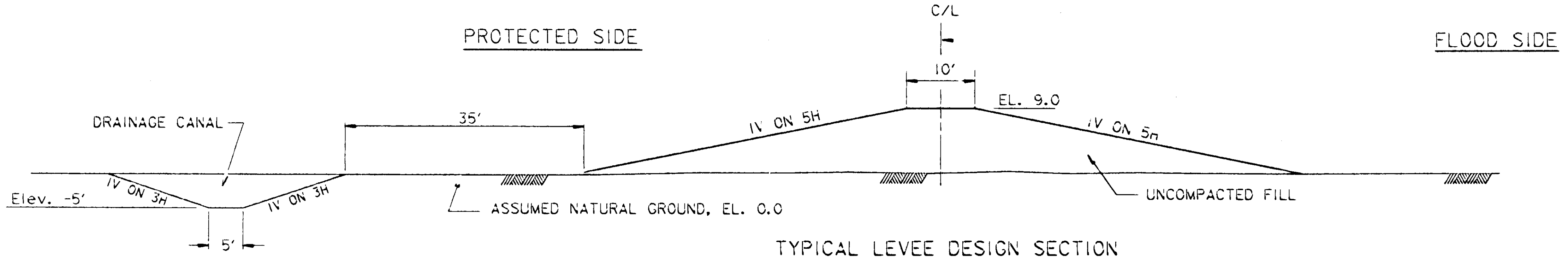
NOT TO SCALE



TYPICAL LEVEE DESIGN SECTION

NORTH SIDE OF HERO CANAL IN THE VICINITY OF HWY.23

NOT TO SCALE



TYPICAL LEVEE DESIGN SECTION

SOUTH OF HERO CANAL IN THE VICINITY OF HWY.23

NOT TO SCALE

COMPUTER AIDED DESIGN DRAFTING

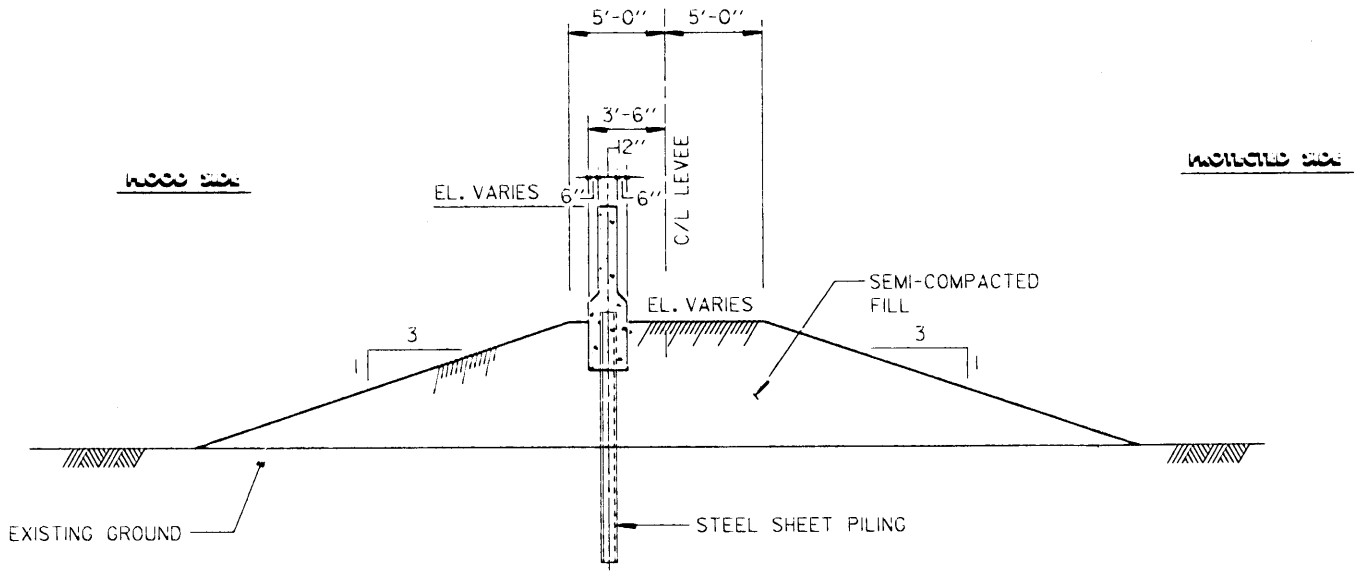
TYPICAL

LEVEE DESIGN SECTIONS

U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS

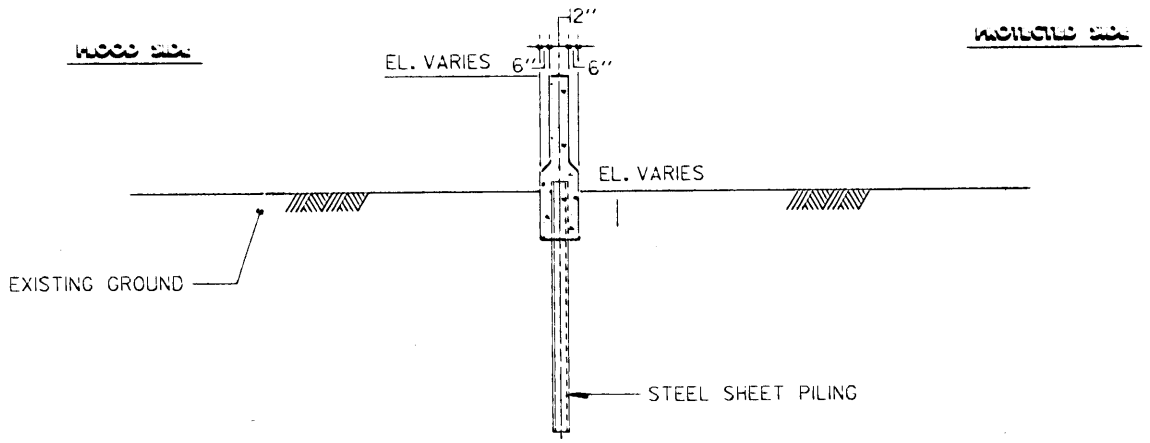
CORPS OF ENGINEERS

PLATE 18



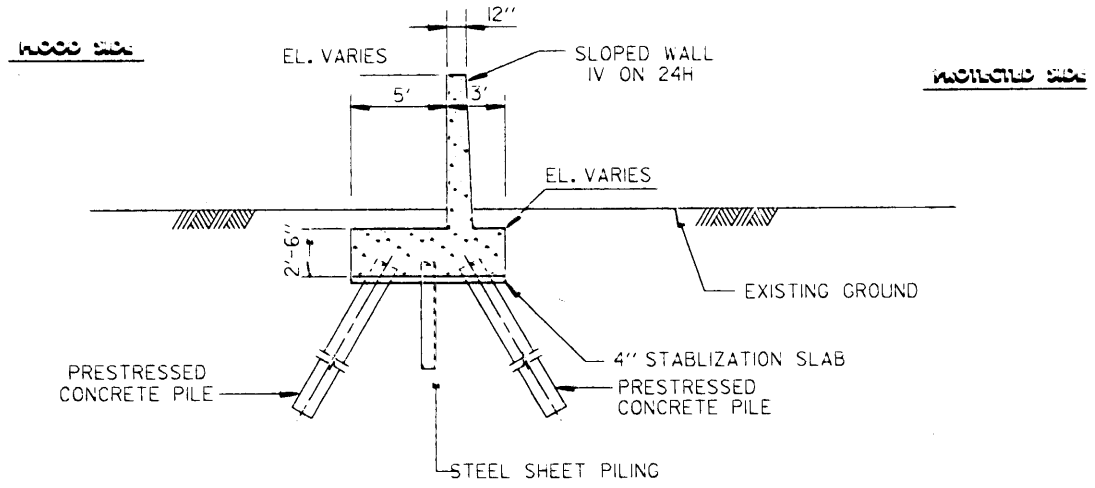
TYPICAL I-WALL - EARTH SECTION

SCALE: 1" = 5'



TYPICAL I-WALL SECTION

SCALE: 1" = 5'



TYPICAL INVERTED T-WALL SECTION

SCALE: 1" = 5'

SCALE: 1" = 5'

5' 0 5' 10' 15' 20'

