Draft

REVISED PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Morganza to the Gulf of Mexico, Louisiana

January 2013

U.S. Army Corps of Engineers
New Orleans District

Coastal Protection and Restoration Authority Board

Terrebonne Levee and Conservation District

ABSTRACT

The U.S. Army Corps of Engineers – Mississippi Valley Division, New Orleans District (CEMVN) – proposes to make changes and improvements in the planning, design, construction, operation, and maintenance of the Morganza to the Gulf hurricane and storm damage risk reduction system project to prevent future disasters to the greatest extent possible. The purpose of this project is to reduce the risk of damage caused by hurricane storm surges. The project is needed because of the increasing susceptibility of coastal communities to storm surge due to wetland loss, sea level rise, and subsidence. The project is located approximately 60 miles southwest of New Orleans, Louisiana, and includes most of Terrebonne Parish and the portion of Lafourche Parish between the Terrebonne Parish eastern boundary and Bayou Lafourche.

Alternatives investigated are a 1% Annual Exceedance Probability (AEP) Storm Surge Risk Reduction System, which would provide risk reduction for water levels that have a 1 percent chance of occurring each year, and a 3% AEP Storm Surge Risk Reduction System, which would provide risk reduction for water levels that have a 3 percent chance of occurring each year. A sponsor-funded additional work item, which would involve deepening the Houma Navigation Canal Lock Complex to -23 feet NAVD88, is an option that could be incorporated into either the 1% or 3% AEP alternatives. The two action alternatives include programmatic elements that would be further investigated in the future and constructible elements for which this Revised Programmatic Environmental Impact Statement would serve as the required documentation under the National Environmental Policy Act. The 1% AEP Alternative is the Tentatively Selected Plan because of increased level of risk reduction and the opportunity for being incorporated into future navigation improvements.

The major impact of the project is the loss of wetlands within the project right of way. Mitigation for wetland impacts would be through the restoration of eroded and subsided wetlands in the project area. The project would complement state and Federal coastal restoration projects in the area by reducing the risk of coastal erosion due to storm surges.

Comments: Please send comments or questions on this Draft Revised Programmatic Environmental Impact Statement (RPEIS) to the U.S. Army Corps of Engineers, New Orleans District, Attention: Nathan Dayan, P.O. Box 60267, New Orleans, LA 70160-0267. Telephone: (504) 862-2530; Fax (504) 862-1892. The official Closing Date before Federal Action can occur on this project will be 45 days from the date on which the Notice of Availability of this Draft RPEIS appeared in the *Federal Register*.
(http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR)

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1. SUMMARY

Major Conclusions and Findings

This Revised Programmatic Environmental Impact Statement (RPEIS) was prepared as a draft response to the Draft Morganza to the Gulf of Mexico, Louisiana, Post Authorization Change (PAC) Report dated January 2013. Because of the loss of life and damage caused by Hurricanes Katrina and Rita in 2005, the USACE has made changes and improvements in the planning, design, construction, operation, and maintenance of hurricane risk reduction projects to prevent future disasters to the greatest extent possible. New design guidelines have been incorporated into revised project alternatives, the environmental effects of which are assessed in this Draft RPEIS.

Authorization: House Resolution, Docket 2376, April 30, 1992, and WRDA 96 (PL 104-303, Sec 425) are the base documents authorizing the project. Following completion of an April 1994 Reconnaissance Report, the Energy and Water Development Appropriation Act of 1995 (PL 103-316) authorized the Morganza, Louisiana, to the Gulf of Mexico feasibility study. It directed the USACE to give particular attention to the interrelationships of the various ongoing studies in the area, and consider improvements for the Houma Navigation Canal (HNC). Section 425 of WRDA 96 (PL 104-303) required the USACE to develop a study of the HNC lock as an independent feature of the Morganza to the Gulf project. That study was completed in 1997. In 1998, Congress authorized the USACE to initiate detailed design of the multipurpose lock in the HNC. The Pre-Construction, Engineering and Design (PED) phase on the HNC Lock Complex was initiated in advance of the PED phase for the Morganza to the Gulf of Mexico, Louisiana Project. The PED Agreement for the lock was signed on January 13, 2000.

The Morganza to the Gulf Feasibility Study and Final PEIS were completed in March 2002 (http://www.mvn.usace.army.mil/prj/mtog/). The FPEIS was filed in the Federal Register on May 3, 2002 (http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR). A Record of Decision (ROD) was not signed. Section 158 of the Energy and Water Development Appropriations Act, 2004 (PL 108-137) authorized construction on reach J1 of the levee identified as work-in-kind. In accordance with the 2002 and 2003 reports of the Chief of Engineers, the Morganza project is authorized as a feature of the Mississippi River and Tributaries (MR&T). Section 1001 of WRDA 2007 (Public Law 110-114) authorized construction for the project. To date, Congress has not appropriated any construction funds. Therefore, the project remains in Pre-Construction, Engineering and Design phase.

Purpose: The purpose of this project is to reduce the risk of damages caused by hurricanes and storms for the communities located within the levee system. The project is needed because of the increasing susceptibility of coastal communities to storm surge due to wetland loss, sea level rise, and subsidence.

Project Location: The project is located approximately 60 miles southwest of New Orleans, Louisiana, and includes most of Terrebonne Parish, excluding the barrier islands, and the portion of Lafourche Parish between the Terrebonne Parish eastern boundary and Bayou Lafourche. The

project area boundary is shown in red in Figure 1-1. The levee alignment of the Tentatively Selected Plan (TSP) is shown in yellow. The project area extends south to the saline marshes bordering the Gulf of Mexico.

Study Partner (Non-Federal Sponsor): The Non-Federal Sponsors for the project are the Louisiana Coastal Protection and Restoration Authority Board (CPRAB) and the Terrebonne Levee and Conservation District (TLCD).

ALTERNATIVES CONSIDERED

1% Annual Exceedance Probability Storm Surge Risk Reduction System (1% AEP Alternative): The 1% AEP provides risk reduction for water levels that have a 1% chance of occurring each year. The 98-mile levee system would extend from high ground along US 90 near the town of Gibson and tie into the Hwy 1 near Lockport, LA in Lafourche Parish. Planned levee elevations range from 15 to 26.5 feet NAVD88. Toe-to-toe levee widths range from 282 feet to 725 feet. Twenty-two floodgates on navigable waterways, ranging in elevation from 17 to 33 feet (NAVD88), would be located on waterways throughout the levee system, including a lock complex on the HNC. Additionally, environmental water control structures would allow tidal exchange at 23 locations through the levee through sluice gates and box culverts.

Nine road gates would be located at the following levee/road crossings: NAFTA, Four Pointe Road, Highway 315 (DuLarge), Highway 55, Highway 56, Hwy 24, Hwy 3235, Union Pacific RR and Highway 665. Fronting protection would be provided for four pumping stations, including the Madison, Pointe aux Chenes, Elliot Jones (Bayou Black), and Hanson Canal pump stations.

The HNC Lock Complex (Figure 1-2) would consist of a 110-foot by 800-foot lock, an adjacent 250 foot-wide sector gate, and a dam closure. The complex would tie into adjacent earthen levees to reduce the risk of storm surge traveling up the HNC. Vessel traffic would pass through the sector gate portion of the structure for the majority of conditions. However, when the sector gates are closed, the lock would be used. The complex would be constructed as part of the Morganza to the Gulf of Mexico, Louisiana project but could also be operated for environmental purposes as part of the Louisiana Coastal Area (LCA) project "Convey Freshwater to Northern Terrebonne Marshes/Multipurpose Operation of the Houma Navigation Lock."

Several LCA projects authorized by WRDA 2007 are located within the Morganza study area, including but not limited to: (1) Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock (2) Modification of Davis Pond Diversion and (3) Land Bridge between Caillou Lake and Gulf of Mexico. By letters dated August 20, 2012 and October 16, 2012, CPRAB has notified the Corps that it desires to suspend study and design on these projects. The decision of CPRAB to suspend these projects results in some degree of uncertainty regarding implementation of these projects as part of the authorized Federal LCA.

Figure 1-1. Project Area and Levee Alignment of the Tentatively Selected Plan

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC Gulf Engineers & Consultants

Figure: 1-1
Date: June 2012
Scale: 1:384,000
Source: USDA/GEC
Map ID: 273160010-2811

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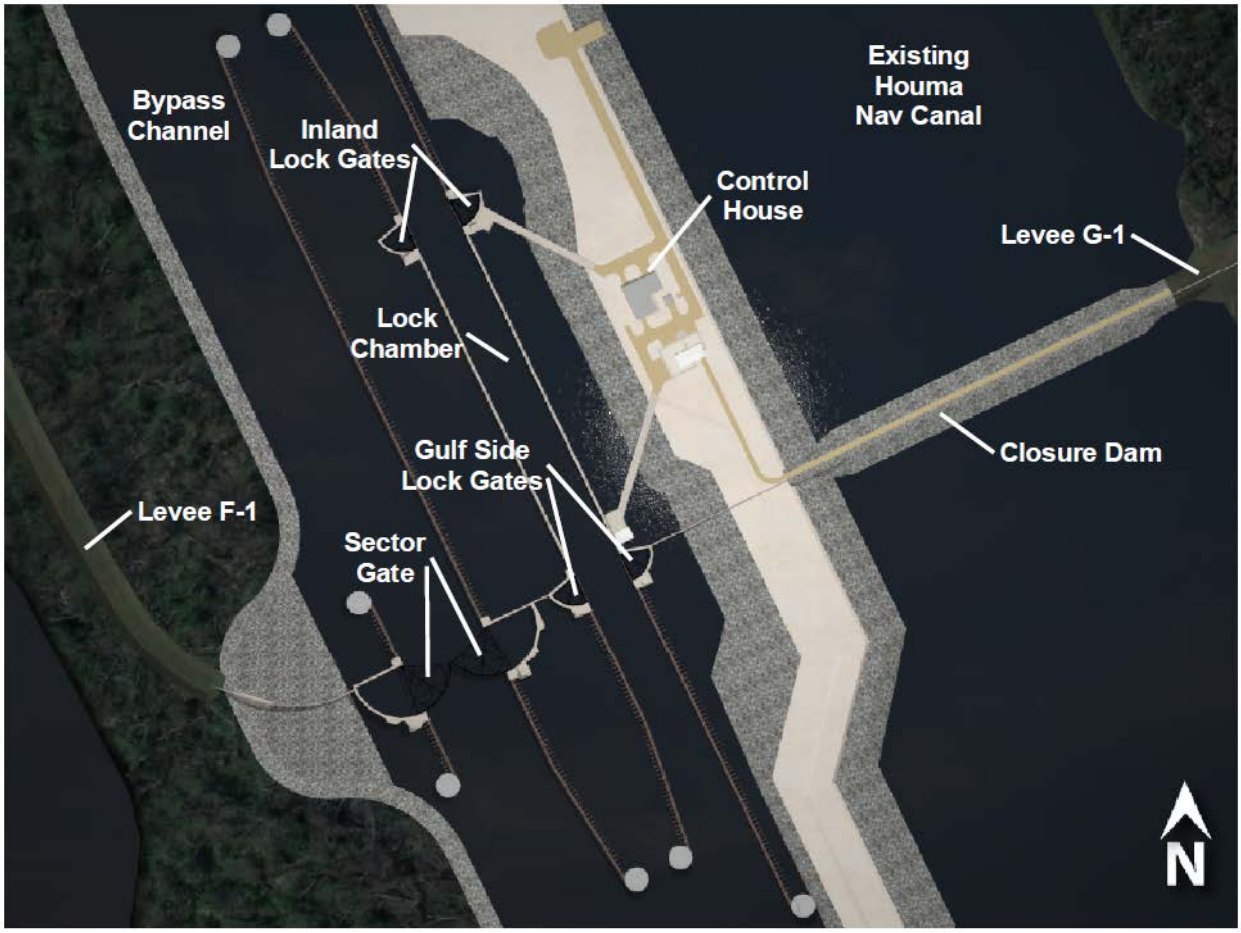

Figure 1-2. Houma Navigation Canal Lock Complex

3% Annual Exceedance Probability Storm Surge Risk Reduction System (3% AEP Alternative): The 3% AEP Alternative would provide risk reduction for water levels that have a 3 percent chance of occurring each year. This alternative would have nearly the same alignment and structures as the 1% AEP Alternative but with levees and structures at lower elevations to meet post-Katrina 3 percent standards. The levee alignment would extend 98 miles. Planned levee elevations range from 12.0 to 20.0 feet NAVD88. Toe-to-toe levee widths range from 174 feet to 440 feet. structures would range from elevations of 14.0 to 25.0 feet NAVD88.

A sponsor-funded additional work item, which is considered an optional feature of both alternatives, would involve deepening the HNC Lock Complex to -23 feet NAVD88. This plan would be implemented in anticipation of a proposal to deepen the HNC, which is the subject of an ongoing feasibility analysis currently being completed by CPRAB. Implementation of the sponsor-funded additional work item would alleviate the necessity of reconstructing the HNC Lock Complex should the HNC deepening project eventually be authorized and funded. Because of the present uncertainty as to the canal deepening, the environmental impacts of the HNC deepening project would be assessed in a separate National Environmental Policy Act (NEPA) document.

RATIONALE FOR DESIGNATION OF THE SELECTED PLAN

The 1% AEP Alternative is the TSP for the following reasons:

- Higher net benefits. According to WRDA Implementation guidance dated May 25, 2011, "recommendations in the PAC report should be made in consideration of maximizing excess benefits over costs." Both plans have positive benefit-cost ratios, but net benefits (excess benefits over costs) for the 1% AEP alternative plan are higher than the net benefits of the 3% AEP alternative plan.
- Lower residual risk. The 3% AEP alternative has a higher probability of overtopping and/or levee breaches than the 1% AEP alternative and therefore has higher residual damages than the 1% AEP alternative.
- More adaptable. The 1% AEP structures would be constructed at higher elevations than the 3% AEP structures, which allows more flexibility to adapt to relative sea level rise in the future. Although the total cost of the 1% AEP alternative is significantly higher than the 3% AEP alternative, not all funding and expenditures are required up front since earthen levees would be constructed in multiple lifts.

CONSTRUCTION

Levees would be constructed using a combination of sidecast and hauled-in borrow materials. Adjacent sidecast was planned for the pre-load section only (3% and 1% alternatives). Haul in scenarios were planned for the initial (1st) lift and projected subsequent lifts for the 3% and 1% alternatives. Borrow pits are oversized to offset the potential for encountering organics, expected losses, etc. The TSP would involve constructing 22 floodgates on navigable waterways, 23 environmental water control structures, nine road gates, and fronting protection for four existing pumping stations. Structures on federally maintained navigation channels include the HNC Lock Complex (and 250-ft sector gate) and two 125-ft sector gates on the GIWW east and west of Houma. In addition, thirteen 56-ft sector gates and five 20- to 30-ft stop log gates are located on various waterways that cross the levee system.

Should CPRAB enter into such an agreement, operation and maintenance of the Morganza to the Gulf project would require the Terrebonne and Lafourche levee districts to expand their current operation and maintenance programs of local levees and other flood control features. The completed project would require mowing approximately 98 miles of earthen levees and dewatering and refurbishing numerous sector gate structures every 10 to 15 years. The HNC Lock Complex and the Gulf Intracoastal Waterway floodgate, features that provide for inland waterway transportation, are a Federal responsibility.

REAL ESTATE ACQUISITION

The Non-Federal Sponsor has been found to have the legal and financial capability for performing acquisition of the Lands, Easements, and Rights-of-Way (LER) required for the project. The Non-Federal Sponsor will comply with all legal requirements regarding rights-of-way. An Assessment of the Non-Federal Sponsor's Real Estate Acquisition Capability is included in the Real Estate Plan.

SECTION 404 FINDINGS

The project features of the TSP have been evaluated with respect to Section 404(b)(1) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material, published by the U. S. Environmental Protection Agency. These evaluations are included in Appendix C. The potential for environmental impact of each disposal activity was estimated on the basis of currently available engineering design data and the pertinent physical, chemical, and biological information that have been compiled as a result of this and other studies.

No particular violations of applicable State of Louisiana water quality standards, other than increased turbidity during construction operations would be expected. Construction methods would be employed to minimize the potential of violating the Toxic Effluent Standards of Section 307 of the Clean Water Act. None of the proposed plans would harm any threatened or endangered species or their critical habitat.

It is expected that the proposed material discharges would not cause or contribute to significant adverse effects on human health; the life stages of organisms within the aquatic ecosystem; or ecosystem diversity, productivity, and stability. No significant adverse impacts were identified on recreational, aesthetic, or economic values.

FINDINGS ON EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

Executive Order 11988 directs all Federal agencies to avoid, if possible, development and other activities in the 100-year base floodplain. Federal agencies are required to:

- Reduce the risk of flood loss
- Minimize the impact of floods on human safety, health, and welfare
- Restore and preserve the natural and beneficial values served by floodplains in carrying out agency responsibility.

The TSP would directly support a reduction in hazards and risks associated with flooding and would minimize the impact of floods on human safety, health, and welfare. The project would support the restoration and preservation of the natural and beneficial values of the base floodplain. The study is in compliance with Executive Order 11988.

FINDINGS ON EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

One of the major considerations for this project was to maintain long-range productivity of coastal wetlands. Although efforts were made to minimize impacts to wetlands, there were no practical alternatives to locating some project features in wetlands. Adverse impacts to wetlands and efforts to mitigate wetland losses are discussed in Section 6. The selected plan is responsive to the planning objectives established for the study and is consistent with the requirements of Executive Order 11990.

FINDINGS ON EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE IN MINORITY AND LOW-INCOME POPULATIONS

Minority and/or low-income population groups residing or working near the construction site itself may experience direct, temporary impacts due to the added traffic congestion and construction noise and dust. The impact, however, would be temporary, lasting only as long as the construction, and all residents are expected to be similarly impacted. The TSP would increase protection from hurricane and storm damages for minority and/or low-income populations in the project area. Regional economic growth resulting from the TSP may create additional jobs, thereby benefitting minority and/or low-income groups living within the project area. There is no disproportionate impact to minority or low income communities due to the construction of the levee.

Construction of the project has the potential to raise water levels outside the levees by several feet during storm events. These areas include portions of the communities of Gibson, Bayou Dularge, Dulac, Isle de Jean Charles, and Cocodrie. For reasons discussed in the PAC report, the USACE, for purposes of this report, has assumed the worst-case compensation scenario, a 100% buy-out of all of the structures outside of the project alignment (including 876 residential structures). Should this scenario prove to be the appropriate mitigation method (again, see the PAC report for details), at least 2,500 people would need to be relocated to areas behind the Federal protection system. There is no disproportionate impact to minority or low income communities due to induced flooding or by the buy-out mitigation.

This study complies with the requirements of Executive Order 12989.

FINDINGS ON EXECUTIVE ORDER 13112, INVASIVE SPECIES

The TSP involves creating borrow canals to obtain material for the construction of levees and other upland structures. Uplands of this nature are susceptible to such invasive species as Chinese tallow tree. Borrow canals can contribute to the spread of invasive aquatic plants such as water hyacinth and giant salvinia, both of which are problematic in southern Louisiana. Maintenance activities, which would be provided by the Non-Federal Sponsor, are considered necessary to control the establishment of invasive species. This project is in compliance with Executive Order 13112.

FINDINGS ON ER 1165-2-132, HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. The investigation identified existing or potential recognized environmental conditions (RECs) in and near the project area, but it is unlikely that HTRW would alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large. However, a waiver may be needed to allow work in and acquisition of real estate interests with HTRW issues. If the project location or methods change, an additional HTRW investigation may be needed. Should HTRW concerns arise at anytime during the project, CEMVN will coordinate with the appropriate Federal and state authorities to implement an approved response action, the removal of HTRW being a responsibility of the Non-Federal Sponsor by virtue of the Project Partnership Agreement (PPA).

FINDINGS ON OTHER SIGNIFICANT RESOURCES OF THE PROJECT AREA

Fisheries Resources: No direct impacts on fishery species would result from the TSP. Minimal indirect impacts would occur on fishery resources due to changes in fishery access, salinity, turbidity, and submerged aquatic vegetation (SAV). The TSP would partially offset the loss of aquatic habitats, thereby benefiting fishery species dependant on these habitats.

Water Quality: Other than temporary and localized effects associated with construction, no direct adverse effects are anticipated with respect to water and sediment quality. The protection and restoration of coastal wetlands is expected to improve water quality.

Threatened and Endangered Species: No direct impacts on protected species are anticipated from the action alternatives. Implementation of the project would partially offset the loss of coastal habitats, thereby benefiting threatened and endangered species dependent on these habitats.

AREAS OF CONTROVERSY

Significant areas of controversy have been identified during the planning phase of this project. Members of the scientific community have stated their preference for a multiple lines of defense alternative rather than the proposed levee alignment. The public, natural resource agencies, and organizations have raised concerns related to adverse impacts to wetlands due to the construction of project levees.

UNRESOLVED ISSUES

Borrow Locations: Borrow costs are by far the largest component of this project. Borrow material for first lift levees is primarily obtained adjacent to the levees. Constructible feature borrow sites have been identified; however, for future lifts, it is assumed that borrow material will come from yet to be identified government-furnished borrow areas. The current status of unknown supply locations may be a concern to project reviewers/approvers. The current estimate of a 25-mile one-way haul distance appears to be very conservative and covers the worst case. The non-Federal sponsor strongly believes that private landowners are ready, willing, and able to supply suitable borrow material for this project.

Sponsor-Funded Additional Work Item: Significant coordination with the resource agencies has been undertaken on both the 1% AEP alternative and the sponsor-funded additional work item. No issues have been raised at this stage in the planning process that would preclude implementation of either project. Considering the uncertainties associated with the future depth of the HNC, the benefits of building a more adaptable lock complex are significant for the Nation. The CPRAB would assume all incremental costs and incremental Operations, Maintenance, Replacement, Repair and Rehabilitation (OMRR&R) of the sponsor-funded additional work item. The overall benefits of implementing the sponsor-funded additional work item outweigh the additional costs that result from the deeper sill depth. Thus, the New Orleans District requests approval to recommend the -23 ft NAVD88 sill elevation as a sponsor-funded additional work item. The Assistant Secretary of the Army (Civil Works)'s approval of the

sponsor-funded additional work item is required before the PAC report is released to the public, which is currently scheduled for January 2013.

Inducements on Larose to Golden Meadow Project: The future-without condition for the Larose to Golden Meadow levee system is uncertain since the Larose PAC analysis is ongoing and future levee elevations for the existing Larose ring levee system have not yet been determined. If the Morganza project is re-authorized to the 1% AEP level of risk reduction, but the Larose project is (a) not re-authorized; (b) re-authorized to less than a 2% AEP level of risk reduction; or (c) is authorized but not supported by a financially capable Non-Federal Sponsor willing to execute a PPA, the Morganza project would have added costs to both offset induced stages on the existing Larose system and to complete the Morganza system to ensure no overtopping of the Larose C-North levees that could impact the Morganza risk reduction area. Therefore, the Morganza to the Gulf PAC analysis assumes no further upgrades to the Larose to Golden Meadow system to ensure that all potential costs to complete the Morganza system are considered.

Inducements on Areas Outside of Levees: Construction of the project has the potential to raise water levels immediately outside the levees by several feet during storm events. These areas include portions of the communities of Gibson, Bayou Du Large, Dulac, Cocodrie, and Isle de Jean Charles. At the current time, information is not available on the specific details on the differences in frequency, depth, and duration of the flooding between the future without-project and future with-project conditions. This detailed information typically would be assessed in light of the uses to which the particular land is zoned, and the appropriate mitigation methods, if any, would be implemented to address the effects of the Federal project. Because of the vast scope of this project and the limited amount of available information at this time, the USACE did not look at each affected parcel individually in order to determine potential impacts to property rights from the proposed Federal action that may give rise to compensation. For example, without more information, it is impossible to rule out the possibility of additional takings for all of the structures in these communities.

Due to this concern, the USACE has assumed the worst case compensation scenario (most expensive option): a 100 percent buy-out of all of the structures in the impacted areas. The total cost for this recommended plan is estimated to be $305,115,300. This cost and associated benefits with this compensation option have been incorporated into the TSP. The potential induced damages and mitigation for economic damages would be further addressed during detailed design and supplemental NEPA documents.