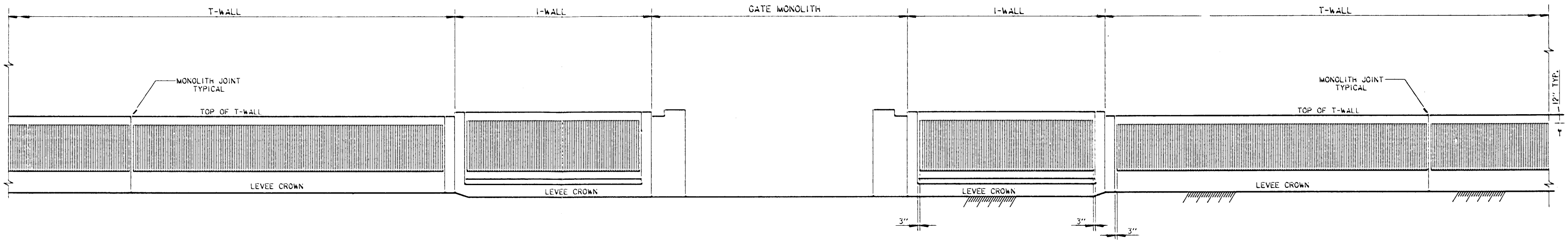
WEST BANK HURRICANE PROTECTION STUDY
EAST OF THE HARVEY CANAL

TYPICAL FLOODWALL SECTIONS

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

DATE: AUGUST 1994 FILE NO. ENCPLS.DGN

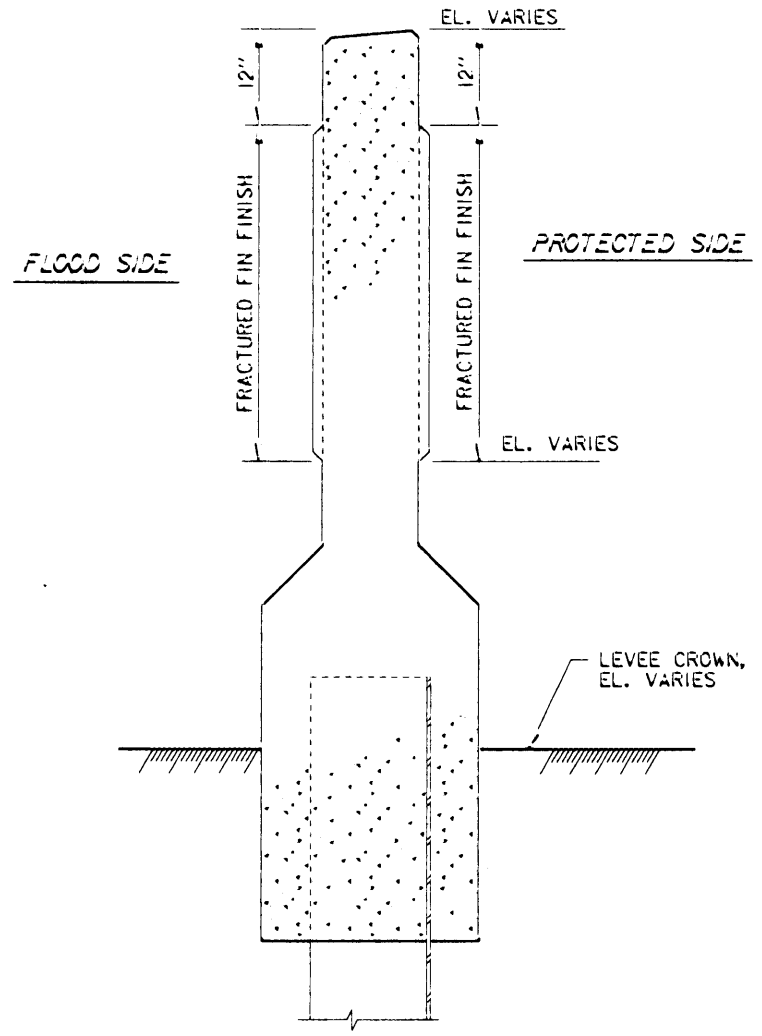
PLATE 13



FRACTURED FIN FINISH LAYOUT

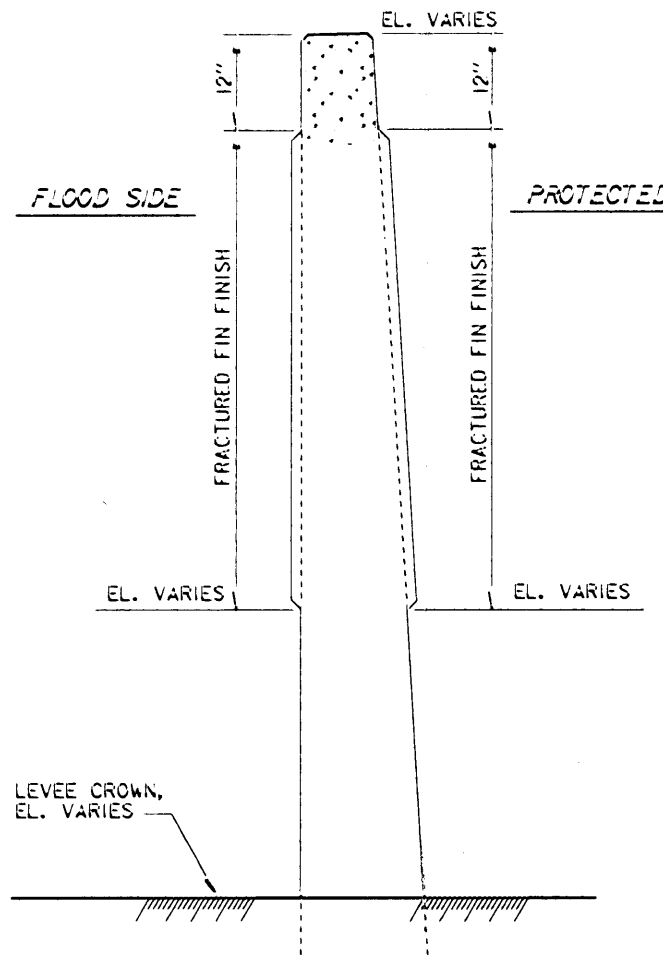
SCALE: 1" = 5'

NOTE:
FLOOD SIDE AND PROTECTED SIDE WILL HAVE FRACTURED FIN FINISH.



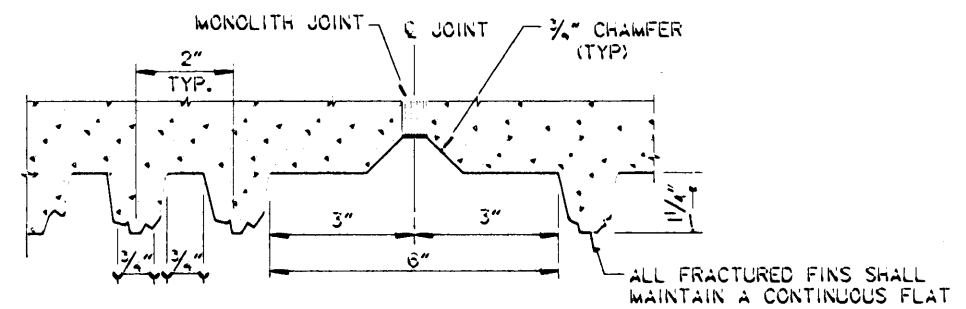
TYPICAL I-WALL SECTION

SCALE: 1" = 1'- 0"



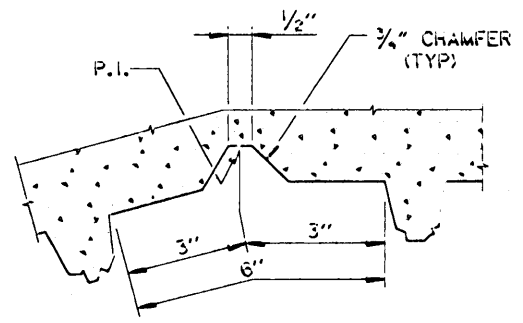
TYPICAL T-WALL SECTION

SCALE: 1" = 1'- 0"



FRACTURED FIN FINISH AT TYPICAL MONOLITH JOINT

SCALE: 6" = 1' - 0"



FRACTURED FIN FINISH AT P.I.

SCALE: 6" = 1' - 0"

SCALE: 1" = 5'

5' 0 5' 10' 15' 20'

SCALE: 1" = 1'- 0"

12" 0 1' 2' 3' 4' 5'

SCALE: 6" = 1' - 0"

6" 0 6"