HNC Lock Complex Operation Plan: The HNC lock complex would be constructed and operated as part of the Morganza to the Gulf project to reduce the risk of flooding due to storm surge and limit saltwater intrusion, but could also be operated for environmental purposes as part of the LCA Convey Freshwater to Northern Terrebonne Marshes/Multipurpose Operation of the Houma Navigation Lock project. For the multipurpose operation to occur, the LCA project will have to develop an OMRR&R plan that goes above and beyond the plan developed for the Morganza to the Gulf project. By letters dated August 20, 2012 and October 16, 2012 the State of Louisiana formally notified the Corps of the State's path forward for the LCA Program. The HNC Lock Complex that provide for inland waterway transportation, are a Federal responsibility for OMRR&R. Any changes to the operation plan would have to be coordinated with US Army

Corps of Engineers and potentially require a supplemental NEPA document. Impacts and benefits for the multipurpose operation will need to be described in detail in a future NEPA document.

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS

Table 1-1 shows in tabular format the relationship of plans to environmental protection statutes

Table 1-1. Relationship of Plans to Environmental Protection Statutes or Other Environmental Requirements

FEDERAL STATUTES	1% AEP	3% AEP
1. Archaeological and Historic Preservation Act of 1974. Compliance requires Corps to undertake recovery, protection, and preservation of significant cultural resources whenever its activities may cause irreparable loss or destruction of such resources.	FC	FC
2. Clean Air Act, as Amended. Compliance requires coordination with the U.S. Environmental Protection Agency and analysis of potential impacts on air quality. Coordination of DEIS would bring project into full compliance.	PC	PC
3. Clean Water Act of 1977. Compliance requires preparation of 404(b)(1) Evaluation and submission of such to Congress with the DEIS or procurement of state water quality certification. The 404(b)(1) Evaluation is located in Appendix C.	PC	PC
4. Endangered Species Act of 1973, as Amended. Compliance requires coordination with the U.S. Fish and Wildlife Service (USFWS) to determine if any endangered or threatened species or their critical habitat would be impacted by the project.	PC	PC
5. Federal Water Project Recreation Act. Compliance requires review by the Department of the Interior. Washington level review of the DEIS will bring the project into full compliance.	PC	PC
6. Fish and Wildlife Coordination Act. Compliance requires coordination with the USFWS. A Draft Fish and Wildlife Coordination Act Report is included in Appendix B.	PC	PC
7. Land and Water Conservation Fund Act. Compliance requires Secretary of the Interior approval of replacement property that would be acquired to mitigate converted property purchased with LWCFA funds.	PC	PC
8. National Historic Preservation Act. Compliance requires Corps to take into account the impacts of project on any property included in or eligible for inclusion in the National Register of Historic Places.	FC	FC

9. National Environmental Policy Act. Compliance requires preparation of this draft EIS, consideration of public comments, and preparation and public review of the final EIS. Signing of the Record of Decision would bring this project into full compliance.	FC	FC
10. River and Harbor Act. No requirements for Corps projects authorized by Congress.	NA	NA
11. Farmland Protection Policy Act. Compliance requires coordination with the Natural Resources Conservation Service to determine if any designated prime or unique farmlands are affected by the project.	PC	PC
12. Watershed Protection and Flood Prevention Act. No requirements for Corps projects.	NA	NA
13. Wild and Scenic River Act. Compliance requires coordination with Department of the Interior to determine if any designated or potential wild, scenic, or recreational rivers are affected by the project. Coordination has been accomplished and there are no such rivers in the project area.	NA	NA
14. Coastal Zone Management Act. Compliance requires documentation that the project is consistent with the state Coastal Zone Management Program.	PC	PC
EXECUTIVE ORDER/MEMORANDA	**1% AEP**	**3% AEP**
1. Executive Order 11988, Floodplain Management. Compliance requires an assessment and evaluation together with the other general implementation procedures to be incorporated into the EIS.	FC	FC
2. Executive Order 11990, Protection of Wetlands. Compliance requires results of analysis and findings related to wetlands be incorporated into GRR and EIS.	FC	FC
3. Executive Memorandum, Analysis of Impacts on Prime and Unique Farmlands in EIS. Compliance requires inclusion of effects of proposed action on prime and unique farmlands in EIS.	FC	FC
4. Executive Order 11593, Protection and Enhancement of the Cultural Environment. Compliance requires Corps to administer cultural properties under their control in stewardship for future generations; preserve, restore or maintain such for benefit of the people; and assure that its plans contribute to preservation and enhancement of non-federally owned sites.	FC	FC
5. Executive Order 13112, Invasive Species. Compliance requires assessment of potential for the project to introduce invasive species to the project area.	FC	FC
6. Executive Order 12898, Environmental Justice in Minority and Low-income Populations. Compliance requires assessment of project effects on minority and low-income populations.	FC	FC

FC - In Full Compliance PC - In Partial Compliance NA - Not Applicable

2. TABLE OF CONTENTS

Title **Page**

Title **Page**

Title **Page**

Title **Page**

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

Figure **Page**

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3. NEED FOR AND OBJECTIVES OF ACTIONS

3.1 Introduction

The U.S. Army Corps of Engineers (USACE), New Orleans District (CEMVN), is preparing a Revised Programmatic Environmental Impact Statement (RPEIS) to evaluate the potential impacts to the environment associated with the proposed Morganza to the Gulf of Mexico, Louisiana hurricane and storm damage risk reduction project in Terrebonne and Lafourche parishes. This RPEIS is a revision to the 2002 Final Programmatic EIS for the project. The 2002 RPEIS was not finalized with the signing of a Record of Decision. A revision is required because project alternatives have been modified as a result of new hurricane and storm damage risk reduction design guidelines issued after hurricanes Katrina and Rita.

The project is located approximately 60 miles southwest of New Orleans, Louisiana, and includes most of Terrebonne Parish, excluding the barrier islands, and the portion of Lafourche Parish between the Terrebonne Parish eastern boundary and Bayou Lafourche. The project area boundary is shown in red in Figure 3-1. The proposed levee alignment is shown in yellow. The project area extends south to the saline marshes bordering the Gulf of Mexico.

The TSP would include the construction of 98 miles of levees, approximately 85 miles of which would overlay existing hydrologic barriers such as natural ridges, roadbeds, and existing levees. The remaining levee alignment would be constructed in unprotected coastal wetlands. Construction would include 22 floodgates on navigable waterways, including the Houma Navigation Canal (HNC) lock complex, and 23 environmental water control structures designed to allow tidal exchange through the levee. The structural features would be integrated into the levee alignment to provide hurricane and storm damage risk reduction, drainage, and navigational passage.

In addition to the No Action (future-without-project) Alternative, two levee-design alternatives that share the same alignment but vary in width and height are being evaluated: the 1% Annual Exceedance Probability Storm Surge Risk Reduction System (1% AEP), which would provide risk reduction for water levels that have a 1 percent chance of occurring each year, and the 3% Annual Exceedance Probability Storm Surge Risk Reduction System (3% AEP), which would provide risk reduction for water levels that have a 3 percent chance of occurring each year. This RPEIS is being prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality's Regulations (40 Code of Federal Regulations (CFR) parts 1500-1508), and the USACE Procedures for Implementing NEPA (33 CFR, part 230).

3.2 Background

The Morganza, Louisiana, to the Gulf of Mexico (Morganza to the Gulf) Reconnaissance Study was authorized by a resolution adopted April 30, 1992, by the Committee on Public Works and Transportation of the U.S. House of Representatives. The Energy and Water Development

Figure 3-1. Project Area and Levee Alignment of the Tentatively Selected Plan

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC
Gulf Engineers & Consultants

Figure: 3-1
Date: June 2012
Scale: 1:384,000
Source: USDA/GEC
Map ID: 273160010-2811

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Appropriation Act of 1995 (Public Law (PL) 103-316) then authorized the Morganza to the Gulf Feasibility Study. A Final Programmatic Environmental Impact Statement (FPEIS) for the Morganza to the Gulf Feasibility Study (USACE 2002) (http://www.mvn.usace.army.mil) was filed in the *Federal Register* on May 3, 2002 (http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR). The project was authorized in the Water Resources Development Act (WRDA) of 2007.

Designs for the final alternatives analyzed in the 2002 Morganza to the Gulf Feasibility Study and FPEIS were developed well before Hurricane Katrina's devastating impact on the hurricane protection levees in New Orleans in August, 2005. The authorized MR&T project, Morganza to the Gulf of Mexico, was intended to function as a 1% AEP hurricane and storm damage reduction system. As part of updating the 2002 Feasibility Study, the CEMVN design team was tasked with updating alternatives to incorporate new, more robust hurricane and storm damage risk reduction design guidelines issued after hurricanes Katrina and Rita, both of which struck south Louisiana in 2005.

The cost to incorporate the new criteria into the Morganza to the Gulf project will exceed the authorized project cost by more than 20 percent, thereby exceeding the Section 902 Limit (WRDA 1986) and triggering the need for reauthorization from Congress. A Post Authorization Change (PAC) report is currently being developed to address the cost and impacts of incorporating these new criteria and to seek reauthorization. A Record of Decision for the 2002 Morganza to the Gulf FPEIS has not been signed due to these changes.

The PAC report was initiated in November 2008 and is scheduled for completion in 2012. The PAC report will develop feasibility-level designs and costs for both alternatives and evaluate and select as the recommended plan the alternative with the greatest net benefits.

This RPEIS is being prepared for concurrent submittal with the PAC report. The RPEIS documents the changes in existing conditions and evaluates all direct, indirect, and cumulative environmental impacts of increased levee footprints and new levee alignments resulting from the incorporation of post-Katrina design criteria. Although programmatic in nature, this RPEIS has sufficient details and impact analyses for some features so that construction can proceed on those features. The features that are expected to be identified as constructible include:

- Levee Reach F1 and F2
- Levee Reach G1
- HNC Lock Complex
- Bayou Grand Caillou Floodgate

These four features are discussed in Section 4, *Alternatives*; figures showing the locations of these features may be found in Appendix G, *Mapbook*, and in Section 4.

3.3 Non-Federal Sponsors

The Louisiana Coastal Protection and Restoration Authority Board (CPRAB) and the Terrebonne Levee and Conservation District (TLCD) intend to be the non-Federal co-sponsors for the

Morganza to the Gulf project (hereafter referred to as the non-Federal sponsor). In a letter dated 21 December 2012, the CPRAB and TLCD expressed their commitment and understanding of non-Federal cost share responsibilities for construction and operation and maintenance, repair, replacement and rehabilitation (OMRR&R). Section 1001(24) of WRDA 2007 specifies Federal responsibility for OMRR&R of the HNC Lock Complex and the GIWW floodgate features that provide for inland waterway transportation in accordance with Section 102 of WRDA 1986, as amended. The non-Federal sponsor is responsible for OMRR&R of all other project features. Additional responsibilities of the non-Federal sponsor are listed in the PAC report. Agencies that assisted through participation as members of the Habitat Evaluation Team (HET) included the U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), Louisiana Department of Wildlife and Fisheries (LDWF), and the Louisiana Department of Natural Resources (LDNR). Other agencies that assisted in the project included the U.S. Geological Survey (USGS), Natural Resources Conservation Service (NRCS), Louisiana Department of Transportation and Development (DOTD), the South Lafourche Levee District, and the Terrebonne Levee and Conservation District.

3.4 Project Authority

3.4.1 AUTHORIZATIONS FOR STUDIES AND CHIEF'S REPORTS

House Resolution, Docket 2376, April 30, 1992; and WRDA 96 (PL 104-303, Sec 425) are the base documents authorizing the project. The 1992 resolution, adopted by the Committee on Public Works and Transportation of the U.S. House of Representatives, states:

> *Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, that the Board of Engineers for Rivers and Harbors, is requested to review the report of the Chief of Engineers on the Mississippi River and Tributaries (MR&T) Project, published as House Document 308, Eighty-eighty Congress, Second Session, and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time in the interest of flood control, navigation, wetlands conservation and restoration, wildlife habitat, commercial and recreational fishing, salt water intrusion and fresh water and sediment diversion, and other purposes in the area between the East Atchafalaya Protection Levee and the Mississippi River/Bayou Lafourche System, from Morganza, Louisiana, to the Gulf of Mexico.*

Following completion of the April 1994 Reconnaissance Report, the Energy and Water Development Appropriation Act of 1995 (PL 103-316) authorized the Morganza, Louisiana, to the Gulf of Mexico feasibility study. It directed the USACE to give particular attention to the interrelationships of the various ongoing studies in the area, and consider improvements for the HNC.

> *The Committee is aware that the Corps of Engineers is proceeding with several studies and projects that impact the coastal area of Louisiana, including the Morganza, La to the Gulf of Mexico feasibility study, the Lower Atchafalaya*

> *Basin reevaluation study, and several projects being pursued under the Coastal Wetlands Planning, Protection, and Restoration Act. The Committee is concerned that these studies and projects are proceeding concurrently, yet independently, and requests that the Corps gives particular attention to the interrelationship of these studies and projects during the imperative and direct involvement of the various local interests during the process. The Committee also directs that the Morganza, La to the Gulf of Mexico study include consideration of improvement at and/or within the Houma Navigation Canal.*

Section 425 of WRDA 96 (PL 104-303) required the USACE to develop a study of the HNC lock as an independent feature of the Morganza to the Gulf project.

> *(1) IN GENERAL.—The Secretary shall conduct a study of the environmental, flood control, and navigational impacts associated with the construction of a lock structure in the Houma Navigation Canal as an independent feature of the overall flood damage prevention study being conducted under the Morganza, Louisiana, to the Gulf of Mexico feasibility study.*
> *(2) CONSIDERATIONS.—In conducting the study under paragraph (1), the Secretary shall—*
> *(A) consult with the South Terrebonne Tidewater Management and Conservation District and consider the District's Preliminary Design Document dated February 1994; and (B) evaluate the findings of the Louisiana Coastal Wetlands Conservation and Restoration Task Force, established under the Coastal Wetlands Planning, Protection and Restoration Act (16 U.S.C. 3951 et seq.), relating to the lock structure. (b) REPORT.—Not later than 6 months after the date of the enactment of this Act, the Secretary shall transmit to Congress a report on the results of the study conducted under subsection (a), together with recommendations for immediate implementation of the study.*

That study was completed in 1997. In 1998, Congress authorized the USACE to initiate detailed design of the multipurpose lock in the HNC. The Pre-Construction, Engineering and Design (PED) phase on the HNC lock complex was initiated in advance of the PED phase for the Morganza to the Gulf of Mexico, Louisiana Project. The PED Agreement for the lock was signed on January 13, 2000.

The Morganza to the Gulf Feasibility Study and Final PEIS were completed in March, 2002 (http://www.mvn.usace.army.mil/prj/mtog/). The FPEIS was filed in the Federal Register on May 3, 2002. A Record of Decision (ROD) has not been signed as of this date. Federal projects aimed at managing the nation's water resources typically receive congressional authorization through the WRDA. In accordance with the 2002 and 2003 reports of the Chief of Engineers, the Morganza project is authorized as a feature of the Mississippi River and Tributaries (MR&T). Historically, Congress has considered WRDA legislation approximately every other year. However, after the 2000 WRDA bill, Congress did not pass any new WRDA legislation until 2007. Thus, the Morganza to the Gulf project was not authorized until the WRDA of 2007. The authorized MR&T project, Morganza to the Gulf of Mexico, was intended to function as a 1% AEP hurricane and storm damage reduction system.

3.4.2 AUTHORIZATIONS FOR CONSTRUCTION INCLUDING IN-KIND CREDIT

Section 158 of the Energy and Water Development Appropriations Act, 2004 (PL 108-137) authorized construction on reach J1 of the levee identified as work-in-kind, and further states that:

> *The Secretary may carry out the Reach J, Segment 1, element of the project for hurricane and storm damage reduction, Morganza to the Gulf of Mexico, Louisiana, in accordance with the report of the Chief of Engineers, dated August 23, 2002, and supplemental report dated July 22, 2003 at a total cost of $4,000,000.*

Section 1001 of WRDA 2007 (Public Law 110-114) authorized construction for the project:

> *. . .for hurricane and storm damage reduction, Morganza to the Gulf of Mexico, Louisiana: Reports of the Chief of Engineers dated August 23, 2002, and July 22, 2003, at a total cost of $886,700,000, with an estimated Federal cost of $576,355,000 and an estimated non-Federal cost of $310,345,000. The operation, maintenance, repair, rehabilitation, and replacement of the Houma Navigation Canal lock complex and the Gulf Intracoastal Waterway floodgate features of the project described in subparagraph (A) that provide for inland waterway transportation shall be a Federal responsibility in accordance with section 102 of the Water Resources Development Act of 1986 (33 U.S.C. 2212).*

3.5 Design Guidelines and Regulation Changes Since Authorization

New design guidelines and regulations pertaining to risk analyses and relative sea level rise scenarios have been issued since the 2002 feasibility study. These changes are incorporated into the current design and evaluation of alternatives.

3.5.1 DESIGN GUIDELINES

Hurricanes Katrina and Rita caused tremendous loss of life and destruction of property when they struck coastal Louisiana in 2005. Since then, the USACE has made changes and improvements in the planning, design, construction, operation, and maintenance of hurricane risk reduction projects to prevent future disasters to the greatest extent possible. New design guidelines have been developed and are outlined in the *US Army Corps of Engineers, New Orleans District Engineering Division, Hurricane and Storm Damage Risk Reduction System Design Guidelines, New Orleans District Engineering Division, February 2011.* The design guidelines have been incorporated into the current project alternatives. More information on the current design guidelines and criteria is provided in the engineering appendix of the PAC report.

3.5.2 DATUM

The primary datum used throughout the study is the North American Vertical Datum of 1988 (NAVD88). If figures or tables have a different datum, it will be clearly stated.

3.5.3 RISK AND UNCERTAINTY

Risk and uncertainty are intrinsic in water resources planning and design. USACE Engineering Regulation (ER) 1105-2-101, dated January 3, 2006, provides guidance on the evaluation framework to be used in USACE flood damage reduction studies. The risk analysis approach for the current alternatives is documented in the PAC report.

In a coastal environment, flood risk can be caused by a combination of hurricane surge, waves, wave overtopping of structures, riverine flooding due to rainfall and/or snowmelt, or other sources. For the Morganza to the Gulf project, the dominant source of flood risk is from hurricane storm surge. For the PAC report, risk has therefore been defined as "the probability an area will be flooded by storm surge, resulting in undesirable consequences."

The current action alternatives include identical levee alignments and structural features. The only difference between them lies in the levee dimensions and structure heights related to two differing levels of hurricane risk reduction as per the February 2011 *Hurricane and Storm Damage Reduction System Design Guidelines*: the 1% and 3% AEP alternatives.

The 1% AEP Alternative is designed to withstand a storm surge that has a 1 percent chance of occurring each year. The levee designed for this system is sometimes referred to as a "100-year levee." The 3% AEP Alternative is designed to withstand a storm surge that has a 3 percent chance of occurring each year. This is sometimes referred to as a "35-year levee." Although a storm surge that has only a 1 percent or 3 percent chance of occurring each year (annual chance surge) seems unlikely, over the course of 30 years, the probability that a 1-percent-annual-chance surge would occur increases to 26 percent. Table 3-1 compares the long-term risks for the final array of alternatives.

Table 3-1. Annual Exceedance Probability and Long-Term Risk

Alternative	Annual Exceedance Probability	Long-Term Risk (Chances of Exceedance Over Indicated Time Period)				
		10 Years	30 Years	50 Years	70 Years	100 Years
No Action	1 in 10 or 0.10 or 10%	65%	96%	99%	100%	100%
1% AEP Alternative	1 in 100 or 0.01 or 1%	10%	26%	39%	51%	63%
3% AEP Alternative	1 in 35 or 0.03 or 3%	25%	58%	77%	87%	94%

3.5.4 RELATIVE SEA LEVEL RISE

Recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in the global mean sea level. Engineering Circular (EC) 1165-2-*212, Sea-Level Change Considerations for Civil Works Programs,* released on October 1, 2011, provides guidance for incorporating the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects.
Coastal Louisiana's low elevation, high rate of subsidence, and accelerated rate of wetland loss make it vulnerable to changes in sea level. Sea level change is defined and evaluated in terms of "relative sea level rise (RSLR)," which includes the effects of global and local sea-level change as well as local subsidence. The PAC report, unlike the 2002 report, includes surge and wave models that account for both sea-level rise and subsidence.

The EC specifically requires the development of three RSLR scenarios: low, intermediate, and high. Feasibility level designs, cost estimates, and benefit-cost ratios developed for the current alternatives are based primarily on the intermediate RSLR scenario of 2.4 feet. Floodgates on navigable waterways were designed to include 2.0 feet of structural superiority, which may accommodate higher levels of RSLR than 2.4 feet, but would not necessarily accommodate the high RSLR scenario of 4.75 feet in all cases. It is expected that the project would be constructed over a period of 40 or more years. If during that time RSLR rates are higher or lower than expected, then final levee heights and project costs would be adjusted accordingly. The structure heights would not change.

3.6 Public Concerns

The NEPA process provides for an early and open public process for determining the scope of issues, resources, impacts, and alternatives to be addressed in an EIS. This process is referred to as scoping. The scoping report documents comments from interested parties and describes where in the EIS individual comments should be addressed. It also outlines the study background and scoping process to date, and summarizes the key issues identified by members of the public during the initial scoping period.

CEMVN held a scoping meeting for a proposed hurricane and storm damage risk reduction system on May 12, 1993, in Houma, Louisiana and written comments were accepted from April 7 to May 24, 1993. Eleven letters were provided to the USACE and 52 individuals attended the scoping meeting. A scoping document that summarized comments and concerns was sent to all interested participants on April 12, 1994. The issues and concerns identified were considered during the planning and analysis of project alternatives.

The greatest area of public concern was related to the importance of providing hurricane and storm damage risk reduction for businesses and residences. Other concerns included potential adverse impacts to existing marshes, improvement of marsh habitat both inside and outside the proposed levee system, maintaining or improving ingress and egress of marine organisms for the benefit of commercial fisheries, and avoiding adverse water quality impacts.

More details on public involvement and coordination can be found in Section 8.0, Public Involvement. A public meeting and a 45-day public commenting period for this RPEIS will commence in mid-2012.

3.7 Purpose and Need

The purpose of this project is to provide hurricane and storm damage risk reduction for the communities located within the levee system. The goal is to maximize the number of residential and commercial structures protected from damage caused by hurricane storm surges. The project is needed because of the increasing susceptibility of coastal communities to storm surge due to wetland loss, sea level rise, and subsidence. Hurricanes and tropical storm tidal surges have caused immense property damage, human suffering, destruction of natural habitat, and loss of human life in the two-parish study area. While the TLCD is currently maintaining a system of forced drainage levees, pump stations, and flood control structures for Terrebonne Parish, adequate hurricane and storm risk reduction is not currently available for the entire area. This project represents an opportunity to reduce the risk of catastrophic hurricane and tropical storm damages by implementing an effective, comprehensive system for hurricane and storm damage risk reduction.

3.7.1 DAMAGES RELATED TO HURRICANES AND STORM SURGE

Lafourche and Terrebonne parishes periodically experience localized flooding from excessive rainfall events. However, the primary causes of flooding in the two parishes are hurricanes and tropical storm tidal surges. During the past 25 years, coastal Louisiana was impacted by eight major tropical events: Hurricane Juan (1985), Hurricane Andrew (1992), Tropical Storm Isidore (2002), Hurricane Lili (2002), Hurricanes Katrina and Rita (2005), and Hurricanes Gustav and Ike (2008). The tidal surges associated with these storm events have inundated structures and resulted in billions of dollars in damages. A summary of the total Federal Emergency Management Agency (FEMA) flood claims paid as a result of tropical storm events is shown in Table 3-2. The table includes the number of paid losses and the total amount paid on each loss. The table includes only those losses that were covered by flood insurance. Hurricanes Katrina and Ike required the largest sums paid, with $18 billion in claims paid for Katrina in 2005, and $2.6 billion in claims paid for Ike in 2008. These hurricanes also caused millions of dollars in emergency costs, such as sandbagging and police overtime, damages to roads and bridges, and the subsequent clean up of private, commercial, and public properties.

The significant flooding impact of Hurricane Ike in the town of Chauvin, located southeast of Houma, is shown in Figure 3-2. The town remained under water for nearly a week.

After being struck by hurricanes Katrina and Rita within one month, Terrebonne Parish was declared a Federal disaster area by the President of the United States. Damage assessment reports provided by FEMA and the Terrebonne Parish Department of Homeland Security revealed that the damages sustained in Terrebonne Parish included over 10,000 flooded homes and businesses and over 200 people displaced from their homes (Louisiana Speaks, 2011).

Table 3-2. FEMA Flood Claims Paid as a Result of Tropical Storm Events Affecting the Study Area, 1985 - 2008

Event	Month/Year	Number of Paid Losses	Total Amount Paid
Hurricane Juan	October, 1985	6,187	$184.3 million
Hurricane Andrew	August, 1992	5,589	$262.9 million
Tropical Storm Isidore	September, 2002	8,441	$137.7 million
Hurricane Lili	October, 2002	2,563	$44.7 million
Hurricane Katrina	August, 2005	167,099	$18 billion
Hurricane Rita	September, 2005	9,507	$523.4 million
Hurricane Gustav	September, 2008	4,524	$111.9 million
Hurricane Ike	September, 2008	46,137	$2.6 billion
Total:			**$21.9 billion**
Note: Total amount paid has been updated to the June 2010 price level using the CPI for all urban consumers.			
Source: FEMA.			

Figure 3-2. Flooding Impacts of Hurricane Ike in Chauvin, Terrebonne Parish

As another example, over 800 homes were inundated in the coastal portion of Terrebonne Parish south of the City of Houma because of Hurricane Juan. Scattered pockets of flooding were also

reported in the portions of Terrebonne and Lafourche Parishes north of Houma. Approximately 40 percent of the homes in the coastal areas of Lafourche Parish were also inundated by the high tides.

Agricultural damages from Hurricane Juan totaled $175 million, with 24 percent of these damages occurring in the two-parish study area. The soybean crop suffered over half of the agricultural damage, while the sugar cane crop incurred 20 percent of the damage. Excessive rains oversaturated the fields and caused a reduction in crop yields.

3.7.2 WETLAND LOSS

Louisiana contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss occurring in the nation (USACE 2011). This ecosystem provides habitat for migratory birds, wildlife, finfish, shellfish, and other aquatic organisms including threatened or endangered species.

The need to minimize the loss of Louisiana coastal wetlands has been recognized by the U.S. Congress. Title VII of WRDA 2007 authorized the Louisiana Coastal Area (LCA) program, confirming the nation's commitment to coastal restoration in Louisiana. Other recent congressional acts have included the Coastal Wetlands Planning, Protection and Restoration Act program (CWPPRA or Breaux Act), which provides for targeted funds through 2019 to be used for planning and implementing projects that create, protect, restore, and enhance wetlands in coastal Louisiana. The Coastal Impact Assistance Program (CIAP) was authorized by Section 384 of the Energy Policy Act of 2005, to assist coastal states and their political subdivisions (parishes, counties, and boroughs) in mitigating the impacts from Outer Continental Shelf oil and gas production. Louisiana is one of the seven coastal states selected to receive funds to implement this program.

According to a 2010 analysis, the land-loss rate in the study area between 1985 and 2008 was approximately 2,600 acres per year, which equates to almost 60,000 acres lost over that time period. Projecting that loss rate over the next 75 years, approximately 200,000 additional acres are expected to be lost. Losses would be greater with higher rates of RSLR (USACE 2010).

Principal impacts to the marshes in the study area are due to storm surge and associated erosion and saltwater intrusion. Storm surge exerts widespread stress upon vegetation through the introduction of higher salinity concentrations than are normally present within the study area and by direct erosion of marsh plants and soils. Hurricanes Rita and Ike resulted in measurable storm surges within the study area (USACE 2010). As area marshes convert to open water, vital fish and wildlife habitat, and economic benefits are lost.

3.8 Opportunities

3.8.1 HURRICANE AND STORM SURGE RISK REDUCTION OPPORTUNITIES

To reduce the risk of damages caused by hurricanes and storms, the USACE has the opportunity to build upon the existing local levee system. The existing levees have a maximum elevation of 10 feet above sea level to protect against weak tidal and rainfall events, but not hurricanes. This project represents an opportunity to avoid catastrophic hurricane and tropical storm damages by implementing an effective, comprehensive system for hurricane and storm damage risk reduction.

3.8.2 COASTAL RESTORATION OPPORTUNITIES

The Morganza to the Gulf project is not a traditional hurricane risk reduction system in that it was also designed to be compatible with the strategic goals of the Coast 2050 Project. Some areas would experience increased tidal exchange thanks to environmental control structures through hydrologic barriers. This benefit would be consistent with the Coast 2050 goals to 'maintain exchange and interface to achieve system linkages' and 'maintain estuarine gradient to achieve diversity' (http://www.coast2050.gov/). More significantly, the Morganza to the Gulf project was designed to not interfere with dedicated dredging for marsh creation, the distribution of freshwater from the GIWW into wetlands, and the multipurpose control of the HNC.

The PAC report does not include any changes to the HNC lock complex operation plan that was proposed in the 2002 feasibility report. The primary purpose of the HNC lock and floodgate structure is for storm surge control. A secondary benefit is the prevention of saltwater intrusion from impacting the Houma Water Treatment Plant and marshes internal of the system. A lock is being built to maintain the existing navigation during the operation for these purposes. The lock operation plan is based on controlling chloride levels (a measure of the salinity) at the Houma Water Treatment Plant. The HNC and Bayou Grand Caillou floodgates would be closed if one or both of the following criteria are exceeded: (1) salinity at the HNC at Dulac monitoring station exceeds 7.5 parts per thousand (ppt) or (2) Atchafalaya River flows are below 100,000 cubic feet per second (cfs) as measured at the Simmesport station. Salinity triggers are based on maintaining less than 250 parts per million (ppm) at the Houma Water Treatment Plant. Once salinity levels at the Bayou Petit Caillou at Cocodrie station (New Orleans District Station Number 76305) fall below 13 ppt, the lock and floodgates would be opened. In order to operate the HNC lock according to the criteria laid out in this plan, a monitoring program must be in place.

After the HNC lock complex is constructed as part of the Morganza to the Gulf project, the LCA program proposes using the lock for ecosystem restoration purposes, such as distribution of freshwater. Proposed operational changes for LCA ecosystem restoration purposes, and associated impacts, are documented in the Final Integrated Feasibility Study and Environmental Impact Statement for the Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock (USACE 2010). A supplemental NEPA document would be needed under the LCA program once a detailed operation plan is developed.

3.9 Planning Objectives

3.9.1 NATIONAL OBJECTIVE

The Water Resources Council's Economic and Environmental Principles for Water and Related Land Resources Implementation Studies states that, "The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements." If the projected benefits of coastal storm damage reduction measures exceed their estimated costs and are judged environmentally acceptable, their construction as a Federal project would contribute to this objective and be in the Federal interest.

3.9.2 PLANNING OBJECTIVE

The overarching goal is to reduce the risk to people and property from damages caused by hurricanes and storm surge in the vicinity of Houma, Louisiana.

3.10 Non-Federal Sponsor's Construction Efforts

The CPRAB and the TLCD are designing and constructing storm damage risk reduction structures along the authorized alignment at their own expense. Completed projects are limited to several miles of first-lift levees and a few floodgates and do not result in a closed hurricane and storm damage risk reduction system. In the absence of an executed Project Partnership Agreement (PPA), the locally constructed levees do not form an integral part of the Morganza to the Gulf project and the work performed by the non-Federal sponsor is not eligible for consideration and approval of work-in-kind credit, nor are the Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas (LERRDs) acquired by the non-Federal sponsor in support of those levees eligible for credit consideration. In order for the non-Federal sponsor to be eligible to receive a credit for levee construction and LERRDs acquisition support of the non-Federal sponsor construction efforts that took place in performed in advance of the execution of the PPA, Congress would have to enact express authority authorizing the USACE to consider and approve such a credit upon a finding that the levees meet USACE engineering criteria, are economically justified and environmentally acceptable.

Below is a brief description of the TLCD's risk reduction projects.

- Levee Reach J-1: First-lift construction was complete to elevation 9 feet in August 2009. The first-lift levee is 3.1 miles long.

- Levee Reach H-3: The first-lift levee is 3.4 miles and was constructed to elevation 12 feet but is expected to settle to 10 feet.

- Levee Reach H-2: The first-lift levee is 2.6 miles long with a height of between 10 and 12 feet.

- Interim Barge Gate Structures on Placid Canal and Bush Canal: The barge gate structures are being constructed to elevation 18 feet but tie-in to levees that are at elevation 10 feet. These interim structures would be removed and replaced with 56-foot-wide sector gates in the proposed Morganza to the Gulf project.

- Pointe aux Chenes Floodgate and Tie-In Levee: This project consists of a 56-foot-wide floodgate across Bayou Pointe aux Chenes and an associated tie-in levee. The western tie-in measures approximately 450 linear feet and is part of Levee Reach J-3. The eastern tie-in levee measures approximately 665 linear feet and is part of Levee Reach K. The tie-in levee and floodgate elevation is 10.0 feet. The first-lift levee is 1,100 linear feet.

- Levee Reaches F and G-1: This project consists of a 9.4-mile earthen levee, a 250-foot-wide floodgate across the HNC, and a 200-foot-wide gate across Bayou Grand Caillou.

3.11 Related Projects

Several existing and authorized water resource projects are located within the Morganza to the Gulf project area, including navigation, hurricane risk reduction, and ecosystem restoration projects. These projects are summarized below. The status of each project was verified by project sponsors in the fall of 2011.

3.11.1 NAVIGATION PROJECTS

Gulf Intracoastal Waterway (GIWW) Navigation Project

The GIWW is the portion of the Intracoastal Waterway located along the Gulf Coast of the United States. It is a navigable inland waterway extending approximately 1,050 miles from Carrabelle, Florida to Brownsville, Texas. The waterway provides a channel with a controlling depth of 12 feet, designed primarily for barge transportation. The GIWW was authorized by the River and Harbor Act of July 24, 1946, and prior River and Harbor Acts. Construction was completed in 1949.

The GIWW extends across the Morganza to the Gulf project area from Bayou Lafourche at Larose, through Houma, and to the Atchafalaya River. The waterway is not only important for commerce; it also supports a variety of other public purposes, including flood control, waterside commercial development, and water-based recreational activities.

Houma Navigation Canal (HNC) Project and Deepening Study

The HNC is a navigable waterway connecting the city of Houma and the GIWW directly to the Gulf of Mexico. The HNC was completed by local interests in 1962, but it is currently maintained by the Federal Government. The authorized channel is 15 feet deep and 150 feet wide from its intersection with the GIWW to Mile 0.0, and 18 feet deep by 300 feet wide to the

Gulf of Mexico. The oil and gas industries in Houma rely heavily upon the 40-mile channel as a critical path to the Gulf of Mexico.

Given that the state is presently preparing an HNC Deepening Feasibility Study, there is the possibility that the HNC will be deepened in the future given the preliminary positive results of that feasibility study. However, in accordance with USACE planning regulations, and because of the uncertainties as to whether the HNC deepening will be authorized and funded, the Morganza to the Gulf project alternatives must assume that the current authorized depth of the canal, -15 feet, will remain as currently authorized in the foreseeable future.

3.11.2 HURRICANE AND STORM DAMAGE RISK REDUCTION PROJECTS

Larose to Golden Meadow, Louisiana, Hurricane Risk Reduction Project

The Larose to Golden Meadow project is a ring levee system that provides hurricane and storm damage risk reduction to roughly 25,000 people living on both sides of Bayou Lafourche, about 50 miles southwest of New Orleans in Lafourche Parish. The 43-mile levee system extends from Larose to a point two miles south of Golden Meadow, Louisiana. The e proposed Morganza to the Gulf levee will be built on the north east and northern sections of the existing Larose to Golden Meadow levee system (C-North). The future-without condition for the Larose to Golden Meadow levee system is uncertain since the Larose PAC analysis is ongoing and future levee elevations for the existing Larose ring levee system have not yet been determined. If the Morganza project is re-authorized to the 1% AEP level of risk reduction, but the Larose project is (a) not re-authorized; (b) re-authorized to less than a 2% AEP level of risk reduction; or (c) is authorized but not supported by a financially capable Non-Federal Sponsor willing to execute a PPA, the Morganza project would have added costs to both offset induced stages on the existing Larose system and to complete the Morganza system to ensure no overtopping of the Larose C-North levees that could impact the Morganza risk reduction area. Therefore, the Morganza to the Gulf PAC analysis assumes no further upgrades to the Larose to Golden Meadow system to ensure that all potential costs to complete the Morganza system are considered.

TLCD Risk Reduction Projects

The non-Federal sponsor has started work on reaches that were initially proposed to be a part of the Morganza to the Gulf project, at their own expense, acknowledging that there is no signed PPA in place. The sponsor has substantially completed approximately nine miles of levees and a few floodgates located along the proposed Morganza to the Gulf project alignment. More details on TLCD's project plans and progress can be found in Section 3.10.

3.11.3 COASTAL RESTORATION PROJECTS

Coastal Impact Assistance Program (CIAP)

Falgout Canal Freshwater Enhancement Project The Energy Policy Act of 2005 established the CIAP program, which authorizes funds for environmental conservation, protection, restoration, or mitigation purposes to be distributed to Outer Continental Shelf oil- and gas-producing states.

Terrebonne Parish and the State of Louisiana dedicated CIAP funding to the Falgout Canal Freshwater Enhancement project. The project is located in the marshes adjacent to Falgout Canal between Bayou du Large and the HNC (Figure 3-1). This project would include construction of an inlet structure at a site located on the HNC north of Falgout Canal, modeling of the basin, and channel improvements, as necessary, to improve efficiency of freshwater flow within the basin area. In addition, existing structures along Falgout Canal would be improved or replaced to facilitate operation and maintenance and to accommodate the possible placement of shoreline protection along unprotected areas of the HNC. If sufficient funding exists, the project could be expanded to facilitate movement of freshwater, nutrients, and sediment to the hydrologic unit south of Falgout Canal. Project benefits include freshwater flow enhancements to approximately 5,000 acres of existing marsh. The goal of this project is to restore project-area salinities to levels that are favorable for fresh and intermediate marshes. As of the writing of this report, modeling has been completed and funding is now in place for design and construction.

This project is located along the proposed footprint of the Morganza to the Gulf project, Reach E, where culverts are also being proposed for environmental benefits. Terrebonne Parish is currently coordinating with CEMVN to capture synergies and efficiencies between the two projects.

GIWW Bank Restoration of Critical Areas in Terrebonne Parish This project will close four breaches along the south bank of the GIWW totaling 14,500 linear feet. The breach closures engineered for this bank line will provide immediate benefits to the adjacent thin-mat floating marshes by stopping water movement through these large breaches where water exchange now occurs. This project was initially engineered, designed, permitted, and received the necessary land rights for construction through the CWPPRA Program. The CIAP program is building only the portion of the project that includes the most critical four breaches as described above. CIAP-funded construction was completed in 2010. More details regarding the CWPPRA portions of the project are provided below.

Small Dredge Program This program involves the use of a small dredge to hydraulically dredge borrow canals and other open water areas to restore approximately 175 acres of marsh apron along levees, cheniers, and roadways near Golden Meadow, on the west side of Bayou Lafourche. Construction was completed in 2010.

Atchafalaya River Long Distance Sediment Pipeline (ARLDSP) This project will restore marsh and ridge habitat in eastern and central portions of the Terrebonne Hydrologic Basin. Although in the conceptual phase at the time of this writing, the proposal is to install a pipeline and required booster pumps and outlets from the Atchafalaya River near Morgan City to transport sediment slurry to eastern and central Terrebonne Basin marshes. Marsh restoration locations would be selected to enhance the sustainability of existing and planned levee systems. The primary project purpose is to identify and apply appropriate design, engineering, and construction techniques so that strategies and infrastructure may eventually become components of larger-scale, system-wide marsh and ridge restoration projects in the basin in the future. Information gained from the planning and design for the Barataria Basin segment of the Mississippi River Long Distance Sediment Pipeline will be fully integrated into the design and implementation of the proposed Terrebonne Basin segment.

Louisiana Coastal Area (LCA) Plan

Title VII of WRDA 2007 authorized the LCA plan to support coastal restoration projects in Louisiana. More information may be found on the LCA website (http://www.lca.gov). The following LCA projects occur within or adjacent to the study area. Several LCA projects authorized by WRDA 2007 are located within the Morganza study area, including but not limited to: (1) Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock (2) Modification of Davis Pond Diversion and (3) Land Bridge between Caillou Lake and Gulf of Mexico. By letters dated August 20, 2012 and October 16, 2012, CPRAB has notified the Corps that it desires to suspend study and design on these projects. The decision of CPRAB to suspend these projects results in some degree of uncertainty regarding implementation of these projects as part of the authorized Federal LCA.

Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock The Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock is one of six near-term critical restoration projects identified in the LCA Plan and is directly linked to the Morganza to the Gulf project, even sharing much of the same project area. The Final Integrated Feasibility Study/Environmental Impact Statement for this project was completed in September 2010. The recommended plan would redistribute existing freshwater to benefit Terrebonne marshes using a variety of measures. Additionally, the following measures to restrict, increase, and control water are proposed for each of the three project-area subunits. In the West – Bayou Penchant Area – dredging, bank protection, a sediment plug, and a weir will be used. In the Central – Lake Boudreaux Area – culverts, levees, dredging, marsh terraces, and berms, sediment plugs, modified operation of the future HNC lock complex, and a large sluice gated box culvert are proposed. In the East – Grand Bayou Area – culverts, dredging, gaps in canal spoil banks, marsh berms, sediment plugs, and removal of a weir and soil plug are proposed.

The recommended plan assumes that the HNC lock complex would be constructed and operated as part of the Morganza to the Gulf project to control storm surge and saltwater intrusion, but could also be operated for environmental purposes as part of the LCA Convey Freshwater to Northern Terrebonne Marshes/Multipurpose Operation of the Houma Navigation Lock project. For the multipurpose operation to occur, the LCA project will have to develop an OMRR&R plan that goes above and beyond the plan developed for the Morganza to the Gulf project. By letters dated August 20, 2012 and October 16, 2012 the State formally notified the Corps of the State's path forward for the LCA Program. The HNC Lock Complex that provide for inland waterway transportation, are a Federal responsibility for OMRR&R. Any changes to the operation plan would have to be coordinated with US Army Corps of Engineers and potentially require a supplemental NEPA document.

Davis Pond Freshwater Diversion This project was being evaluated under the LCA plan as a Federal/state cooperative action. By letter dated October 16, 2012 the State formally requests suspension of expenditures on this project by the Corps of Engineers. The diversion structure was authorized for construction in 1986 and completed in 2002. Located on the west bank of the Mississippi River in St. Charles Parish, the Davis Pond diversion could bring up to 10,650 cubic feet per second (cfs) from the Mississippi River to marshes south of the river. The benefits occur

almost exclusively in the Barataria Basin. However, some of the flows could extend to the eastern portion of the Terrebonne Basin via the GIWW. The resulting higher stages in the GIWW may have a minor influence on eastward flows of the GIWW to Grand Bayou (Figure 3-1).

Small Bayou Lafourche Reintroduction This LCA project would reintroduce flow from the Mississippi River into Bayou Lafourche. The flow would be continuous and would increase riverine influence in the wetlands between bayous Lafourche and Terrebonne, south of the GIWW. Several alternatives are being considered that would provide year-round flow into the bayou, including gated culverts and a pump/siphon station at Donaldsonville. Additional features that would be required, regardless of the type of diversion structure built, include modification of existing infrastructure, bank stabilization, dredging, and channel improvements. This project could reduce saltwater intrusion in the eastern Terrebonne marshes. Moreover, potential measures to improve distribution of Bayou Lafourche reintroduction waters (e.g., enlargement of Bayou L'Eau Bleu and/or Grand Bayou) could facilitate efforts to move Atchafalaya waters into areas of critical need. The State and the Corps have not signed a PPA for this project.

Maintain Land Bridge between Caillou Lake and Gulf of Mexico This LCA project would maintain the land bridge between Caillou Lake and the Gulf of Mexico by placing shore protection in Grand Bayou du Large to minimize saltwater intrusion. This feature would involve rock armoring or marsh creation to plug/fill broken marsh areas on the west bank of lower Grand Bayou du Large, thereby preventing a new channel from breaching the bayou bank and allowing a new hydrologic connection with Caillou Lake. Gulf shoreline armoring might be required where shoreline retreat and loss of shoreline oyster reefs has allowed increased water exchange between the gulf and the interior water bodies (between Bay Junop and Caillou Lake). By reducing marine influences in these interior areas, this feature would allow increased freshwater influence from Four League Bay to benefit marshes in the surrounding areas. By letter dated October 16, 2012 the State formally requests suspension of expenditures on this project by the Corps of Engineers.

The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA)

CWPPRA of 1990 was the first Federal statutory mandate for restoration of Louisiana's coastal wetlands. The CWPPRA Task Force is composed of five Federal agencies: USACE, U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and Natural Resources Conservation Service (NRCS), and the State of Louisiana. The CWPPRA program plans projects to have a 20 year project life. The present authorization will end in 2019 and there is uncertainty with respect to if the program will be reauthorized and funded. CWPPRA has many restoration projects located within or adjacent to the Morganza to the Gulf project area in Terrebonne Parish. These projects may have an effect on the hydrology or habitats in the project area. More information may be found on the CWPPRA website (http://lacoast.gov).

Brady Canal Hydrologic Restoration This project is located 21 miles southwest of Houma, Louisiana, in Terrebonne Parish and is bounded by Turtle Bayou to the east, Bayou DeCade to

the south, and Bayou Penchant to the north. Land loss in the area has been caused by saltwater intrusion, subsidence, and increased tidal energies. The project measures include replacing and maintaining weirs, constructing a rock plug, stabilizing channel cross sections, and restoring and maintaining channel banks. These measures maintain and enhance existing marshes and increase the use of sediment and fresh water introduced from the water control structures and overbank flow. Construction was completed in July 2000. A monitoring plan has been developed, and the Louisiana Department of Natural Resources is currently collecting data so that the project's effectiveness can be evaluated.

Central Terrebonne Freshwater Enhancement Grand Pass in Terrebonne Parish is a 900-foot-wide artificial cut through the Bayou du Large Ridge south of Lake Mechant. The project would reestablish the historic ridge function of Bayou du Large that separated Lake Mechant from the gulf. This would moderate salinities that have adversely impacted the marshes to the north of Lake Mechant. The project would also increase the Atchafalaya River freshwater influence in the area by modifying the current structure located in Liners Canal north of Lake Decade, and provide maintenance dredging at Minors Canal to maintain optimal freshwater conveyance from the GIWW. The project is currently in the Planning and Design Phase and is expected to receive Phase II funding in 2013. This project could synergistically increase beneficial impacts of the Morganza to the Gulf project if both are implemented.

GIWW Bank Restoration of Critical Areas in Terrebonne In the past 20 years, as the efficiency of the Lower Atchafalaya River has decreased; flooding in the northwestern portion of Terrebonne Parish has increased because of amplified Atchafalaya River flows via the GIWW, causing deterioration of fresh and intermediate wetlands. This project is designed to restore and stabilize critical lengths of deteriorated channel banks of the GIWW with hard shoreline stabilization materials to control damaging overflows and saltwater intrusion detrimental to area marshes. This project could impact the Morganza to the Gulf study area by reducing the loss rates of fresh marsh along the GIWW. Construction is expected to begin in December 2011 and be completed by July 2012.

Lost Lake Marsh Creation and Hydrologic Restoration The project is located in Terrebonne Parish near the vicinity of Lost Lake (Figure 3-1). Approximately 465 acres of marsh would be created between Lake Pagie and Bayou De Cade, north of Bayou De Cade, and along the northwestern Lost Lake shoreline. Borrow material would be taken from within Lost Lake and pumped via a hydraulic dredge into the marsh creation sites. Tidal creeks would be constructed within the marsh creation cells to ensure tidal connectivity and prevent ponding within the created marsh. In addition, 30,000 linear feet (26 acres) of terraces would be constructed to reduce fetch in an area of deteriorated marsh north of Bayou De Cade. Four fixed-crest weirs would be replaced with variable-crest structures to increase freshwater and sediment delivery from the Atchafalaya River/Four League Bay system and to provide flow-through conditions in the system. Similar structures would be installed along Little Carencro Bayou to increase freshwater and sediment delivery into the marshes north of Lost Lake. Construction is expected to begin in 2013.