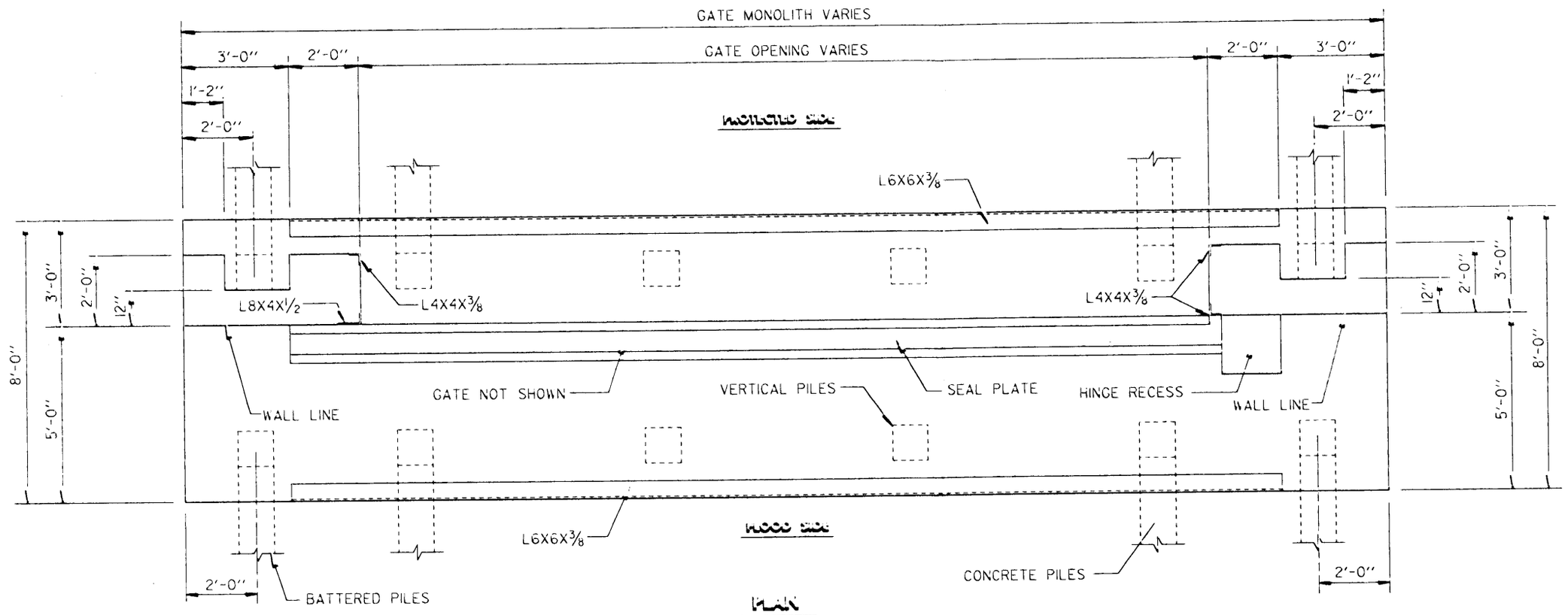
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