Madison Bay Marsh Creation and Terracing This 1,019-acre project is located in Terrebonne Parish north of Madison Canal between Bayou Terrebonne and Humble Canal. This area has

experienced tremendous wetland loss due to a variety of forces including subsidence, salt water intrusion, a lack of sediment supply, and oil and gas activities. Project goals include creating 417 acres of marsh and nourishing 258 acres of marsh. Proposed terraces would reduce the wave erosion of created and existing marshes along Madison Bay. Approximately one-half of the marsh creation area would be planted with smooth cord-grass (*Spartina alterniflora*) or marsh hay cord-grass (*Spartina patens*). Reducing shoreline erosion would protect about six acres of existing marsh, and the percent cover of submerged aquatic vegetation (SAV) is projected to increase in the project area. Funding for the construction of this project has not yet been approved.

North Lake Mechant Landbridge Restoration This project was completed in 2009 to protect and restore a critical landbridge barrier between the easily erodible fresh marshes north of Bayou De Cade and the higher saline environment of Lake Mechant. Material dredged from northern Lake Mechant was used to create marsh. Smooth cordgrass was also planted along the shorelines of Lake Mechant, Goose Bay, and Lake Pagie. The project also repaired breeches formed by erosion and oilfield access canals that threaten the integrity of the landbridge. Shoreline vegetation plantings were installed in summer 2003. Approval of construction unit two was granted in October 2004, which included dedicated dredging for marsh creation and several other bank stabilization measures. Problems surrounding the recently established public oyster seed grounds and several private oyster leases in Lake Mechant were resolved and construction of that unit was completed in late 2009.

Penchant Basin Natural Resources Plan, Increment 1 Construction of this project began in May, 2010 and was completed in May, 2011. The project is bounded on the north by the GIWW, the east by a north/south line from Lake De Cade to the GIWW, the south by Lake Mechant and Lost Lake, and to the west by a north/south line from Lost Lake to Avoca Island. This project combines the long-term realignment of Penchant Basin hydrology with restoration and protection measures aimed at maintaining the physical integrity of the area during the transition toward greater riverine influence. The project includes about 6,520 feet of foreshore rock dike along the southern bank of Bayou Chene at its intersection with Bayou Penchant and approximately 35 acres of marsh creation. Two freshwater introduction structures were constructed to improve freshwater conveyance from Bayou Penchant into the central Terrebonne marshes. Earthen embankments were constructed and maintained on the north bank of Bayou De Cade between Lake De Cade and Turtle Bayou and between Voss Canal and Lost Lake.

South Lake De Cade Freshwater Introduction This project is located approximately 15 miles southwest of Houma, Louisiana. The project area is experiencing marsh deterioration due to subsidence, rapid tidal exchange, and human-induced hydrologic changes that result in increased salinities. Shoreline erosion along the south embankment of Lake De Cade threatens to breach the hydrologic barrier between the lake and interior marshes. Proposed project components include installing three control structures along the south rim of the lake and enlarging Lapeyrouse Canal to allow the controlled diversion of Atchafalaya River water, nutrients, and sediments south into project area marshes. Outfall management structures are planned in the marsh interior to provide better distribution of river water. Additionally, approximately 1.6 miles of foreshore rock dike is planned to protect the critical areas of the south lake shoreline from breaching. Construction began in August 2010 and is expected to be completed in August 2013.

Terrebonne Bay Marsh Creation - Nourishment Project This project is located along the northern shoreline of Lake Barre/Terrebonne Bay near Bayou Terrebonne continuing east a short distance past Bayou Chitique. The high loss rate of emergent marshes north of Terrebonne Bay has directly contributed to the ongoing flooding problems of many communities along Bayou Terrebonne, including the town of Montegut. The proposed features of this project consist of filling approximately 365 acres of shallow open water and nourishing approximately 299 acres of very low or fragmented marsh with material hydraulically dredged from Terrebonne Bay/Lake Barre. Containment dikes would be degraded or gapped within three years of construction to allow for greater tidal and estuarine organism access. The project would result in approximately 353 net acres of marsh over the 20-year project life. This project is still in the planning stage and has not yet received construction authorization.

West Lake Boudreaux Shoreline Protection and Marsh Creation This project is located in the Terrebonne Basin along the western shoreline of Lake Boudreaux. Project construction began in July 2007 and was completed in April 2011. The west bank of Lake Boudreaux has experienced high erosion rates due to wind-driven waves and high water. The project's objectives include: reducing erosion of the west Lake Boudreaux shoreline to protect 80 acres of emergent marsh and SAV; maintaining the shallow, open water habitat, including its SAV, located west of the lake rim; and creating 284 acres of marsh along the southwestern shoreline of Lake Boudreaux and at interior marsh sites through the deposition of dredged material.

4. ALTERNATIVES

In the evolution of this project, several sets of alternative plans have been developed and evaluated with the goal of maximizing the number of residential and commercial structures protected while minimizing adverse impacts to the environment, local interests, navigation, and industry. This section summarizes those alternative plans, including those retained for further analysis and those eliminated during the evaluation and screening process. A summary of the potential environmental impacts associated with each alternative is provided at the end of this section. For a more detailed description of plan formulation, the screening processes, and the final array of alternatives, please refer to the Alternative Plans section of the Morganza to the Gulf PAC report.

4.1 Future-Without Project Condition (No Federal Action)

Evaluation of the No Action Alternative, also known as the future-without-project condition, is a requirement of NEPA regulations. This alternative assumes no Federal project implementation and forms the basis on which all other alternative plans will be measured. Under the future-without-project condition, the TLCD would continue to operate the forced drainage and partial hurricane risk reduction system that currently exists. The existing system contains segments and components, including ring levees, pump stations, and flood gates that have been built to be individually self-sufficient. This work does not provide a closed system or the levee and structure heights needed to protect surrounding communities from hurricanes and tropical storm tidal surges. Under the No Action Alternative, storm surges would continue to cause immense property damage, human suffering, destruction of natural habitat, and loss of human life in the two-parish study area.

4.2 Alternatives Considered in Preliminary Analyses

This section summarizes post-authorization changes that have resulted in alternative plans that have been developed and evaluated for the project. The USACE term "Recommended Plan" is synonymous with the NEPA term "Preferred Alternative." This is the plan preferred by the USACE.

4.2.1 2008 MORGANZA TO THE GULF HURRICANE RISK REDUCTION FOR 1% AEP EVENT

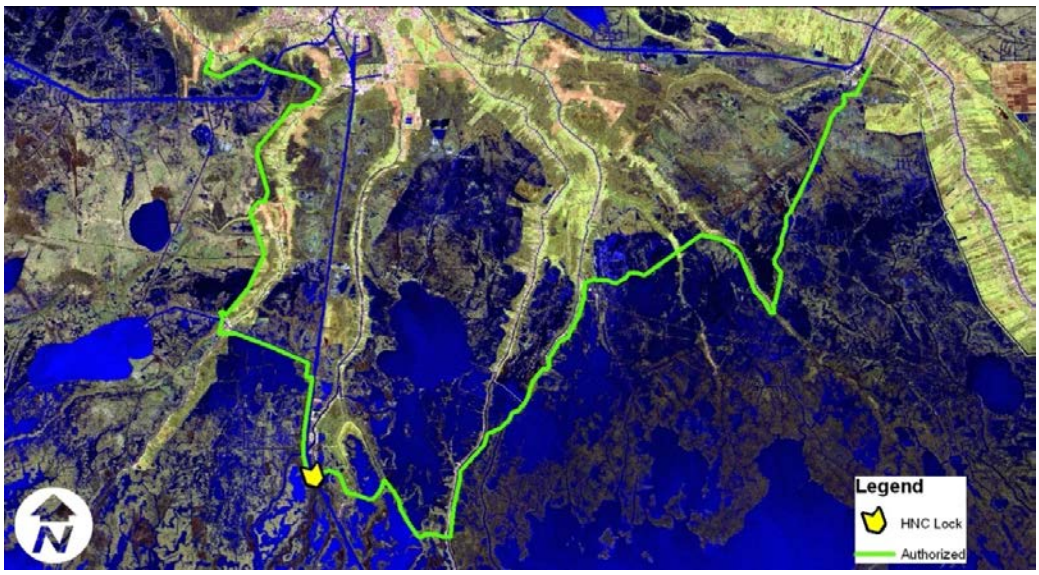
Designs for the final alternatives analyzed in the 2002 Morganza to the Gulf Feasibility Study and PEIS were developed well before Hurricane Katrina's devastating impact on the hurricane risk reduction levees in New Orleans in August, 2005. The authorized MR&T project, Morganza to the Gulf of Mexico, was intended to function as a 1% AEP hurricane and storm damage reduction system. As part of updating the 2002 Feasibility Study, the MVN design team was tasked with updating alternatives to incorporate new hurricane and storm damage risk reduction design guidelines issued after hurricanes Katrina and Rita.

Four action alternatives, three of which are based on levee alignments from the 2002 feasibility report, were developed in coordination with the CPRAB and TLCD in 2008. Alternatives 1, 2, and 3 were formulated to provide hurricane risk reduction at the post-Katrina 1% AEP (100-year) storm surge event. In contrast, Alternative 4 included the levee and structure elevations used in the 2002 feasibility report, ranging from 10.0 to 16.0 feet (NAVD 88). This alternative would not meet post-Katrina design standards to reduce the threat of coastal flooding from the 1% AEP storm surge event.

A brief description of each of the 2008 alternatives is provided below. Each alternative extends from Bayou Black to Grand Bayou Canal and consists of similar levee sections and structures. To reduce the potential for new indirect impacts on estuarine hydrology, the alternatives include numerous culverts to allow hydrologic exchange through the levees.

Alternative 1

Alternative 1, based on the Recommended Plan (Modified Highway 57, Alternative 6) from the 2002 feasibility study, was re-designed to provide hurricane risk reduction up to the 1% AEP (100-yr) surge. Alternative 1 is approximately 65 miles long and has structures and levees ranging from 18.5 to 28.5 feet and is shown in Figure 4-1.



Source: USACE.

Figure 4-1. Levee Alignment for Alternatives 1 and 4 (authorized alignment)

Alternative 2

Alternative 2, based on the Reconnaissance Alternative (Alternative 5) from the 2002 feasibility study, was re-designed to provide hurricane risk reduction up to the 1% AEP (100-year) surge. Alternative 2 is approximately 55 miles long with levee/structure elevations ranging from 18.5 feet to 28.5 feet (NAVD 88). This alternative's alignment is the same as the alignment in

Alternative 1 on the eastern side of the project, but turns north at Bush Canal on the western side (Figure 4-2).

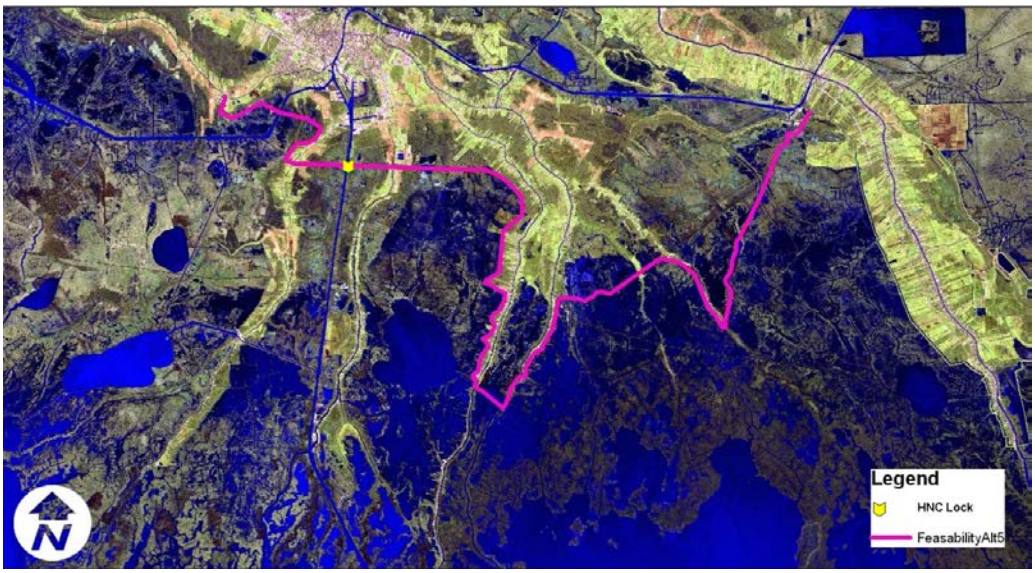


Figure 4-2. Alternative 2 Levee Alignment

Alternative 3

Alternative 3 is based on a Multiple Lines of Defense Strategy (MLODS) alignment presented to the Corps by a group of non-governmental organizations (NGOs) in April 2008 and was not previously considered in the feasibility report. This alternative was also intended to provide hurricane risk reduction up to the 1% AEP (100-yr) surge. The Alternative 3 alignment is similar to Alternative 2 but also includes Theriot and Dulac ring levees (Figure 4-3). Including the two ring levees, Alternative 3 is approximately 63 miles long with levee/structure elevations ranging from 18.5 feet to 23.0 feet (NAVD 88).

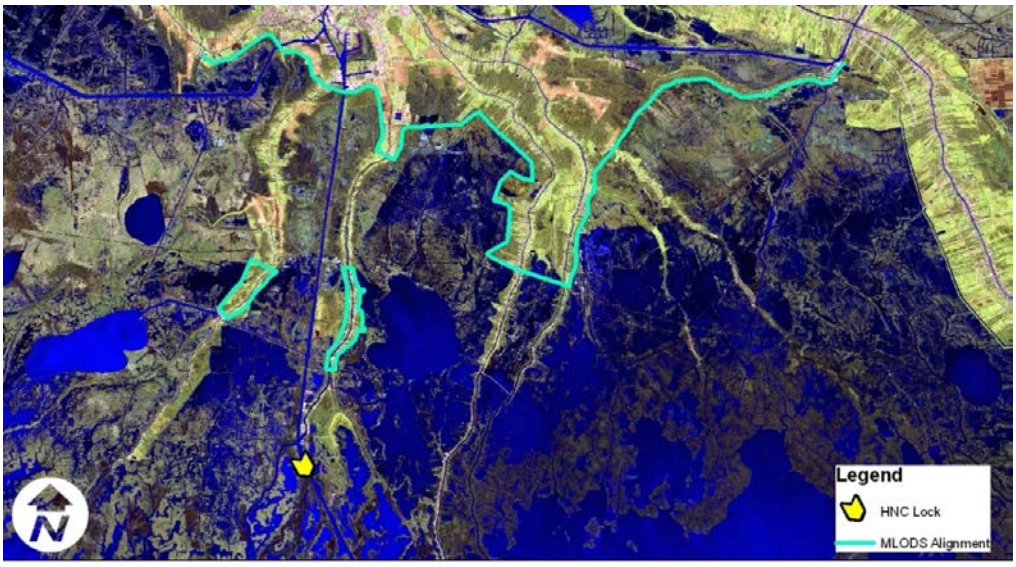


Figure 4-3. Alternative 3 Levee Alignment

Alternative 4

Alternative 4 is most similar to the 2002 feasibility study Recommended Plan, sharing not only the same alignment but also having similar levee and structure heights. Levees, locks, floodgates, environmental facilities and floodwalls were reengineered to meet post-Katrina design criteria, but not the post-Katrina 1% AEP (100-year) design elevations. Levee/structure elevations for this alternative range from 11.0 feet to 15.0 feet (NAVD 88). Alternative 4 is approximately 65 miles in length. The alignment for this alternative is the same as that of Alternative 1 (Figure 4-1).

Comparison of 2008 Alternatives

The four alternatives were compared for their average annual benefits (the value of prevented hurricane and storm-surge damages) versus annualized costs (design and construction costs, etc.) over a period of analysis from 2010 to 2060. The analysis factored in without-project potential future damages under low and high scenarios for RSLR. Potential damage estimates included damages to residential and non-residential buildings, agricultural resources, transportation infrastructure, and other categories. The alternatives were also compared in terms of both their adverse and beneficial effects on wetland habitat in the study area. Please refer to the PAC report for a more comprehensive discussion on the comparison of the four alternatives.

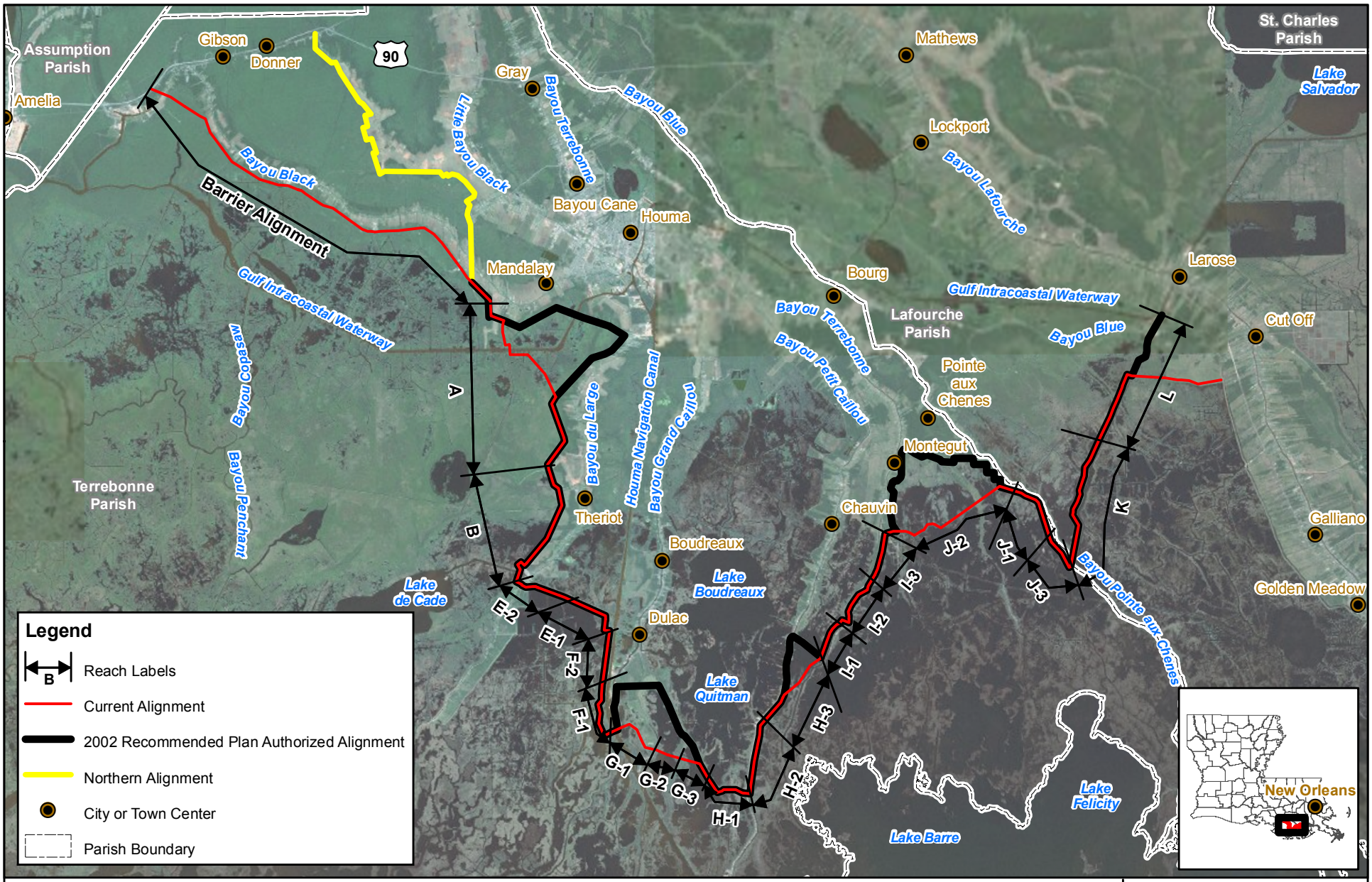
The results of these comparisons revealed that only alternatives 1 and 4, both of which incorporate the authorized alignment (Recommended Plan in 2002 feasibility report) (Figure 4-1), were economically justified with a benefit/cost ratio over 1.0. Alternatives 1 and 4 were shown to impact the least acreage of bottomland hardwood (dry and wet), and had the largest water storage area behind them in case of levee overtopping from waves and storm surges. Therefore, alternatives 2 and 3 were dropped from further analysis, and alternatives 1 and 4 were retained for detailed evaluations.

4.2.2 REFINEMENTS TO THE AUTHORIZED ALIGNMENT

After the 2008 analysis, the authorized levee alignment was refined to reduce costs, reduce direct environmental and cultural resources impacts, and improve risk and reliability based on lessons learned from Hurricane Katrina. For example, advances in storm surge modeling revealed that narrow, sharp indentations in the alignment can lead to stacking of surge, which increases risk and makes the levee less reliable. For these reasons, the levee was extended to the west and east, and reaches A, G, H, J, and L of the authorized alignment were modified (Figure 4-4). All of the refinements resulted in more cost effective plans and reduced direct environmental impacts.

Levee Extension

Based on higher post-Katrina surge levels, the authorized alignment was extended to the west to tie into high ground. Two alternative alignments were considered—a “Barrier Alignment” and a “Northern Alignment” both alignments originate at Minor’s Canal.



N

0 2.5 5 Miles

Figure 4-4. REFINEMENTS TO THE AUTHORIZED ALIGNMENT

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC Gulf Engineers & Consultants

Figure: 4-4
Date: February 2012
Scale: 1:320,000
Source: USACE/GEC
Map ID: 273160010-2811

- The Barrier Alignment is 15.4 miles long and generally follows the edge of development along the south side of the Bayou Black Ridge (LA 182/Old US 90).

- The Northern Alignment is 15.6 miles long and runs west along Bayou Black Ridge for approximately 2 miles, then turns north and follows Savane Road (Parish Road 23) up to the Little Bayou Black Ridge. The alignment then follows the southern development boundary along Bull Run Road (Chacahoula ridge) northwest until it ties in to Highway 90.

As shown in Figure 4-4, the Barrier Alignment incorporates additional assets not included within the Northern alignment. The elevations and lengths of the Barrier and Northern alignments are similar but the Barrier Alignment would reduce risk to more people and structures. The Barrier Alignment was selected to complete the Morganza to the Gulf levee alignment.

The following paragraphs briefly describe the various options .evaluated for reaches A, G, H, J, and L and summarize the cost and environmental impact comparisons. More detailed discussions are found in PAC Report.

Reach A

In October 2009, the USACE evaluated three alignment options for Reach A (Figure 4-5):

- A1: 11.8 miles of levee, four box culvert locations
- A1-A: 14.3 miles of levee, four box culvert locations
- A2: 10.3 miles of levee, two box culvert locations
- A3: 9.2 miles of levee, four box culvert locations

Each alternative would include two 125’ floodgates, one 56’ sector gate, and 6’ by 6’ box culverts at various locations. A2 would have three tainter gates associated with the sector gate. All earthen levees would be constructed from material hauled in from off-site borrow sources.

Cost estimates included the cost of construction, real estate, and mitigation. Environmental impacts were evaluated based on the amount of direct and indirect impacts to both marsh and bottomland hardwoods (wet and dry), and the approximate cost of mitigation.

Option A3 was selected for the current alignment because it was found to be the most cost effective alternative. Compared to the original authorized alignment, this alignment would impact more acres of bottomland hardwood (dry) but would impact fewer acres of bottomland hardwood (wet) and marsh. Option A3 would enclose approximately 1,500 additional acres compared to A1, but box culverts would reduce any potential indirect impacts to water exchange.