WALL TEXTURE TYPICAL DETAILS

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

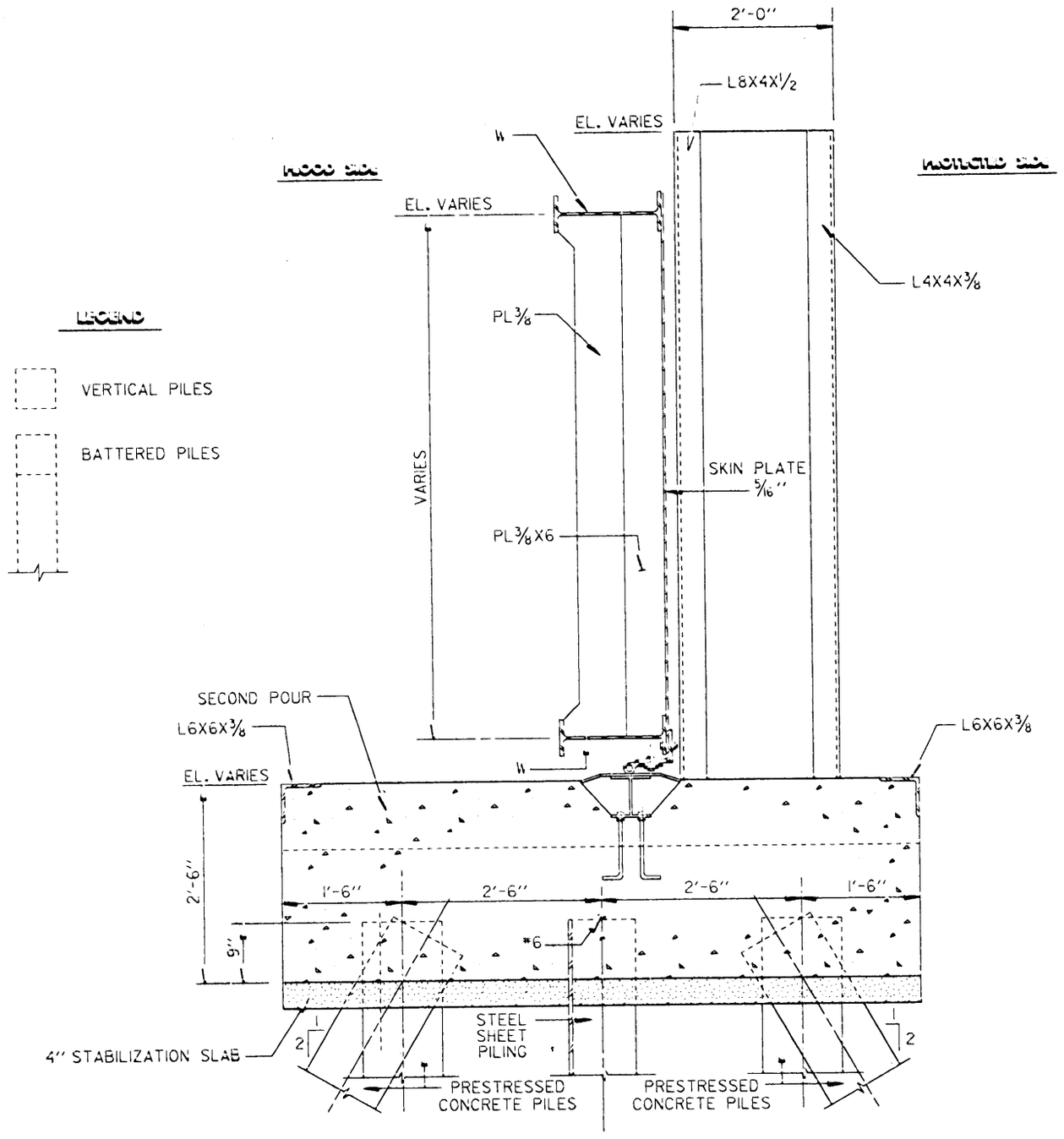
DATE: AUGUST 1994 FILE NO. EHOPLISALOGA

PLATE 15A



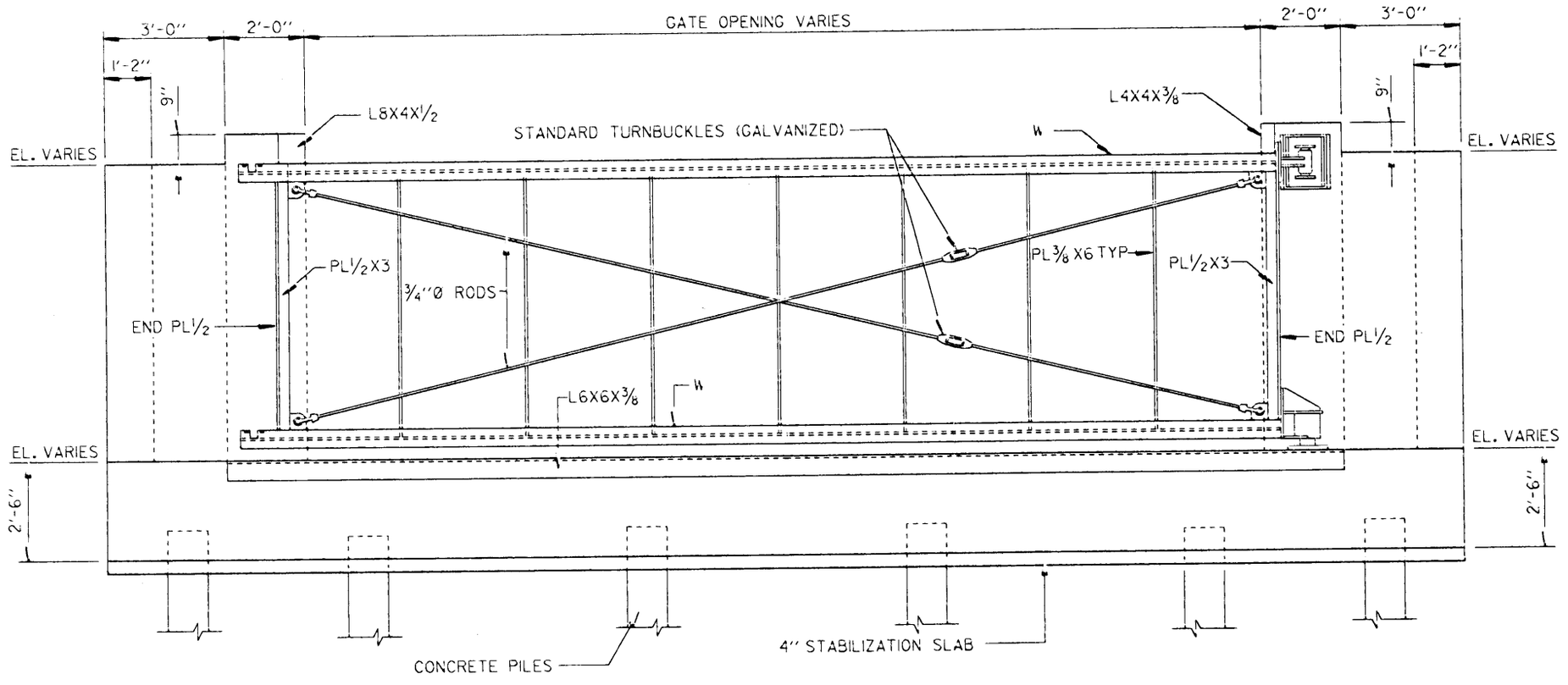
PLAN

SCALE: 1/2" = 1'-0"



TYPICAL SECTION

SCALE: 1" = 1'-0"



FLOOD SIDE ELEVATION

SCALE: 1/2" = 1'-0"

2' 0 2' 4' 6' 8'

SCALE: 1" = 1'-0"

1' 0 1' 2' 3' 4'

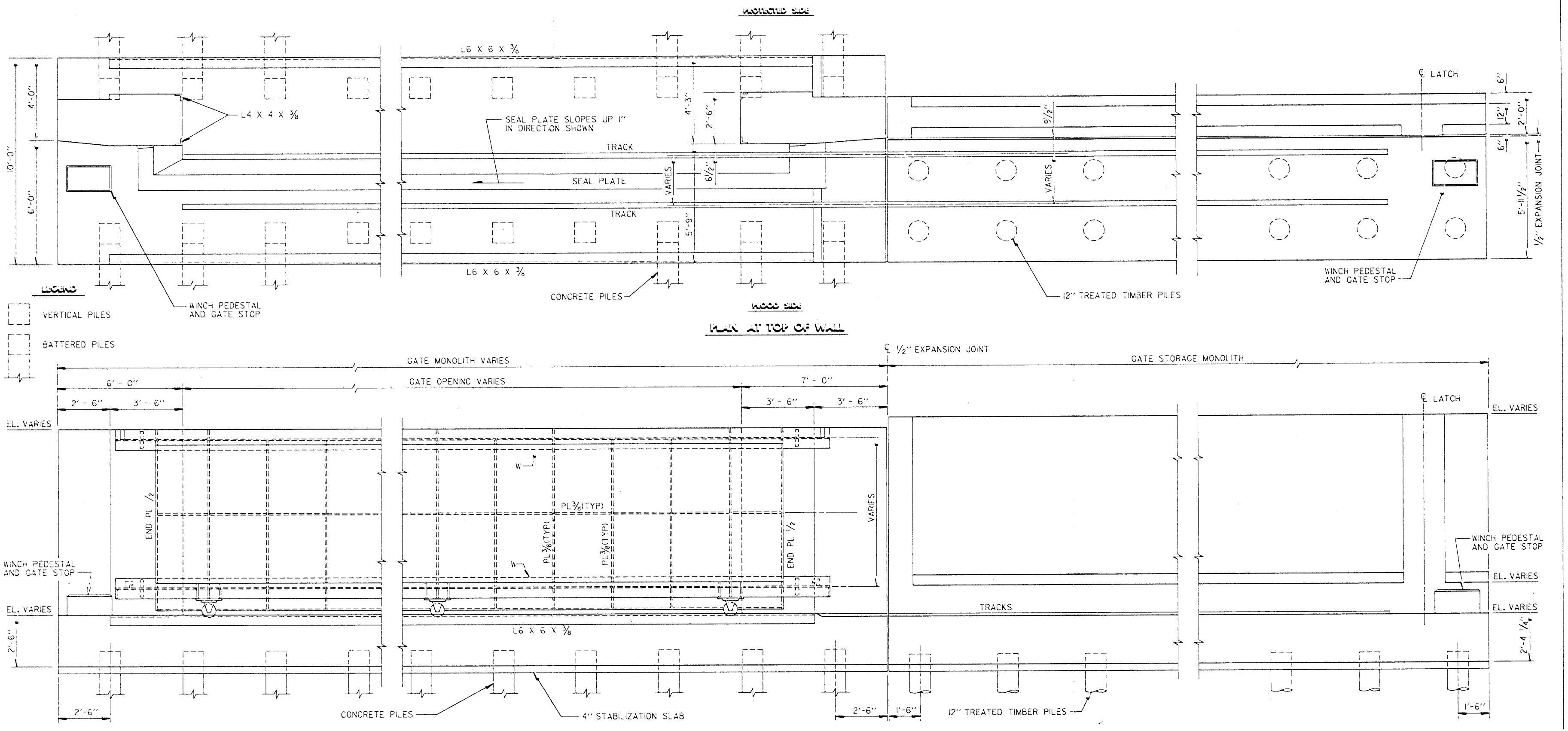
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