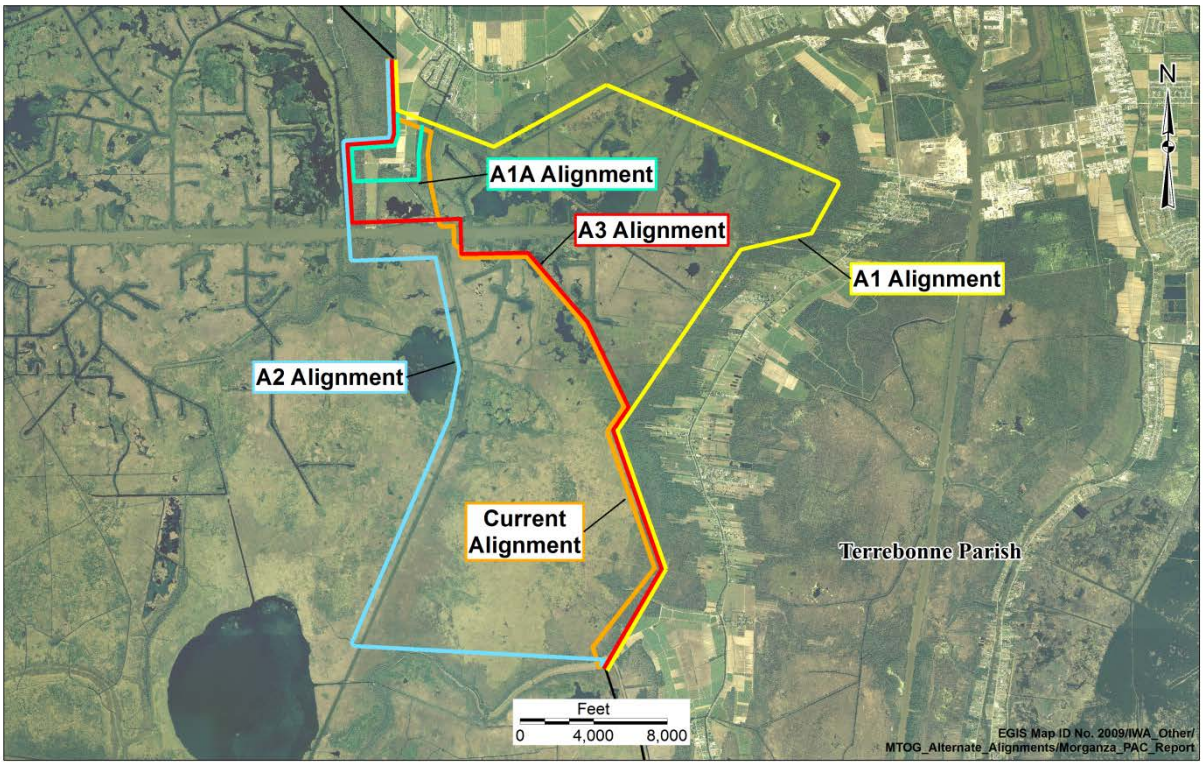


Figure 4-5. Alternative Alignments Analyzed for Reach A

Reach G

In October 2009, the USACE evaluated five alignment options for Reach G (Figure 4-6). The options included the authorized alignment from the 2002 feasibility report, an alignment developed during PED, and three other alignments developed for the PAC report as follows:

- PED Alignment (5.25 miles): Includes one road crossing, a 30’ stop log, and two drainage structures
- PAC 1 Alignment (4.60 miles): Includes one road crossing, a 30’ stop log, and two drainage structures
- PAC 2 Alignment (4.29 miles): Includes one road crossing, a 30’ stop log, and three drainage structures
- PAC 3 Alignment (4.90 miles): Includes one road crossing and two drainage structures
- Feasibility Alignment (authorized alignment) (7.48 miles): Includes one road crossing and two drainage structures

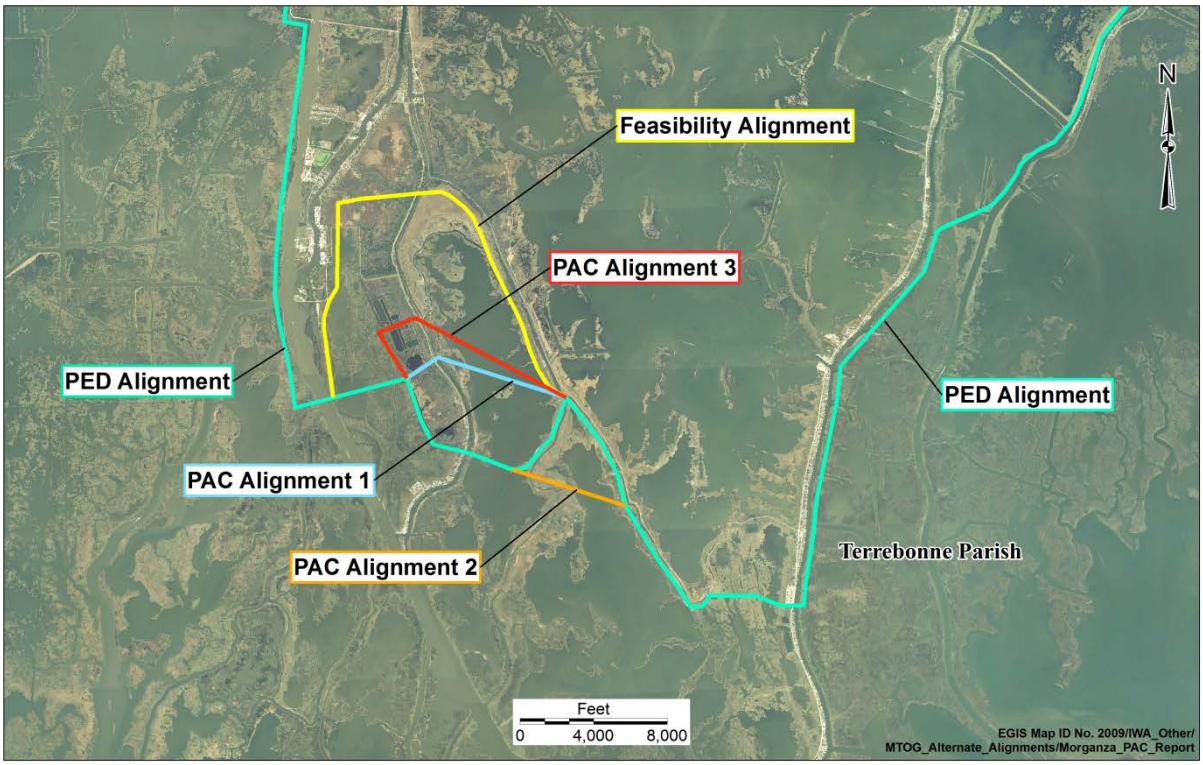


Figure 4-6. Alternative Alignments Analyzed for Reach G

The estimated project cost was compared for each alternative alignment as shown. Cost estimates included the cost of construction, real estate, and mitigation.

Environmental impacts were evaluated based on the amount of direct impacts to both marsh and bottomland hardwoods (wet and dry) due to the levee placement and the borrow pits. Costs for the mitigation were based on a ratio, not on habitat value. No indirect impacts were quantified.

The feasibility alignment was screened out because it has the highest cost, highest direct impacts, and two known cultural sites within the alignment. The PAC2 option was selected as the preferred alternative because it is the most cost effective alternative. The PAC2 option presents a tradeoff between direct and potential indirect impacts. Of all the options, the PAC2 option would have the least direct wetland impacts, but would enclose the largest amount of marsh and open water. The National Marine Fisheries Service (NMFS) and the rest of the Habitat Evaluation Team were initially concerned about the potential for indirect impacts to marsh and fishery access to wetlands and Essential Fish Habitat on the protected side; however, those concerns have been reduced by demonstrating minimal indirect impacts through systemwide modeling of environmental control structures.

Reach H, Segments 2 and 3

In 2005, the TLCD performed an alternative alignments analysis for Reach H, segments 2 and 3. Agency representatives from USACE, USFWS and NMFS provided input on the analysis, which

considered engineering feasibility, environmental impacts, and construction costs. The following four alignments were evaluated (Figure 4-7):

- The Existing Alignment from the 2002 feasibility report which follows the natural ridge,
- A Set Back Alignment, which moves the levee alignment away from the ridge,
- An Existing Alignment Cross Over, which follows the existing alignment from the south but then crosses over to the northeast to join Reach I, eliminating the need to improve the Bush Canal levee and associated pump station in Reach I.
- A Set Back Alignment Cross Over, which follows the setback alignment from the south but then crosses over to the northeast to join Reach I, eliminating the need to improve the Bush Canal levee and associated pump station in Reach I.

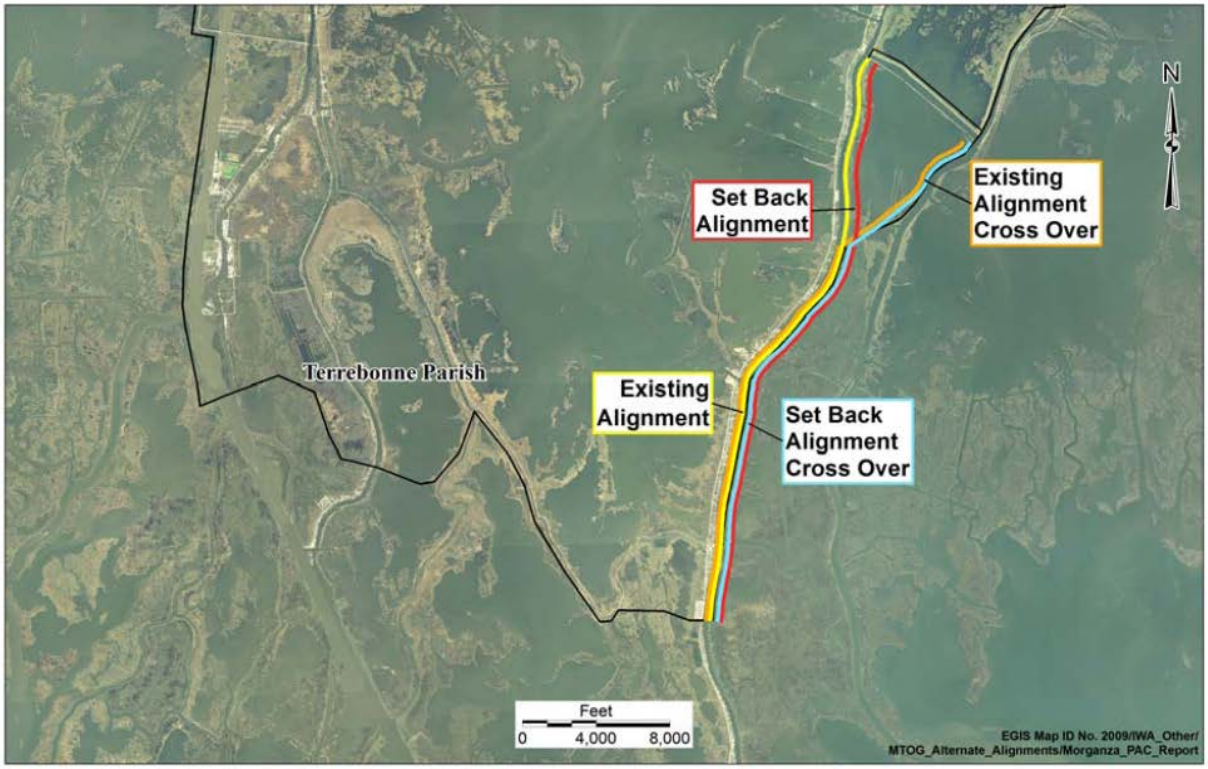


Figure 4-7. Alignments Analyzed for Reach H.

Additional alternatives were evaluated by combining the above alignments with different borrow material assumptions (for example, using fill material from adjacent borrow areas or fill material hauled-in from offsite sources). Using adjacent borrow material was found to be the most cost effective method.

The Existing Alignment Cross Over alternative was selected as the new alignment because it had the lowest total cost of all the alternatives, both with and without the Bush Canal savings. Therefore, based on both economic and environmental benefits, the team moved the alignment to its current location. The TLCD was granted a USACE permit for reaches H-2 and H-3 on November 13, 2008.

Reach J, Segment 2

In 2004, the TLCD, in coordination with the USACE, performed an alternative alignments analysis of Reach J, Segment 2 (Figure 4-8). In the cost projections prepared for the 2002 feasibility report, the proposed hurricane levee was assumed to be located on natural levee soil landforms consisting of moderately strong to strong clays. However, an analysis of geotechnical and historic data indicated that as much as 70 percent of the J-2 alignment would be placed on landforms consisting of relatively deep peat layers, overlying weak clay deposits. The unanticipated soil conditions led to an increase in projected costs.

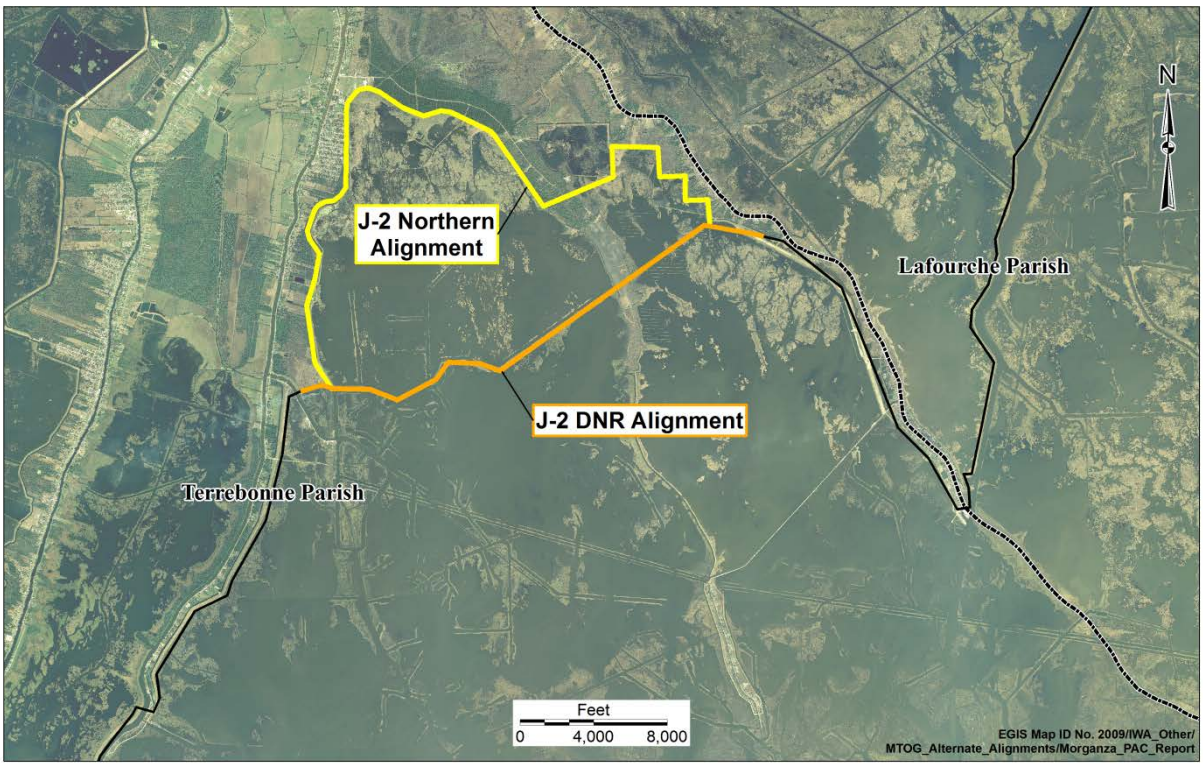


Figure 4-8. Alternative Alignments Analyzed for Reach J2

As an alternative to the original J-2 alignment, the team evaluated an alignment following the existing Louisiana Department of Natural Resources (DNR) marsh restoration levee. The DNR alignment would shorten the total levee length by more than 20,000 feet, reduce direct wetland impacts from 345 acres to 83 acres, and eliminate bottomland hardwood impacts. Indirect impacts would be minimal because of the existing levees and structures associated with the J-2 DNR alignment's marsh management system. Additionally, the cost savings associated with the construction of the DNR alignment versus the construction of the original alignment were estimated at over $14 million because most of this levee alignment would be constructed on existing levees that would not require reinforced geotechnical fabric, sand base, or additional fill. For these reasons, this new alignment was chosen for Reach J-2.

Reach L

In October 2009, the USACE evaluated three alignment options for Reach L (Figure 4-9):

- L1: 5.4 miles of levee, two box culvert locations (authorized alignment)
- L2: 6.1 miles of levee, two box culvert locations
- L3: 6.1 miles of levee, one box culvert location

Each alternative would include one 56' sector gate with three 46' tainter gates and 6' by 6' box culverts at various locations. All earthen levees would be constructed of hauled-in material from off-site borrow sources.

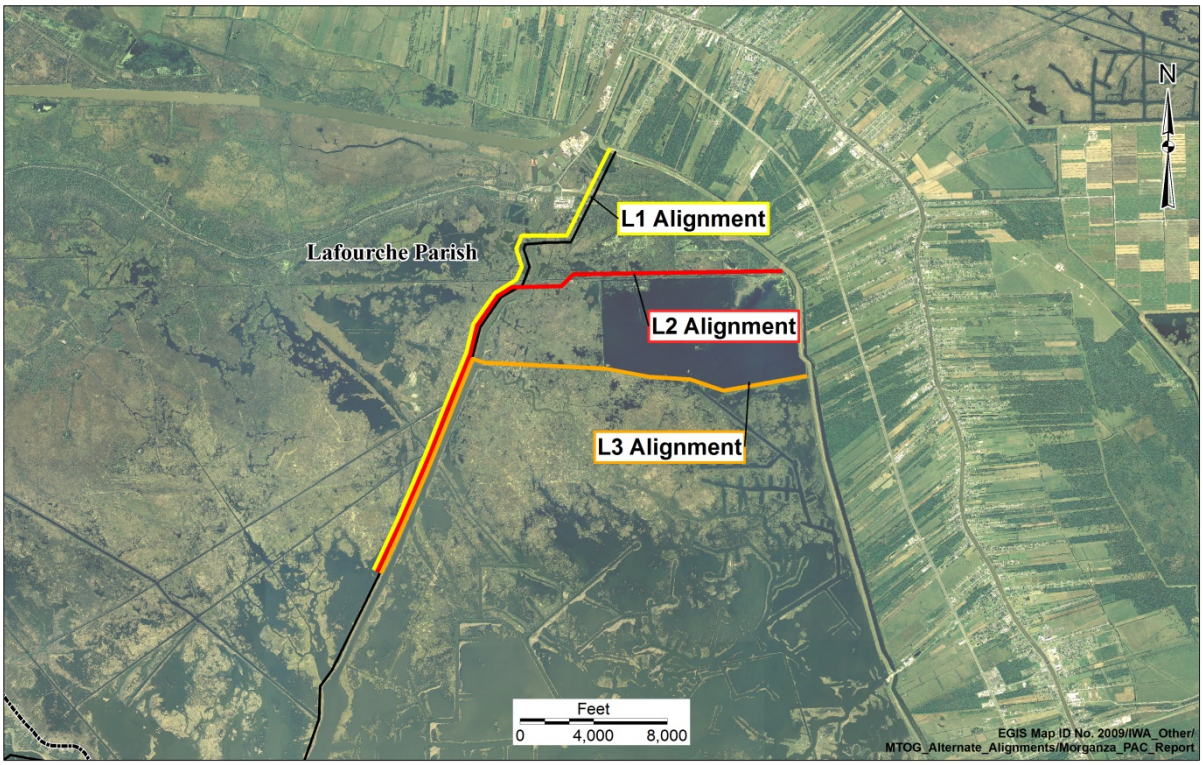


Figure 4-9. Alternative Alignments Analyzed for Reach L

Cost estimates included the cost of construction, real estate, and mitigation. Although Reach L3 is longer than the authorized alignment (L1), it would reduce the length of the existing Larose to Golden Meadow levee that would need to be raised resulting in an overall lower net cost. Environmental impacts were evaluated based on the amount of direct and indirect impacts to both marsh and bottomland hardwoods (wet and dry).

Option L3 was selected for the current alignment because it is the most cost effective alternative. As compared to the authorized alignment, this alignment would impact fewer acres of

bottomland hardwood and marsh. Option A3 would enclose approximately 2,000 additional acres compared to the authorized alignment (A1), but box culverts would reduce any potential indirect impacts to water exchange.

Levee Extensions to the East: The alternative was extended on its eastern extent to address potential costs in the event that other previously proposed hurricane and storm damage reduction projects in the area are never authorized and/or constructed. The following reaches were added to the 77-mile TSP alignment, resulting in a longer 98-mile alignment (Figure 4-10 and the mapbook in Appendix G):

- Lockport to Larose Ridge - A 14-mile levee reach following an alignment formerly being proposed under the Donaldsonville to the Gulf feasibility study and tying into Lockport, Louisiana. This reach would include two environmental control structures and three pump stations.

- Larose Section C-North Variant - A seven-mile levee reach following Larose to Golden Meadow sections C-North and E-1. Approximately 5,300 feet of existing T-wall would have to be removed and replaced or built adjacent to or on urban land. This reach would include one pump station and two floodgates.

4.3 Final Alternatives Considered in Detail

In addition to the No Action Alternative (4.1), the following alternatives have been evaluated in detail for comparison and plan selection. For further details on plan formulation, please refer to the PAC report.

- 1% Annual Exceedance Probability Storm Surge Risk Reduction System (1% AEP Alternative)—Tentatively Selected Plan (TSP)
- 3% Annual Exceedance Probability Storm Surge Risk Reduction System (3% AEP Alternative)

Alternatives 1 and 4 brought forward from the 2008 analysis form the basis of the two final action alternatives under current consideration. Both share the same alignment for 98 miles (figures 4-10 and 4-11), which is based on the alignment chosen as the Recommended Plan in the 2002 feasibility study, but with the alignment modifications described above and extensions to the project.

Detailed maps of the alternatives are provided in Appendix G, “Maps of Final Alternatives”. Although this RPEIS is programmatic in nature, the following features of the action alternatives have sufficiently detailed designs to be fully assessed in this RPEIS, and would not require additional NEPA documentation. These features, termed “Constructible Features”, include levee reaches F1, F2, G1; the HNC Lock Complex; and the Bayou Grand Caillou Floodgate (Figure 4-10). The remaining components of the project are termed “Programmatic Features.”