SWING GATE DETAILS

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

DATE: AUGUST 1994 FILE NO. EHOPL20.DGN

PLATE 20



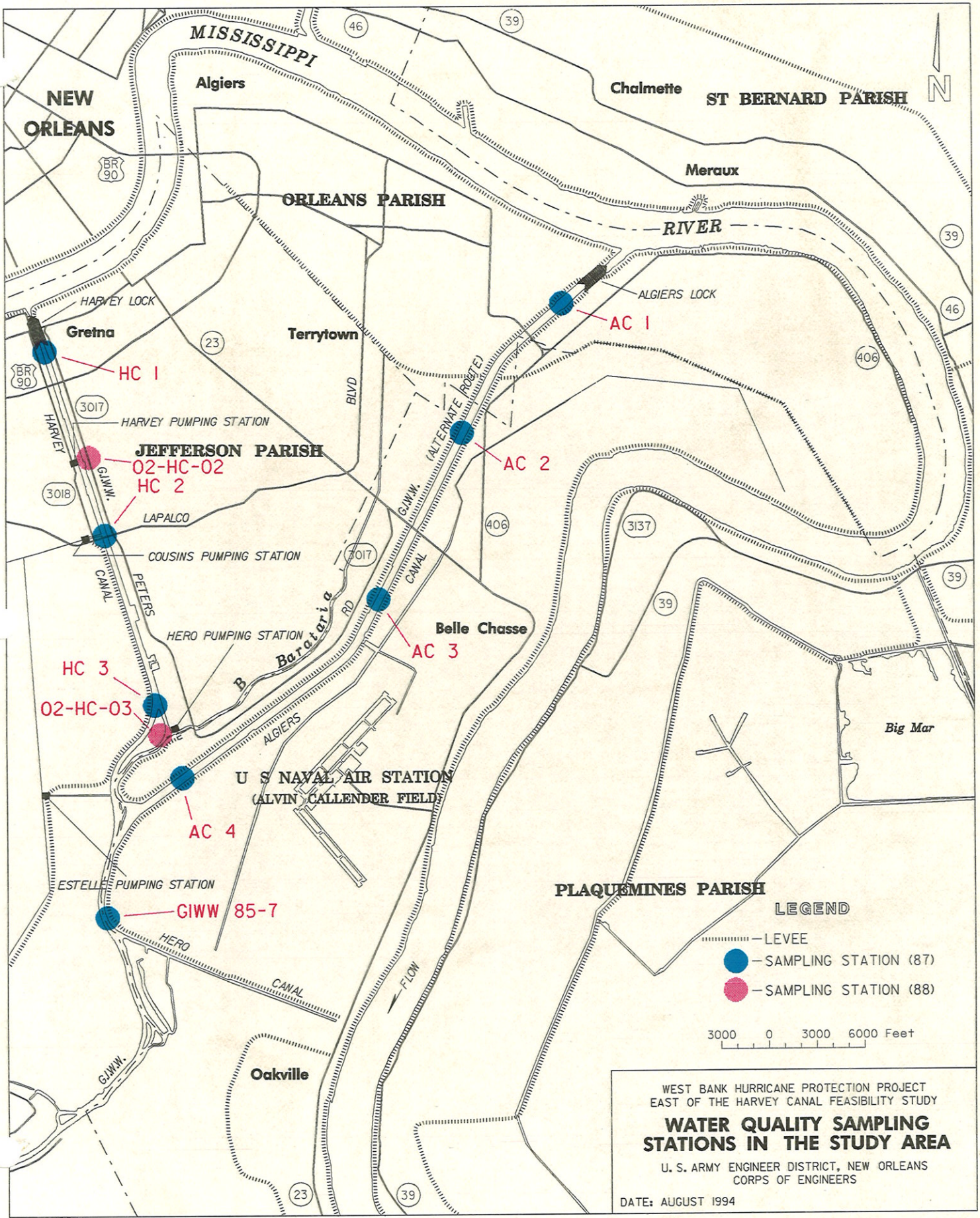
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