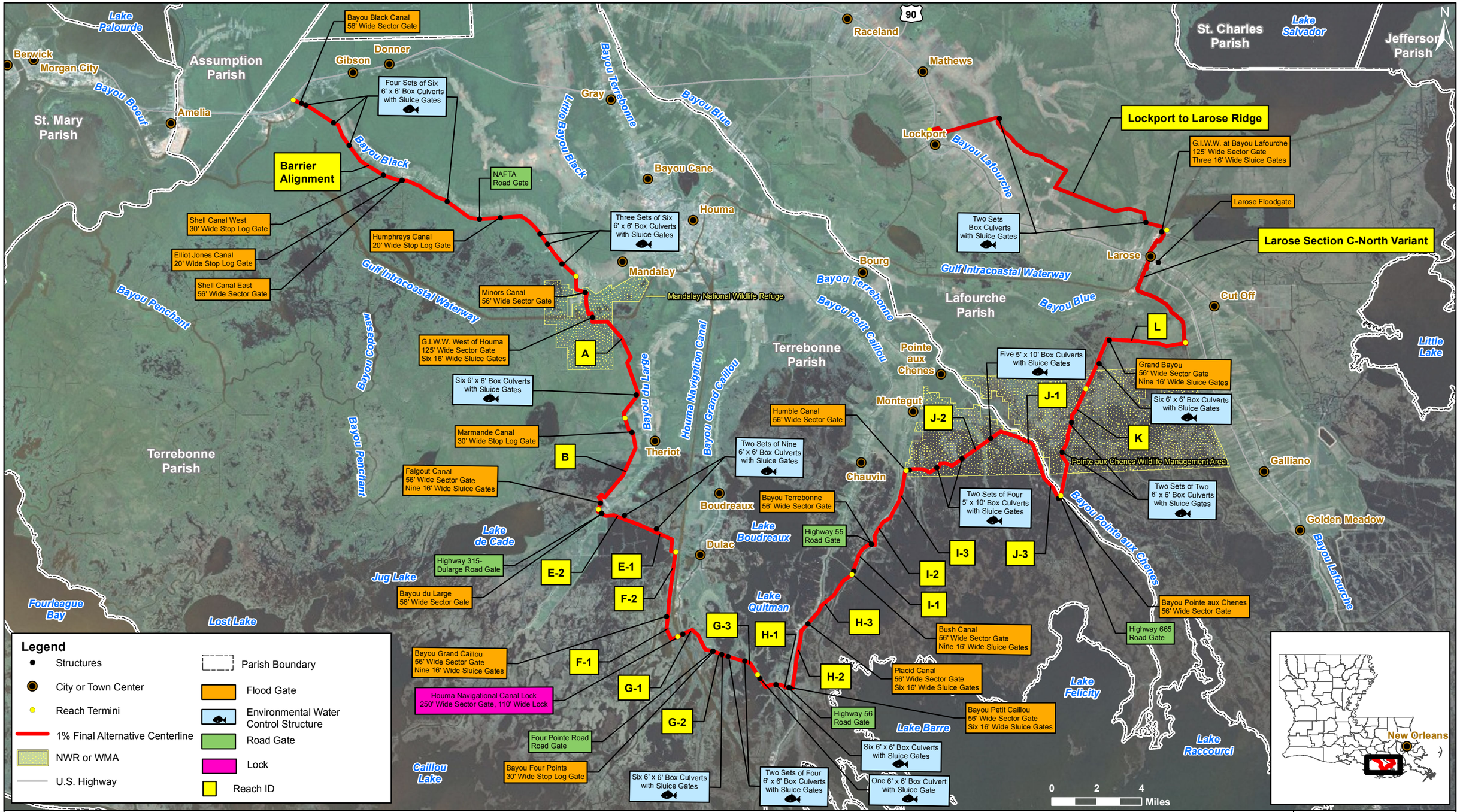


Figure 4-10. ALIGNMENT AND STRUCTURES OF THE
1% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVE

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC
Gulf Engineers & Consultants

Figure: 4-10
Date: June 2012
Scale: 1:256,000
Source: USACE/GEC
Map ID: 273160010-2811

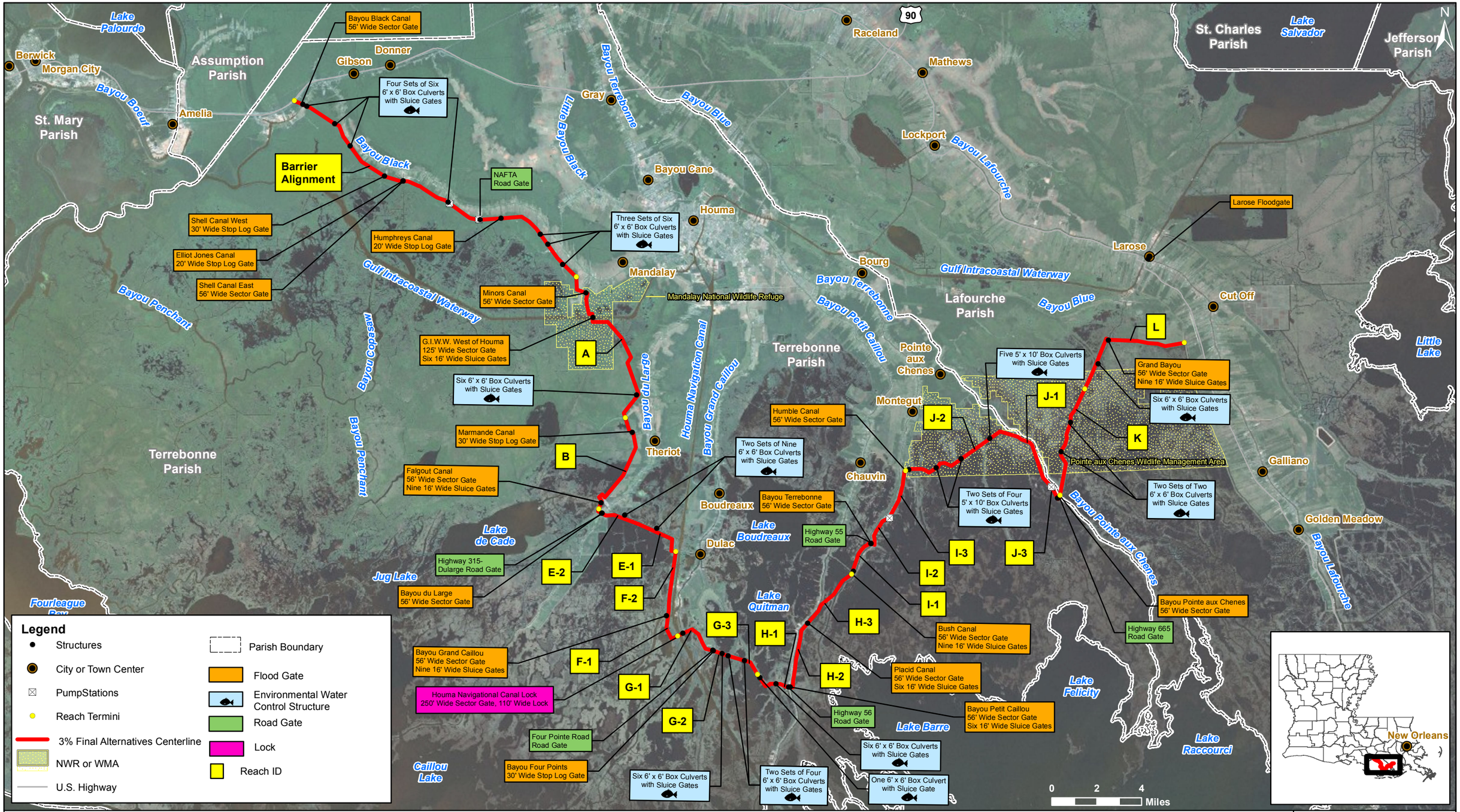


Figure 4-11. ALIGNMENT AND STRUCTURES OF THE 3% ANNUAL EXCEEDANCE PROBABILITY STORM SURGE RISK REDUCTION SYSTEM ALTERNATIVES

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

GEC Gulf Engineers & Consultants

Figure: 4-11
Date: May 2012
Scale: 1:256,000
Source: USACE/GEC
Map ID: 273160010-3004

4.3.1 1% AEP ALTERNATIVE

The 1% AEP Alternative is a hurricane levee system that provides risk reduction for water levels that have a 1 percent chance of occurring each year. This alternative is closely based on Alternative 1 (authorized alignment) from the 2008 analysis.

The levee system would extend from high ground along US 90 near the town of Gibson and tie into Hwy 1 near Lockport, LA in Lafourche Parish (Figure 4-10; detailed maps shown in Appendix G). Planned levee elevations range from 15.0 to 26.5 feet NAVD88. Toe-to-toe levee widths range from 282 feet to 725 feet. Twenty-two floodgate on navigable waterways, ranging in elevation from 17.0 to 33 feet (NAVD88), would be located on waterways throughout the levee system, including a lock complex on the HNC. Additionally, environmental water control structures would allow tidal exchange at 23 locations through the levee through sluice gates and box culverts (Figure 4-10 and Appendix G).

A total of nine road gates would be located at the following levee/road crossings: NAFTA, Four Pointe Road, Highway 315 (DuLarge), Highway 55, Highway 56, and Highway 665. Fronting protection would be provided for four pumping stations, including the Madison, Pointe aux Chenes, Elliot Jones (Bayou Black), Hwy 24, Hwy 3235, Union Pacific RR, and Hanson Canal pump stations.

HNC Lock Complex: The HNC lock complex would consist of a 110-foot by 800-foot lock, an adjacent 250 foot-wide sector gate, and a dam closure that tie into adjacent earthen levees to reduce the risk of storm surge traveling up the HNC (Figure 4-12). Vessel traffic would pass through the sector gate portion of the structure for the majority of conditions. However, when the sector gates are closed, the lock would be used. The complex would be constructed as part of the Morganza to the Gulf of Mexico, Louisiana project but could also be operated for environmental purposes.

4.3.2 3% AEP ALTERNATIVE

The 3% AEP Alternative would provide risk reduction for water levels that have a 3 percent chance of occurring each year. This alternative is a modification of the 2008 analysis Alternative 4 (Recommended Plan from the 2002 feasibility study), which was based on outdated (pre-Katrina) storm and levee design standards for the 100-year level of risk reduction. To update this alternative to current risk reduction standards, a statistical analysis on each levee reach was performed after the 2008 report. This analysis did not produce a consistent level of risk reduction along the entire levee alignment. Return intervals varied from a low of 18 to 23 years (Reach L) to a high of 66 to 83 years (Reach A). Further statistical analyses determined that a 3 percent annual chance (35-year) surge most closely represents the current overall level of risk reduction for the 2002 authorized levee system. For the current study, the authorized project alternative was subsequently redesigned to represent a consistent 3 percent annual exceedance probability.

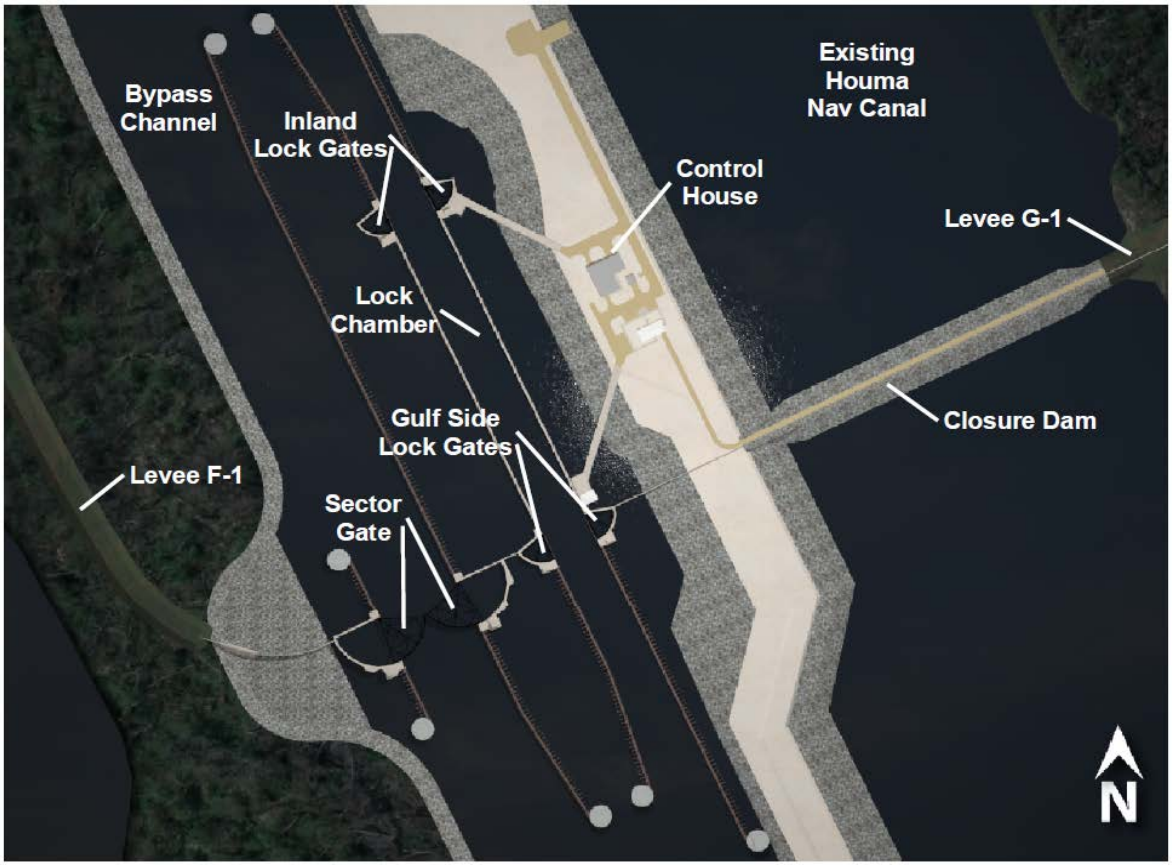


Figure 4-12. Houma Navigation Canal Lock Complex.

This alternative would have a similar alignment and structures as the 1% AEP Alternative (see above) but with levees and structures at lower elevations to meet post-Katrina 3 percent standards (Figure 4-11 and Appendix G). Planned levee elevations range from 12.0 to 20.0 feet NAVD88. Toe-to-toe levee widths range from 174 feet to 440 feet. Structures would range from elevation 14.0 to 25.0 feet NAVD88.

The levee alignment would be 98-miles long. It was found that the net benefits of this alternative would be lower than the net benefits of the 1% AEP Alternative.

4.3.3 SELECTED LEVEL OF RISK REDUCTION (1% AEP ALTERNATIVE)

The 1% AEP has tentatively been selected for the following reasons:

- **Higher net benefits**. According to WRDA Implementation guidance dated May 25, 2011, "recommendations in the PAC report should be made in consideration of maximizing excess benefits over costs." Both plans have positive benefit-cost ratios, but net benefits (excess benefits over costs) for the 1% AEP Alternative are higher than the net benefits of the 3% AEP Alternative.
- **Lower residual risk**. The 3% AEP Alternative has a higher probability of overtopping and/or levee breaches than the 1% AEP Alternative and therefore has higher residual damages than the 1% AEP Alternative.

- **More adaptable**. The 1% AEP structures would be constructed at higher elevations than the 3% AEP structures, which allows more flexibility to adapt to relative sea level rise in the future. Although the total cost of the 1% AEP Alternative is significantly higher than the 3% AEP Alternative, not all funding and expenditures are required up front since earthen levees would be constructed in multiple lifts.

4.3.4 LEVEE AND STRUCTURE DIMENSIONS TO ACCOMMODATE RELATIVE SEA LEVEL RISE

As described above, one main difference between the two final alternatives lies in the levee dimensions and structure heights related to the differing levels of hurricane risk reduction (tables 4-1 and 4-2).

Table 4-1. Comparison of Levee Reach Dimensions for the 1% and 3% AEP Alternatives

Levee Reach	Length (miles)	Authorized Elevation (NGVD)	Range of Levee Design Elevations Between 2035 and 2085 (ft NAVD88)		Maximum Levee Toe to Toe Width (ft)	
			3% AEP Alternative	1% AEP Alternative	3% AEP	1% AEP
Barrier	15.7	N/A	10 to 13	15.5 to 20	174	329
A	8.2	10.5	10 to 13	15.5 to 20.5	174	329
B	5.1	12	11.5 to 13.5	17.5 to 20.5	355	610
E	4.4	14	14.5 to 15.5	21.5 to 23.5	440	725
F	4.1	14	14.5 to 15.5	22 to 23.5	270	490
G	5.8	15	16.5 to 17.5	22.5 to 24	270	550
H	7.9	15 to 16	18.5 to 20	24 to 26.5	330	500
I	5.7	14 to 15	18.5 to 20	24 to 26.5	319	570
J	9.3	14	18.5 to 20	24 to 26.5	337	660
K	5.1	12 to 14	16.5 to 17.5	22.5 to 25.5	400	635
L	5.9	10 to 11	16.5 to 17.5	22.5 to 25.5	400	635
Larose C-North	7.0	N/A	13.5 to 15.5	18 to 20.5	252	467
Lockport to Larose	12.6	N/A	8.5 to 12	10.5 to 15	282	282
Note the different datum for the authorized (NGVD) and current (NAVD88) elevations. The change in elevation due to datum differences varies by location, and is around 0.5 to 1.5 ft.						

Table 4-2. Comparison of Floodgate Elevations for the 1% and 3% AEP Alternatives

Reach	Waterway	Structure Design Size/Type (subject to change during detailed design)	3% AEP Design Elevation (ft)	1% AEP Design Elevation (ft)
Barrier	Bayou Black	56-ft sector gate	15.0	22.0
	Shell Canal West	30-ft stop log gate	16.0	23.5
	Shell Canal East	56-ft sector gate	16.0	23.5
	Elliot Jones Canal	20-ft stop-log gate	16.0	23.5
	Humphreys Canal	20-ft stop-log gate	16.0	23.5
A (north of GIWW)	Minor's Canal	56-ft sector gate	16.0	23.0
A	GIWW West (at Houma)	125-ft sector gate	16.0	23.0
B	Marmande Canal	30-ft stop-log gate	16.5	23.0
	Falgout Canal	56-ft sector gate	16.5	23.0
E-2	Bayou Du Large	56-ft sector gate	18.0	25.5
F-1	Bayou Grand Caillou	56-ft sector gate	18.0	25.5
G-1	HNC	250-ft sector gate and lock	22.5	30.5
G-2	Four Point Bayou	30-ft stop-log gate	22.5	30.0
H-1	Bayou Petit Caillou	56-ft sector gate	22.5	30.5
H-2	Placid Canal	56-ft sector gate	24.0	31.5
H-3	Bush Canal	56-ft sector gate	25.0	33.0
I-1	Bayou Terrebonne	56-ft sector gate	25.0	33.0
I-3	Humble Canal	56-ft sector gate	25.0	33.0
J-3	Bayou Pointe aux Chenes	56-ft sector gate	25.0	33.0
L	Grand Bayou	56-ft sector gate	21.0	29.5
Larose C-North	Bayou Lafourche	56-ft sector gate	14.0	17.0
	GIWW East (at Larose)	125-ft sector gate	17.0	21.5

The levee design heights, cost estimates, and benefit-cost ratios for the alternatives are based on the intermediate RSLR scenario of 2.4 feet. Since this project will be constructed over 40 or more years, the RSLR rates and associated levee heights may be updated in the future to reflect actual conditions. If over time it appears that the actual RSLR rate is higher than expected, additional lifts can be added to levees (adding to the cost of the project), and an additional NEPA document would be prepared. If RSLR rates are lower than expected, then final levee lifts will not need to be constructed (reducing the cost of the project).

Conversely, structures were designed to include two feet of structural superiority to accommodate the *high* RSLR scenario. If RSLR rates are lower than expected, the structures will remain overbuilt.

4.3.5 SPONSOR-FUNDED ADDITIONAL WORK ITEM

A sponsor-funded additional work item would involve deepening the HNC lock complex to -23 feet (NAVD88). This option could be implemented in anticipation of a proposal to deepen the HNC, which is the subject of an ongoing feasibility analysis currently being completed by the local sponsor.

Section 203 of the Water Resources Development Act of 1986 allows local sponsors to conduct feasibility studies at their own cost for navigation projects. The completed feasibility report will be submitted to the Assistant Secretary of the Army (Civil Works) for approval to be constructed as a Corps project. If approved, the project will require Congressional authorization and funding prior to actual construction. If the project is authorized and funded, the local sponsor will receive a credit toward construction costs, 50 percent of the feasibility study cost, and Independent External Technical Review costs.

Implementation of the sponsor-funded additional work item would alleviate the necessity of reconstructing the HNC Lock Complex should the HNC deepening project be authorized and funded. The environmental impacts of the HNC deepening project would be assessed in a separate NEPA document.

4.3.6 IMPACTS TO AREAS OUTSIDE PROPOSED RISK REDUCTION SYSTEM

Under the 2007 authorization, not all structures were included in the risk reduction system. Approximately 1,000 structures, in Isle de Jean Charles, Bayou Du Large and Bayou Grand Caillou, would remain outside of the risk reduction system.

Although areas south of the levee system would already receive damages under the without-project conditions, the action alternatives could increase these damages. The alternatives also have the potential to flank the western extent of the Barrier Reach, although this effect is less apparent from the storm surge modeling results. Based on post-Katrina surge modeling, the 1% AEP Alternative would increase water levels during storm events by approximately two to three feet over without-project conditions in areas immediately outside the risk reduction system.

At the current time, detailed information regarding the differences in frequency, depth, and duration of the flooding between the future without-project and future with-project conditions is not available. This detailed information typically would be assessed in light of the uses to which the particular land is zoned, and the appropriate mitigation methods, if any, would be implemented to address the effects of the Federal project.

In order to prevent increased risk to people and structures, which are already located in high risk areas, a preliminary nonstructural compensation plan has been developed. Because of the vast scope of this project and the limited amount of available information at this time, each affected

parcel could not be assessed individually to determine what the level of impact would be, and whether that impact would be categorized as a taking of property rights. A worst case scenario (most expensive option) was assumed, which would be a 100 percent buy-out of all of the structures in the impacted areas. Should this scenario prove to be the appropriate mitigation method, more than 2,500 people would need to be relocated to areas behind the Federal levee system.

The benefits and costs of the buy-out plan have been incorporated into the total project cost and benefits analysis. The buy-out plan increases equivalent annual benefits for the 3% and 1% AEP alternatives by approximately $39 million and $57 million, respectively. The total real estate cost associated with this acquisition is estimated to be approximately $305 million. The potential induced damages and mitigation for economic damages would be further addressed during detailed design and supplemental NEPA documents.

Additional information on induced damages may be found in Section 5 of the PAC report.

4.3.7 INDUCED FLOODING IMPACTS

Given the modeling resolution at the time, the potential for induced flooding outside the levee was not identified in the 2002 feasibility report and DEIS, however, post-Katrina surge modeling results indicate that the project could increase water levels in areas immediately outside the risk reduction system during storm events. When comparing the results of the ADCIRC runs for the without-project to the with-project conditions for existing 1% AEP water levels, the with-project water levels under a storm event are approximately 2 to 3 ft higher. For more details please see section 6.5 of the PAC report.

Approximately 1,000 structures would remain outside of the Morganza to the Gulf risk reduction system. These areas include Isle de Jean Charles and parts of Bayou Du Large and Bayou Grand Caillou. Although areas outside the levee system would already receive damages under the without-project conditions, the alternatives could increase damages during some events. In order to prevent increased risk to people and structures, which are already located in high risk areas, a preliminary nonstructural plan has been developed. To ensure that the public is informed of all potential impacts of the project and to prevent future delays to project schedule, for purposes of this report, the worst case scenario (most expensive option) has been assumed, which would be a 100 percent buy-out of all of the structures in the impacted areas. Should this scenario prove to be the appropriate mitigation method, approximately 2,500 people would need to be relocated to areas behind the Federal levee system. The potential induced damages and mitigation for economic damages would be further addressed during detailed design and supplemental NEPA documents.

Modeling showed that the proposed project may also induce flooding (due to overtopping) south of the Larose Section C-North Variant Reach, on the west side of the Larose to Golden Meadow levee (Figure 4-13: shown with a dashed line). This levee would need to be raised approximately one to three feet to bring it up to a level of risk reduction comparable to the proposed Morganza project. If Congress does not re-authorize and fund improvements to the Larose to Golden Meadow ring levee, the costs to raise the levee and mitigate for any impacts,

currently estimated at $166 million, would be covered by the Morganza to the Gulf project. As a worst-case scenario, these costs are included in the 1% AEP Alternative costs.

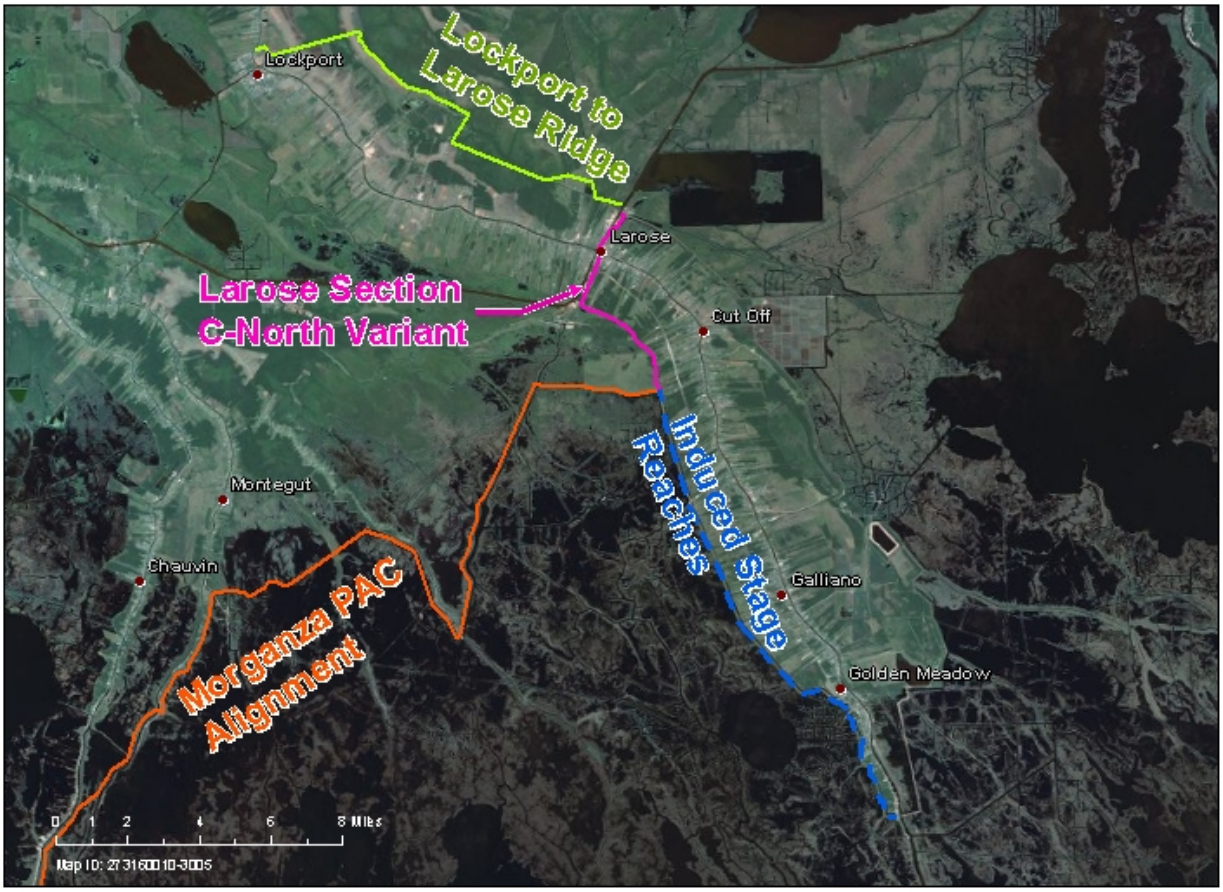


Figure 4-13. Area of Potential Induced Flooding of Larose to Golden meadow ring levee.

4.3.8 OPERATION OF STRUCTURES

The following sections describe the operation plan for the HNC lock complex, GIWW floodgates, other floodgates, and environmental control structures.

4.3.8.1 Operation of HNC Lock Complex

The primary purpose of the Houma Navigation Canal (HNC) lock and floodgate structure is for storm surge control. Secondary benefits include prevention of saltwater intrusion from impacting drinking water quality at the Houma Water Treatment Plant, and protection of marsh areas inside the system along the HNC channel. A lock is being built as a feature of the hurricane, storm damage risk reduction project in order to address impacts to navigation as a result of the operation of these features for project purposes. The lock operation plan has two triggers based on the two purposes. First, maintaining a safe water elevation in the channel for storm control and navigation, and second, controlling chloride levels at the Houma Treatment Plant and controlling salinity to protect environmental habits upstream of the structure.

The HNC complex (HNC lock, HNC floodgate, and Bayou Grand Calliou floodgate) will be closed for storm surge control if:

1. The water surface elevation on the staff gage reaches +2.5 feet NAVD88 downstream of the lock when there is a named tropical storm in the Gulf.
2. If the National Weather Service issues a hurricane warning for the project area, the gates will be closed, if they have not already been closed due to condition (1) above.

The HNC lock and floodgate will be closed for salinity control if:

1. Flows in the Atchafalaya River flows are below 100,000 cfs as measured on the Simmesport gage (USGS 07381490 Atchafalaya River at Simmesport, LA) or
2. If a gage on the outside of the HNC Lock exceeds a salinity value that has been correlated with preventing exceedance of the maximum allowable chloride level of 250 ppm as defined in EPA's secondary drinking water standard at the Houma Treatment Plant. The structure should be closed for at least 12 hrs and fluctuations in chloride levels should be monitored and recorded hourly.

The HNC complex will be opened after a hurricane or other high water event has passed. The gates may be opened when all of the following criteria have been met:

1. The differential between the interior water level and exterior water level is equal to or less than the +1.0 feet as measured on the upstream and downstream staff gage respectively.
2. Navigation can resume, as soon as the hurricane and small craft warning no longer apply to the project area, and the channel has been cleared of obstructions.
3. If the salinity level at Bayou Grand Calliou at Cocodrie (USACE 76305) falls below 13 ppt.
4. After monitoring chloride levels over the 12 hour period indicates chloride levels have stabilized and are below the maximum allowable level of 250 ppm.

It is important to note the operational plan is preliminary and will be refined in the future once the detailed structure design is completed. In order to operate the HNC lock according to the criteria laid out in this plan, a monitoring program must be in place.

4.3.8.2 Operation of GIWW Floodgates

GIWW floodgates at Houma and Larose will be closed for storm surge control if:

1. The water surface elevation on the staff gage reaches +2.5 feet NAVD88 at the floodgates when there is a named tropical storm in the Gulf.
2. If the National Weather Service issues a hurricane warning for the project area, the gates will be closed, if they have not already been closed due to condition (1) above.

4.3.8.3 Operation of Environmental Control Structures

Environmental control structures will be closed for storm surge control if:

1. The water surface elevation on the staff gage reaches +2.5 feet NAVD88 at the flood gates when there is a named tropical storm in the Gulf.
2. If the National Weather Service issues a hurricane warning for the project area, the gates will be closed, if they have not already been closed due to condition (1) above.

The environmental control structures would be used for drainage of isolated areas within a certain timeframe and maximum inundation of the marsh areas. Refer to the H&H appendix for more details.

4.3.8.4 Operation of Other Floodgates on Navigable Waterways

Other floodgates on navigable waterways will be closed for storm surge control and tidal flooding if similar conditions occur to those outlined in recent TLCD permit applications. The floodgates will remain open at all times except during tropical storm events, including hurricanes or other extreme tidal events. Gages will be installed upstream and downstream of each structure. When water levels at the gates approach +2.5 ft NAVD88, the floodgates shall be closed until the differential between the interior water level and exterior water level is equal to or less than the +1.0 feet as measured on the upstream and downstream staff gage respectively. The trigger elevation may vary at different structure locations and will be further refined in the final PAC report.

The number of times closure occurs each year under existing conditions will depend on tropical storm events and location of the structures. The structures located south and east in close proximity to the Gulf are influenced by tidal exchange. These structures would reach the closure stage more frequently than those located in the north and west areas of the project. Proposed structures are expected to be operated in a similar manner to existing flood gates owned and constructed by the locals. Table 4-3 summarizes recent historical closures and frequency of closure by location and year. Most closure durations were less than 48 hours.

Table 4-3. Number of Gate Closures Between 2001 and 2012
Source: Terrebonne Levee and Conservation District

Gate	Total Number of Closures from 2001 to 2012	Maximum Number of Closures Per Year
Bayou Terrebonne	45	8
Little (Petit) Caillou	29	9
Lower Bayou Du Large	5	2
Upper Little Caillou Barge	4	1
Humble Canal	9	5

4.3.8.5 Adapting Operation Plans to Future Conditions

Under future conditions, closure frequency could increase if the closure trigger is not adjusted to account for sea level rise. For example, under existing conditions, HNC floodgate closure (based on a 2.5-ft closure stage only, not the salinity triggers) would occur approximately 1.5 days per year. If the trigger remained the same through 2085, low RSLR would require closure 5 days per year by 2035 and 168 days per year by 2085 (refer to RSLR rates in table 3-1). Intermediate RSLR would require closure for 15 days per year by 2035 and 354 days per year by 2085. High RSLR would require closure for 24 days per year in 2035 and 365 days per year in 2085. To prevent frequent structure closings, operation plans will need to be re-evaluated periodically and closure trigger elevations may need to be increased if significant sea level rise occurs.

In the future, the non-Federal sponsor may desire more frequent closure of structures to reduce damages from higher stages unrelated to storm events, however, that operational purpose is not covered by the RPEIS for this PAC report. In the event that the project purpose and operation of structures changes in the future, impacts to navigation and development could be reduced by adding a second set of gates to turn floodgates into locks in conjunction with additional pumps behind the levee system. If these changes in operation are requested in the future, a supplemental NEPA document and additional PAC report would be required.

After the HNC lock complex is constructed as part of the Morganza to the Gulf project, the lock could also be operated for ecosystem restoration purposes, such as distribution of freshwater. Proposed operational changes for LCA ecosystem restoration purposes, and associated impacts, are documented in the *Final Integrated Feasibility Study and Environmental Impact Statement for the Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock* (USACE, 2010). For the multipurpose operation to occur, the LCA project would need an OMRR&R plan that considers operation of the lock beyond the current authorization of the Morganza to the Gulf project. By letters dated August 20, 2012 and October 16, 2012 the State formally notified USACE of the State's path forward for the LCA program.The HNC Lock Complex that provides for inland waterway transportation is a Federal responsibility for OMRR&R. Any changes to the operation plan would have to be coordinated with USACE and would potentially require a supplemental NEPA document

4.3.9 MITIGATION

Bottomland hardwood forest; swamp; and fresh, intermediate, brackish, and salt marshes would be adversely impacted by construction of the project. Approximate acres of direct impact both the constructible features (Figure 4-10) and programmatic features have been determined. Only the average annual habitat units (AAHUs) of marsh habitat lost for the constructible features have been determined at this time using Wetland Value Assessment (WVA) methodology. Results are presented in tables 6-1 and 6-2. The detailed WVA report is located in Appendix F.

To offset these losses, coastal marsh habitat would be created as compensatory mitigation for the 1% and 3% AEP alternatives. Acreage and AAHUs are presented in Table 6-6. Areas where compensatory mitigation would be located are shown in Appendix G, *Mapbook*. More information on the proposed mitigation program can be found in Section 6.19.

4.3.10 IMPLEMENTATION SCHEDULE

Project construction is expected to take place over a range of years. The implementation schedule has not been constrained based on any funding stream assumptions or constraints. The schedule assumes completion to base year design elevations by year 2035 with final lifts completed by 2071. Because anticipated sea level rise and land subsidence between 2035 and 2085 would increase elevations necessary to provide appropriate levels of protection, levees would be constructed to remain above the target elevations during the 50-year period of analysis.

4.4 Comparison of Environmental Consequences of Alternatives

Table 4-4 compares the environmental impacts of the No Action and action alternatives. The significant resources are individually described in Section 5 of this environmental impact statement, and the impacts of each alternative plan on each significant resource are detailed in Section 6. More details on the methods used to evaluate alternatives and the evaluation results, including costs, can be found in the PAC report.

Table 4-4. Comparative Impacts of Alternatives

Significant Resource	No Action	1% AEP Alternative	3% AEP Alternative
Wetlands	Most of the study area will lose vegetated wetlands. Salinity regimes would likely move northward, converting fresh and intermediate marshes. High subsidence rates, salinity and erosion associated with southeasterly winds and tropical storms may convert most of the marshes to open water within 20 to 40 years.	More than 3,000 acres of vegetated wetlands would be displaced by project features. These losses would be compensated through the restoration of vegetative wetlands in the project area.	More than 2,500 acres of vegetated wetlands would be displaced by project features. These losses would be compensated through the restoration of vegetative wetlands in the project area.
Prime and Unique Farmland	Hurricane and tropical storm tidal surges would continue to cause damage to prime farmland.	More than 400 acres of prime farmland would be directly affected by construction and 53 acres incorporated into mitigation areas.	Approximately 234 acres of prime farmland would be directly affected by construction and 32 acres incorporated into mitigation areas.
Aquatic Resources	The project area is likely to convert from a mainly estuarine habitat to a predominately marine habitat.	Direct effects include loss of open water habitat through conversion to project features, temporary habitat disruption due to construction. Habitat conversion may occur	Indirect and cumulative impacts would generally be similar to the 1% AEP but direct effects would involve a smaller area.

		from hydrologic alteration. Long-term maintenance of existing habitats would result.	
Fisheries	Continued land loss, conversion of habitats, sea level change, and increased storm intensity in the project area are expected to lead to a net decrease in coastal habitats supporting fisheries.	Direct impacts could result from the construction of levees, water control structures. Indirect impacts include continued loss of coastal habitats supporting fisheries.	Indirect and cumulative impacts would generally be similar to the 1% AEP but direct effects would involve a smaller area.
Essential Fish Habitat	Continued land loss, conversion of habitats, sea level change, and increased storm intensity in the project area are expected to lead to a net decrease in EFH.	Direct impacts could result from the construction of levees, water control structures. Indirect impacts include continued loss of EFH.	Indirect and cumulative impacts would generally be similar to the 1% AEP but direct effects would involve a smaller area.
Significant Resource	**No Action**	**1% AEP Alternative**	**3% AEP Alternative**
Wildlife	Wildlife abundance is expected to decline due to the ongoing conversion of marsh to open water and subsidence of forested habitat.	Construction of levee, structures, and other features would convert wetland and open water habitat to uplands and project features. Indirect impacts would include creation, restoration, and protection of wetland habitat used for nesting, rearing of young, resting, and foraging activities.	Results would be similar to the 1% AEP Alt except for fewer acres converted to levees and project features.
Threatened and Endangered Species	The project area is expected to continue to lose estuarine wetland habitats used by T&E species for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements.	No direct impacts on T&E species. The project would partially offset the loss of coastal habitats thereby benefiting T&E species dependant on these habitats.	Effects would be similar to those described for the 1% AEP Alt.
Noise	No effects on noise levels are expected.	Any effects would be temporary and localized.	Same as 1% AEP Alt
Air Quality	No effects on air quality	Any effects would be temporary and localized.	Same as 1% AEP Alt
Hydrology	Amounts of Atchafalaya River water would increase. Greater areas of open water would form in marsh areas leading to higher storm surges in	Within the levee, normal water/land interface would remain as it was pre-project. If structures are properly operated, the proposed levee system would have a minimal	Same as 1% AEP Alt

	developed areas.	effect on the global salinity values.	
Water Quality	Water quality for the study area is expected to remain similar to current conditions. It is most likely that the average number of days annually exceeding the EPA chloride standard will remain relatively constant.	Levees would provide barriers to saltwater impacts from storms and long-term saltwater intrusion.	Same as 1% AEP Alt
Hazardous, Toxic, and Radioactive Waste	No effects on HTRW are expected.	It is unlikely that HTRW would alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large.	Same as 1% AEP Alt
Significant Resource	**No Action**	**1% AEP Alternative**	**3% AEP Alternative**
Socioeconomics	Risks and effects of hurricane and storm damages would continue to affect socioeconomic resources.	Displacement of approximately 10 housing units and temporary effects and disruptions of socioeconomic resources near construction sites. Indirect impacts include increased protection from flooding. The project may raise water levels outside the levees by several feet during storm events. For the PAC and this RPEIS, the USACE has assumed a worst-case compensation scenario, a 100% buy-out of all of the structures outside of the project alignment. Should this scenario prove to be the appropriate action, all residents located outside of the project alignment would be relocated to areas behind the federal protection system.	Approximately 7 housing units displaced; otherwise same as 1% AEP Alt
Cultural Resources	Flooding due to storm events would erode landmasses containing cultural resources; this	The construction of levees may directly adversely impact any cultural resource that lies in the	Impacts would generally be similar to the 1% Alternative.

	impact is permanent and its severity is based on the duration of the storm event. Adverse impacts would result from continual incremental loss of natural ridges that hold both known and potential unknown cultural resources due to sea level rise, subsidence and erosion.	path of the levee or its associated borrow or mitigation areas. Potential direct positive impacts result to areas protected by the proposed hurricane and storm damage risk reduction system.	
Recreation	By taking no action, continued saltwater intrusion, storm surge inundation and wetland and shoreline erosion and associated wetland fragmentation and conversion to open water will likely continue in the study area with negative impacts on recreation resources.	There will be no direct impacts to recreational facilities, as the proposed levee alignment avoids these features. An expanded levee system will have beneficial and detrimental effects on recreation. Indirect impacts include positive benefits to recreation.	Impacts would generally be similar to the 1% Alternative.
Aesthetics	Resources could be temporarily impacted by storms reducing accessibility to the Wetland Cultural Byway. Adverse indirect impacts to visual resources in the study area would be due to the incremental loss of wetlands and the natural ridges due to sea level rise, subsidence and erosion.	Visual resources may be directly adversely impacted by levee construction Visual resources may be positively impacted due to an enhanced hurricane and storm damage risk reduction system.	Impacts would generally be similar to the 1% Alternative.

5. AFFECTED ENVIRONMENT

The President's Council on Environmental Quality (CEQ) regulations (40 CFR Part 1500 *et seq*.), promulgated to implement NEPA; provide guidance for the preparation of environmental impact statements. Section 1502.15 of the CEQ regulations provides direction for preparing the Affected Environment section and states that this section shall contain data and analysis "commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced."

This section provides a general overview of the environmental setting of the study area, and then describes the significant resources that may be affected by the project, including: vegetation, with an emphasis on wetlands; prime and unique farmland; aquatic resources; fisheries; essential fish habitat (EFH); wildlife; threatened and endangered species; noise; air quality; hydrology; water quality; socioeconomics; recreation; aesthetics; cultural resources; and hazardous, toxic, and radioactive waste (HTRW). A resource is considered significant if it is recognized by laws, regulations, or Executive Orders, or if it is recognized as important by stakeholders.

5.1 Environmental Setting of the Study Area

5.1.1 DESCRIPTION OF THE WATERSHED

The study area is situated within the Barataria-Terrebonne estuary (Figure 5-1). This estuary extends from the west bank levees of the Mississippi River (north and east), to the East Guide Levee of the Atchafalaya River (west), to the Gulf of Mexico (south), and to the town of Morganza (north). The Barataria Basin covers about 1,551,800 acres while the Terrebonne Basin covers an area of about 2,063,500 acres. The study area lies at the southern end of the Terrebonne Basin and contains a complex of habitat types, including natural levees, lakes, swamps, marshes, and bayous formed from sediments of abandoned Mississippi River deltas. Elevations in the study area vary. Near Houma, the largest city in the area, the elevation is approximately 10 feet (NGVD). The elevation along the bayou ridges is four to five feet (NGVD) and less than one foot (NGVD) along the southern portion near the Gulf of Mexico.

The major waterways located in the study area or that influence the study area include the Atchafalaya River, Bayou Black, Bayou du Large, Bayou Grand Caillou, Bayou Petit Caillou, Bayou Terrebonne, Bayou Pointe aux Chenes, Bayou Lafourche, and Bayou Blue (Figure 3-1). There are no scenic streams in the study area designated under the Louisiana Natural and Scenic River System. The HNC runs north and south mainly between Bayou du Large and Bayou Grand Caillou. The GIWW traverses the northern portion of the study area from east to west. Other significant features located within the study area include Lake Boudreaux and Lake Quitman, located south of Houma between Bayou Grand Caillou and Bayou Petit Caillou. In addition to these major water features, hundreds of smaller natural bayous and manmade canals are located within the study area.

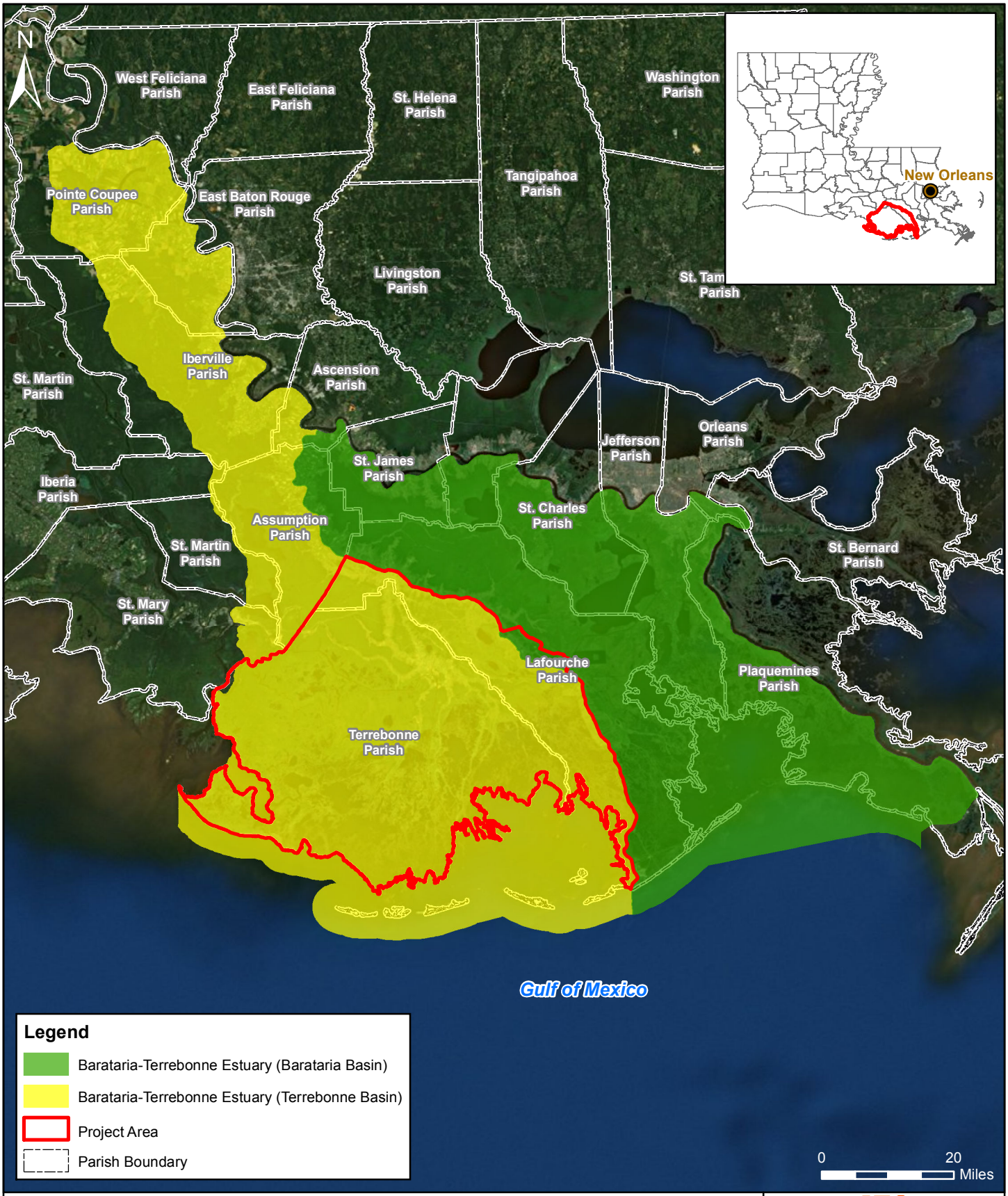


Figure 5-1. Barataria-Terrebonne Estuary

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery

Gulf Engineers & Consultants

Figure: 5-1
Date: June 2012
Scale: 1:1,280,000
Source: USGS/GEC
Map ID: 273160010-3004

The major waterways divide the study area into three main subbasins of the Terrebonne Basin (Figure 5-2). The Verret subbasin lies north of Bayous Boeuf and Black, and west of Bayou Terrebonne. The Verret subbasin is dominated by fresh water from the Atchafalaya River and Atchafalaya Bay. The Penchant subbasin is located between the Atchafalaya River and Atchafalaya Bay to the west and Bayou du Large to the east and is partly within the study area. The Gulf of Mexico forms its southern boundary and the natural ridge along Bayou Black demarcates its northern extreme. It is heavily influenced by flood flows from the Atchafalaya River. The Timbalier subbasin is located between Bayou du Large on the west, Bayou Lafourche on the east, the GIWW on the north, and the Gulf of Mexico to the south. The Timbalier subbasin has very limited fresh water inflow coming from rainfall and occasional high flows from the Atchafalaya River via the GIWW to the HNC and Grand Bayou Canal. The Fields subbasin is found between Bayou Lafourche to the northeast, Bayou Terrebonne to the west and northwest, and the GIWW to the south. This subbasin has the least variety of wetland habitat types of the three subbasins, containing mostly fresh marsh and swamp.

Several LCA projects authorized by WRDA 2007 are located within the Morganza study area, including but not limited to: (1) Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock (2) Modification of Davis Pond Diversion and (3) Land Bridge between Caillou Lake and Gulf of Mexico. By letters dated August 20, 2012 and October 16, 2012, CPRAB has notified the Corps that it desires to suspend study and design on these projects. The decision of CPRAB to suspend these projects results in some degree of uncertainty regarding implementation of these projects as part of the authorized Federal LCA.

5.1.2 LAND USE/LAND COVER

Data from the U.S. Geological Survey (USGS) National Land Cover Database (2006) for the study area reveal that 50 percent of the study area is emergent herbaceous wetlands (Table 5-1 and Figure 5-3). The marsh habitat in the study area transitions from fresh marsh in the more northerly portions to intermediate and brackish marshes, and to saline marsh near the coast. The remaining wetlands consist mainly of woody wetlands (primarily baldcypress/tupelo swamps and bottomland hardwood forest), which comprise about 14 percent of the study area.

Open water comprises a majority of the remaining land use (about 23 percent), and includes the Atchafalaya River and numerous bayous and drainage canals. Navigation canals include the GIWW and the HNC.

Only about 12 percent of the study area has been developed. Cultivated crops, which mainly include sugar cane, occupy about 5 percent of the study area. Residential and commercial land is located on only slightly more than 4 percent of the area. Population centers include Thibodaux and Shriever in northern Terrebonne Parish; the city of Houma; Donner and Gibson in western Terrebonne Parish; Chauvin, Dulac, and Montegut in southern Terrebonne Parish; Raceland, Lockport, and Pointe aux Chenes in Lafourche Parish; and the other population centers shown in Figure 3-1.