BOTTOM ROLLER GATE

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

DATE: AUGUST 1994 FILE NO. EHCPE2LDGA

PLATE 22



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

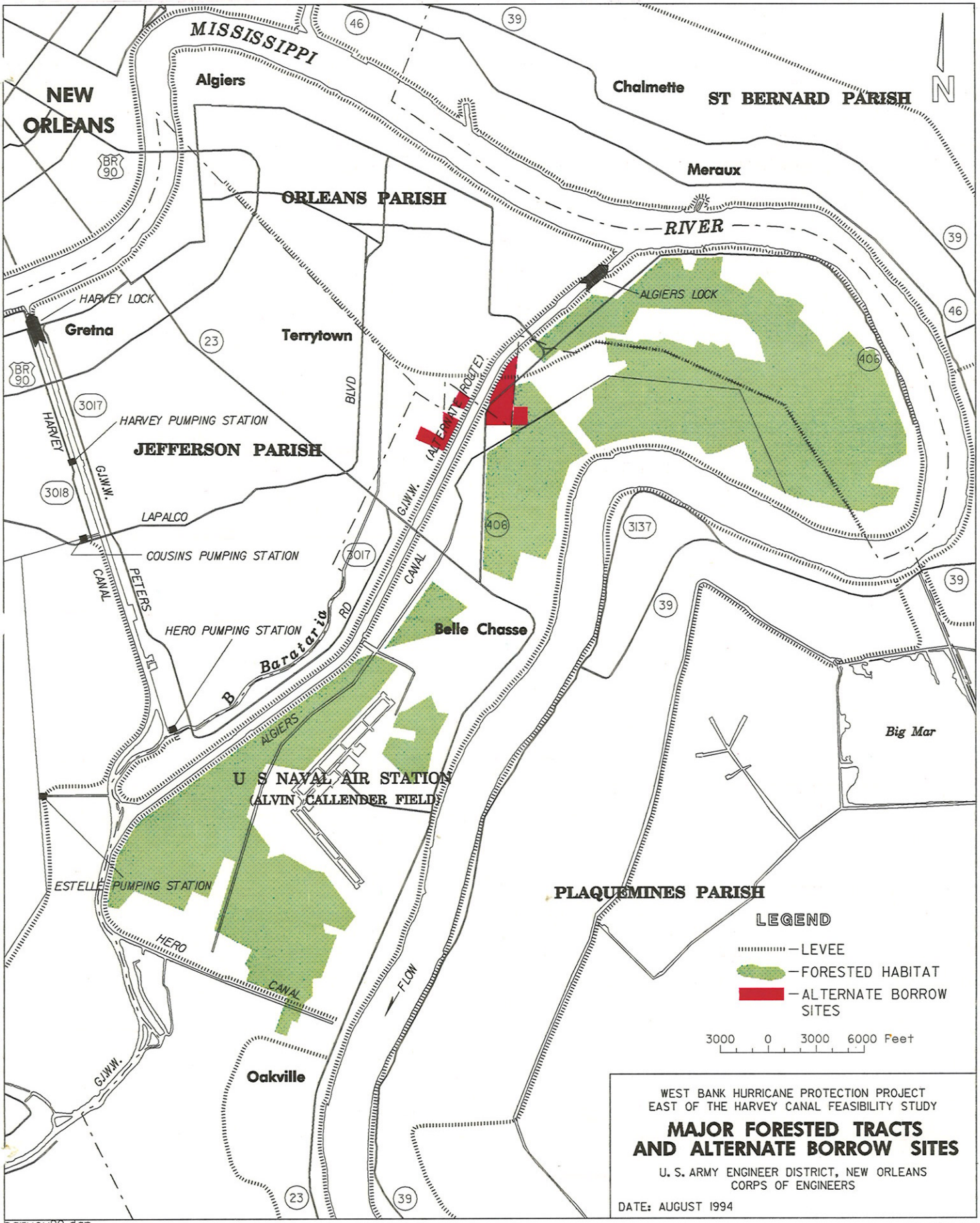
WATER QUALITY SAMPLING STATIONS IN THE STUDY AREA

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

DATE: AUGUST 1994

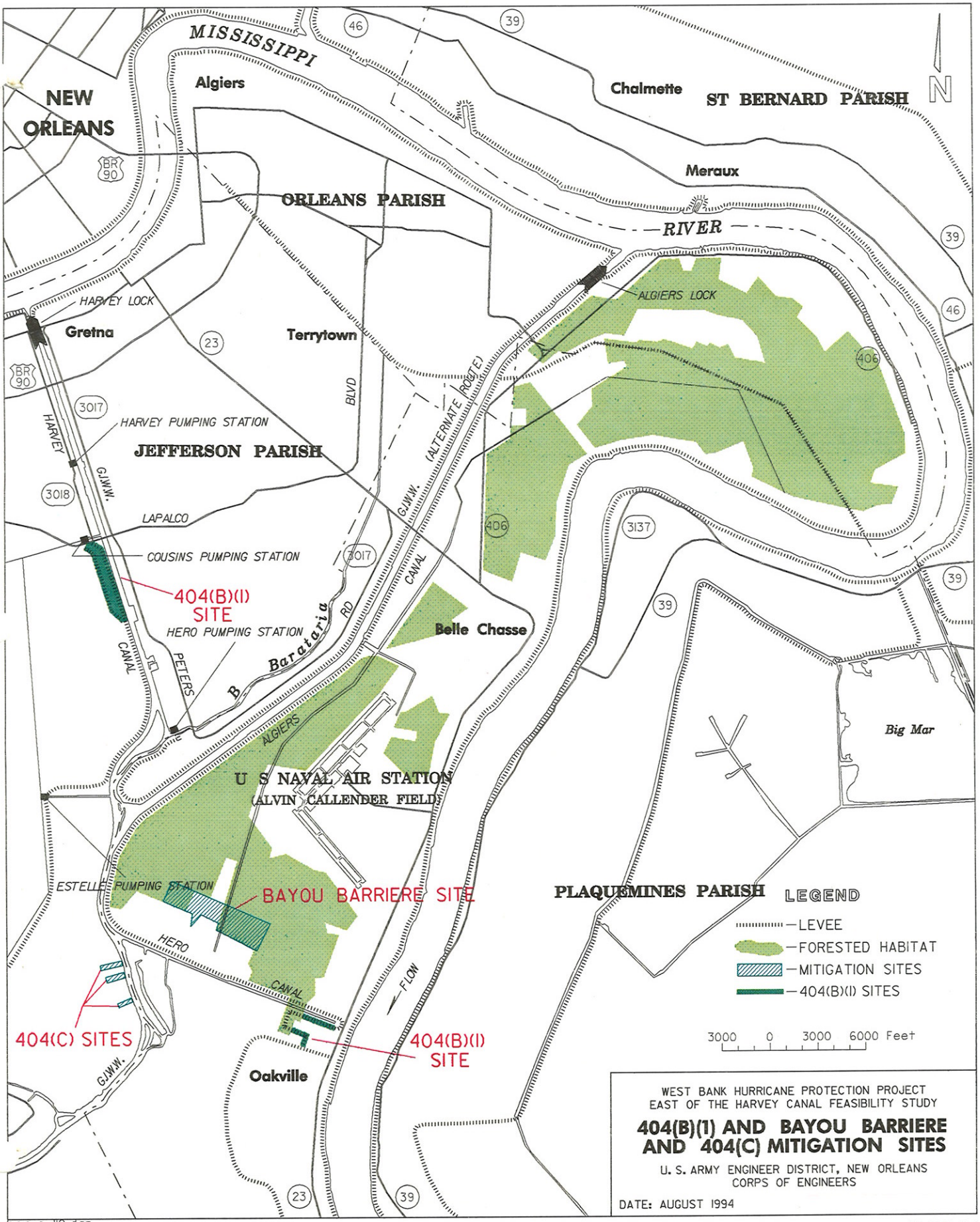
harvey100.dgn

PLATE 22



harvey90.dgn

PLATE 23



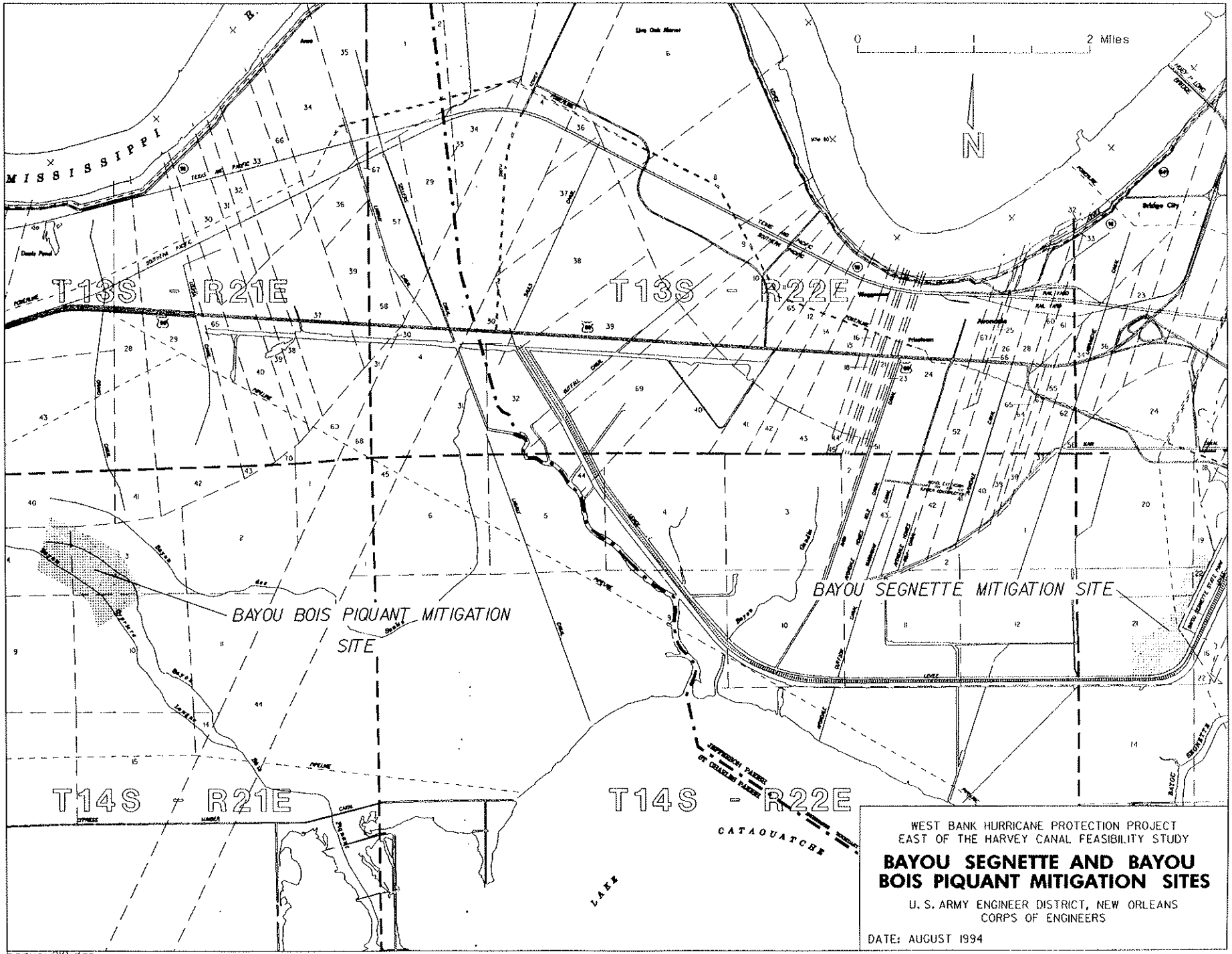
WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

404(B)(1) AND BAYOU BARRIERE AND 404(C) MITIGATION SITES

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

DATE: AUGUST 1994

harveyll0.dgn



WEST BANK HURRICANE PROTECTION PROJECT
EAST OF THE HARVEY CANAL FEASIBILITY STUDY

BAYOU SEGNETTE AND BAYOU BOIS PIQUANT MITIGATION SITES

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

DATE: AUGUST 1994

harvey210.dgn

PLATE 25