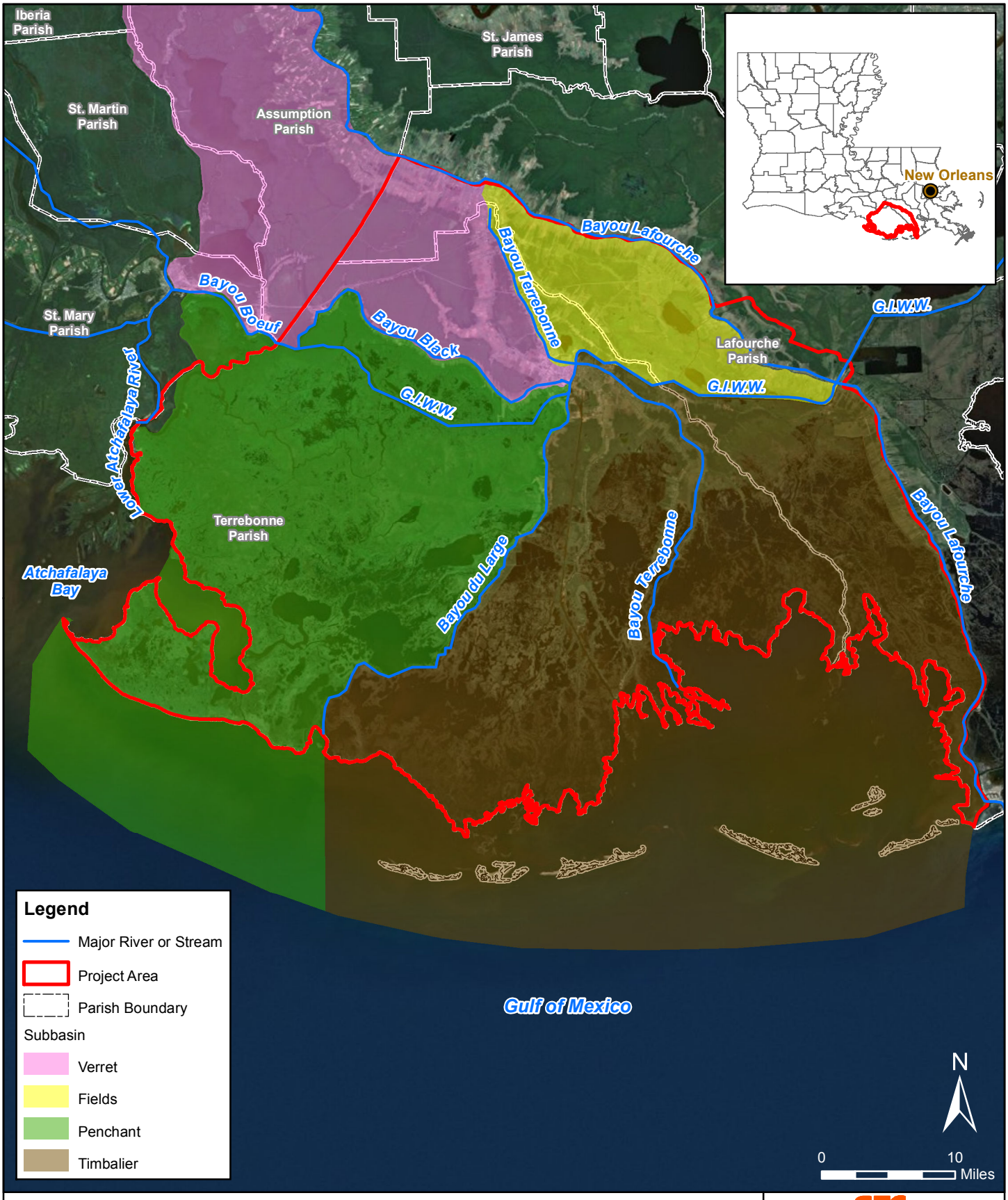


Figure 5-2. Lower Terrebonne Subbasins in Project Area

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Image: I3 USA Prime Imagery
Subbasins adapted from Louisiana Coastal Wetlands Restoration Plan, November 1993

GEC Gulf Engineers & Consultants

Figure: 5-2
Date: June 2012
Scale: 1:635,000
Source: USGS/GEC
Map ID: 273160010-3004

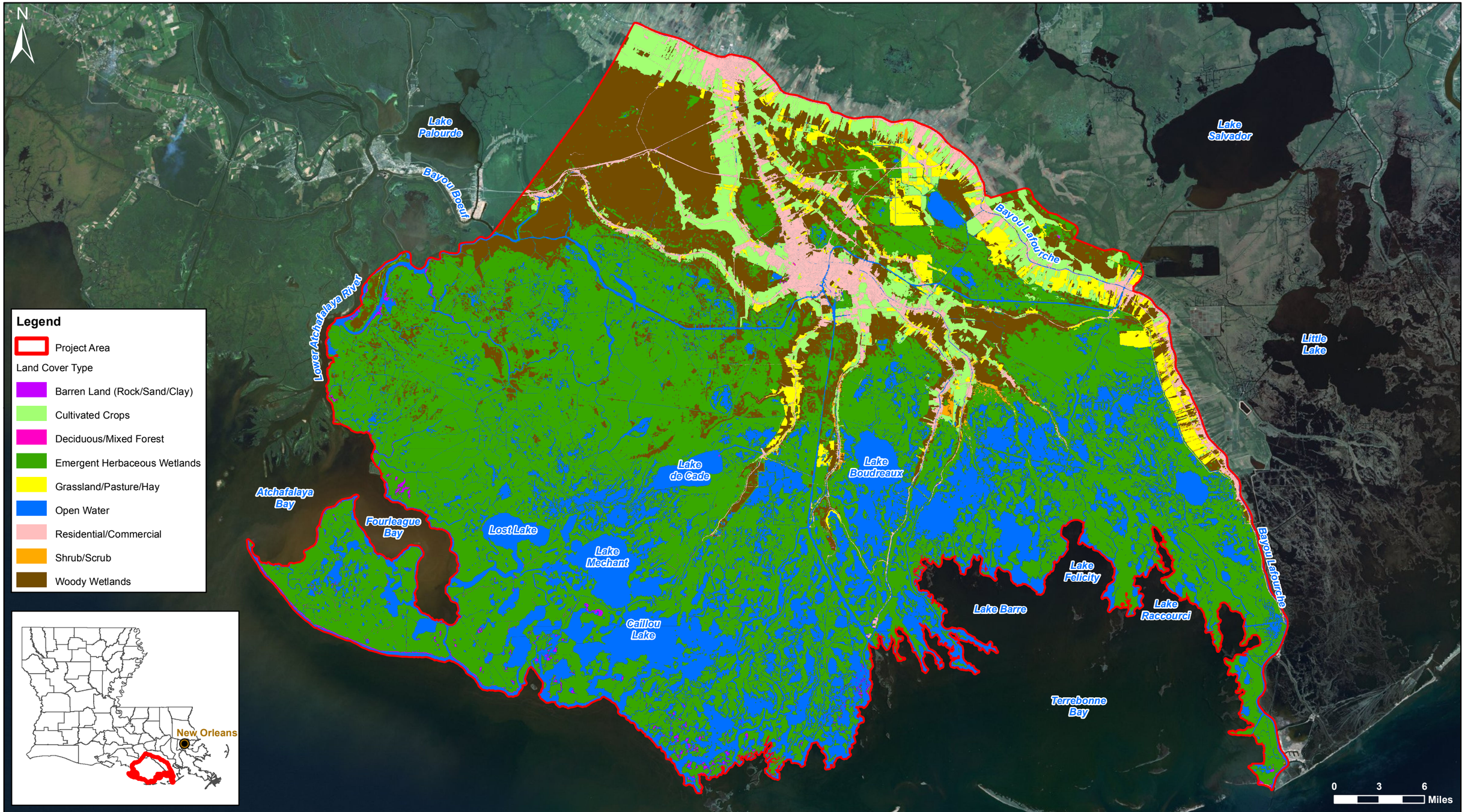


Figure 5-3. Land Use/Land Cover in Project Area

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

Land Cover Data: 2006 National Land Cover Database
Image: I3 USA Prime Imagery

GEC Gulf Engineers & Consultants

Figure: 5-3
Date: June 2012
Scale: 1:384,000
Source: USGS 2006/GEC
Map ID: 273160010-3004

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Table 5-1. Land Cover of the Study Area

Land Cover Type	Acres	Percent of Study Area
Emergent Herbaceous Wetlands	612,966	49.98%
Open Water	278,846	22.74%
Woody Wetlands	173,229	14.13%
Cultivated Crops	65,859	5.37%
Residential/Commercial	52,186	4.26%
Grassland/Pasture/Hay	33,704	2.75%
Barren Land (Rock/Sand/Clay)	5,345	0.44%
Shrub/Scrub	4,161	0.34%
Deciduous/Mixed Forest	84	0.01%
Total	1,226,380	100.00%

Source: National Land Cover Database, USGS, 2006 (http://seamless.usgs.gov/nlcd.php).

Very few residential structures are located in marsh. Only hunting and fishing camps built on pilings are typically constructed in those areas. Nearly all residential development in the study area occurs along one of the major bayou ridges, which do not generally flood except during extended or strong tropical events. Future development is expected to remain within forced drainage systems and along the ridges due to the increased costs associated with constructing homes outside of those areas.

5.1.3 CLIMATE

The climate of the study area is subtropical marine with long humid summers and short moderate winters. The climate is strongly influenced by the water surface of the many sounds, bays, lakes, and the Gulf of Mexico, as well as by seasonal changes in atmospheric circulation. During the fall and winter, the study area experiences cold continental air masses that produce frontal passages and drops in temperature. Snow is very infrequent. Mean temperatures collected from the National Oceanic and Atmospheric Administration (NOAA) station in Houma indicate an October to March mean temperature of 59.2ºF. During the spring and summer, the study area experiences tropical air masses that produce a warm, moist airflow conducive to thunderstorm development. Winds during the summer are generally from the south, bringing warm, moist air from the Gulf of Mexico, which can produce periods of intense rainfall associated with thunderstorms. Mean temperature from April through September in Houma is 77.4ºF with an average annual mean temperature of 68.3ºF. NOAA data indicate that average annual rainfall for the area is approximately 65 inches, while mean monthly rainfall is 5.5 inches, with the highest rainfall typically occurring from July through September (NOAA 2011a). The study area is subject to periods of both drought and flood, and the climate rarely seems to truly exhibit "average" conditions.

The study area is susceptible to tropical waves, tropical depressions, tropical storms, and hurricanes. These weather systems can cause considerable property and environmental damage and loss of human life. Data obtained from the NOAA Coastal Services Center indicate that the storm centers of at least 38 tropical cyclones with a Saffir-Simpson Hurricane Scale of Category 1 or higher have passed within 50 miles of the study area during the interval 1851-2008 (the latest year available in the NOAA database), and at least 54 such tropical cyclones have passed within 100 miles of the study area during the same interval (NOAA 2011b). Although it is assumed that storms with higher wind speeds produce more damage, Hurricane Juan, which was a Category 1 Storm, produced significant damage from tidal flooding. These storms can also produce large amounts of rain in a given location. According to NOAA data from 1851 through 2008, tropical storms (exclusive of hurricanes) occur with a frequency of about one storm every five years, and hurricanes of Category 1 or higher occur about once every four-and-a-half years within 100 miles of Houma.

The most recent tropical cyclones to affect the study area were hurricanes Katrina and Rita, which occurred in August 2005 and September 2005, respectively, and hurricanes Gustav and Ike, which occurred in September 2008. The area of marsh lost along the Louisiana coast as a result of hurricanes Katrina and Rita (192,000 acres) was over one third of the total wetland losses predicted to occur by the year 2050 by the Coast 2050 Report (LCWCRTF and WCRA 1998). Within the Terrebonne Basin, roughly 12,160 acres of wetlands were converted to open water between 2004 and 2005 (Barras 2006), equal to 8.4 percent of the losses predicted to occur by 2050.

Climate Change

USACE Engineering Circular 1165-2-212 requires consideration of impacts of sea level change on all phases of USACE Civil Works programs and provides guidance for incorporating the direct and indirect physical effects of projected future sea-level change in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects. It is important to distinguish between eustatic and RSLR. RSLR consists of eustatic or regional sea level rise combined with subsidence. Eustatic sea level rise is defined as the global increase in oceanic water levels primarily due to changes in the volume of major ice caps and glaciers, and expansion or contraction of seawater in response to temperature changes. Regional sea level rise may differ slightly from eustatic sea level rise in large, semi-enclosed water bodies like the northern Gulf of Mexico. Regional sea level rise in the project area was determined to be approximately 0.75 feet per century. Subsidence is the decrease in land elevations, primarily due to the consolidation of sediments, faulting, groundwater depletion, and possibly oil and gas withdrawal. Subsidence in the project area was calculated using the two closest long-term gauges, located at Grand Isle and Eugene Island, and was determined to be approximately 2.35 feet per century. RSLR affects project area marshes by gradually inundating marsh plants. Marsh soil surfaces must vertically accrete to keep pace with the rate of RSLR, or marshes eventually convert to open water due to the depth of submergence.

5.1.4 GEOLOGY

The geology of the area is heavily influenced by the Mississippi River and its delta plain, a complex of abandoned and active deltas of the Mississippi River. Three of four abandoned delta complexes shaped Terrebonne and Lafourche parishes as sediments were deposited on the Pleistocene Prairie. The Mississippi River laid down sediments from 100 to 200 meters thick at each delta (Penland *et al*. 1988). The abandoned deltas were formed generally from the west to the east in chronological sequence starting about 9,000 years before present and ending less than 100 years ago (Sevier 1990). The most recent sediments of an abandoned delta were laid down as part of the Lafourche delta.

The Lafourche delta complex in the study area, which includes Bayou Terrebonne, Bayou Black, Bayou Blue, Bayou Pointe aux Chenes, Bayous Grand and Petit Caillou, and Bayou du Large, began forming some 3,500 years ago. Delta development ended when the Mississippi River shifted to the east about 500 years ago to adopt its current configuration. From that time until about 100 years ago, overflows from the Mississippi River continued to maintain the Lafourche delta complex. The complex began to degrade when Bayou Lafourche was closed off early in the 20th century (Mossa *et al*. 1990).

After delta abandonment occurs, sediments slowly deteriorate as they subside under their own weight. In addition, sea level has been rising throughout this time by about 5 to 8 meters (Mossa *et al*. 1990). Historically, the cycle of delta growth and destruction took about 5,000 years (Gosselink and Sasser 1991). However, because of a variety of factors (most notably human), delta destruction is taking place in a few human generations rather than over thousands of years.

According to Turner (1990), the driving factors in landscape changes include sea level rise, geological compaction, a 50 percent reduction in sediment supply from the Mississippi River since the 1950s, and hydrologic changes. Delaune *et al*. (1994), Kuecher (1994), and Gagliano (1999) conclude that geological factors, such as consolidation of deltaic sediments and active faulting, appear to be the underlying cause for a majority of the land loss in coastal Louisiana. Hydrocarbon withdrawals may also be a significant factor by activating faults that lead to subsidence (White and Morton 1997).

Subsidence

Louisiana has the highest subsidence rates of any other land area around the Gulf of Mexico at 0.8 cm/year to 1.07 cm/year (Penland *et al*. 1987). Louisiana is also experiencing the highest rate of RSLR in the Gulf of Mexico, with rates between 1.03 cm/year and 1.19 cm/year. Concerning coastal wetlands and flood damages to coastal communities, RSL (apparent subsidence) is a more critical unit of measure than subsidence or sea level rise by themselves, as described in the Climate Change section above.

Published literature shows that Terrebonne Parish is subsiding at an average de-compacted rate of 0.31 cm/year according to Kuecher (1994), a much higher rate than the 0.12 cm/year eustatic rise in sea level reported by Gornitz *et al*. (1982). Wiseman *et al*. (1991) determined a subsidence rate of 1.0 cm/year near the coast with a decreasing rate moving northward. Penland

et al. (1989) found that subsidence in the Terrebonne Basin was the highest in Louisiana. Turner and Cahoon (1987) discovered at least a 5.0-mm difference between annual subsidence and accretion in the Terrebonne Basin. Adding to that difference the 0.12 cm/year eustatic sea level rise gives a conservative estimate for RSLR of 0.17 cm/year in southern Terrebonne Parish.

5.1.5 SOILS

Soils are a critical element of coastal habitats because they support vegetation growth and open-water benthic productivity. The study area lies entirely within the south-central region of the Mississippi River Delta Plain. It falls within two major land resource areas (MLRAs): MLRA 131 and MLRA 151. MLRA 131, the Southern Mississippi River Alluvium, makes up about 29 percent of the study area. MLRA 151, the Gulf Coast Marsh, makes up the remaining 71 percent of the study area (NRCS 2011). The soils formed from sediments deposited by former channels of the Mississippi River and its distributaries on the Atchafalaya and Lafourche Delta Complex. Loamy soils are dominant on the high and intermediate parts of the natural levees, and clayey soils are dominant on the lower parts of the natural levees and in backswamps. Elevations range from about 14 feet above mean sea level along the natural levee of Bayou Terrebonne in the northern part of the study area to about five feet below sea level in the former marshes and swamps that have been drained.

The Swamp and Marsh soil associations comprise approximately 80 percent of soils within the study area (Figure 5-4) (McDaniel and Trahan 2007; Matthews 1984). These associations occur over a broad plain about level with the Gulf of Mexico between the ridge areas and are frequently flooded. Marsh soils, both fresh and saline, generally have a semifluid peat or muck surface layer, up to four feet thick, over alluvial clays and silty clays. Soil associations include Fausse-Barbary, Harahan-Rita, Allemands-Kenner, Clovelly-Lafitte, Timbalier-Bellpass, and Scatlake. These soils are generally too wet and soft for any agricultural uses. The marsh soils' organic content decreases as conditions move from fresh to saline. Fresh marsh soils contain a mean of 52 percent organic matter, whereas saline soils contain only 18 percent organic matter (Chabreck 1982). Soils in the swamp soil association are usually wet and frequently flooded. These soils, identified primarily as Barbary-Fausse soils, are level, very poorly drained soils that have a mucky or clayey surface layer and a clayey subsoil. Some acreage of former marshes and swamps have been protected, pumped-off, and drained and are used as pasture or for urban use. Rita-Harahan soils have been identified in these areas. Rita-Harahan soils are level, poorly drained soils that have a clayey or mucky surface layer and a clayey or loamy subsoil; in former swamps and marshes. Uses include woodland, pasture, recreation, and campsites. The remaining 20 percent of soils in the study area are comprised of natural ridges, levees, and open water (Figure 5-4).

The lower portions of the natural levees are formed by the Sharkey and Schriever soil associations. These soils are black to dark gray on the surface and have higher clay material and organic matter content than do soil associations on the highest portions of the natural levees. They are subject to rare or occasional flooding, and support bottomland vegetation. Uses include woodland, pasture, recreation, campsites, and wildlife habitat. The highest parts of the natural levees along the bayous, including along Highway 57 to the south of Lake Boudreaux, contain soils of the Commerce and Cancienne-Grammercy associations. These level, somewhat poorly

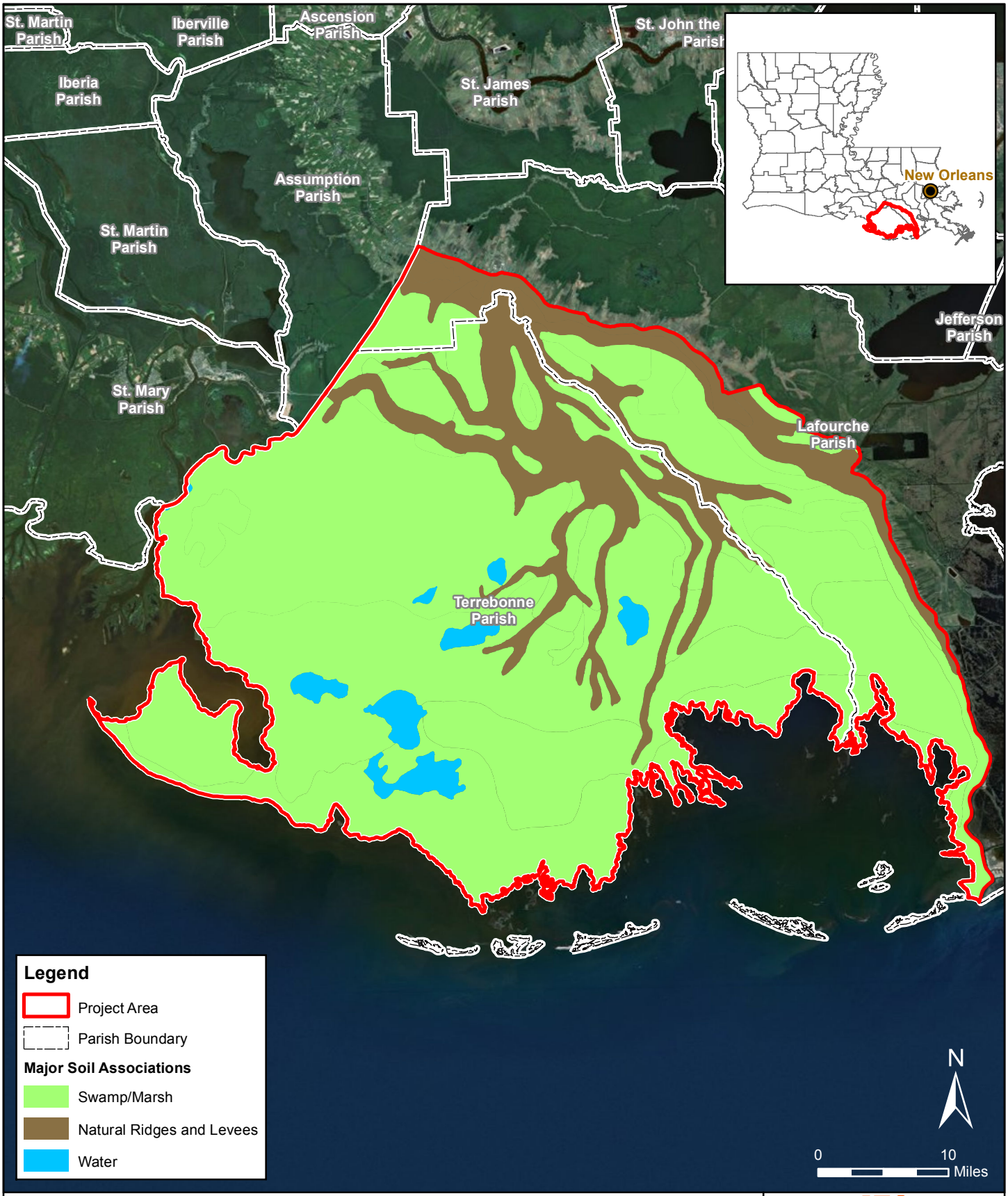


Figure 5-4. Major Soil Associations in Project Area

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

USGS STATSGO Soils Data

GEC Gulf Engineers & Consultants

Figure: 5-4
Date: June 2012
Scale: 1:650,000
Source: USGS/GEC
Map ID: 273160010-3004

drained and poorly drained brown to grayish brown soils have a loamy or clayey surface layer and clayey subsoil or are loamy throughout. They rarely flood and are used mainly for cropland, pasture, woodland and urban purposes. Some narrow, loamy, natural levee ridges in the southeastern and east-central parts of Terrebonne Parish extend south into the Gulf Coast Marsh. These areas are subject to occasional flooding during tropical storms and are used mainly for camps, homesites, and activities associated with the seafood industry.

Sugar cane is the principal agricultural crop grown in the region (McDaniel and Trahan 2007; Matthews 1984). Corn is also a major crop. Soybeans, rice, vegetables, and pasture grasses are also grown. Approximately 10.6 percent of the total acreage in the study area meets the soil requirements for prime farmland, as discussed in more detail in the Prime Farmland section below.

5.2 Significant Resources

This section describes the significant resources that may be impacted by the project. These significant resources are recognized by laws, executive orders, regulations, and other standards of national, state, or regional agencies and organizations; technical or scientific agencies, groups, or individuals; and the general public. The institutional, technical, and public importance of each resource is described in Table 5-2.

Table 5-2. Significant Resources in the Study Area

Resource	Institutionally Important	Technically Important	Publicly Important
Coastal Vegetation and Wetlands	Clean Water Act of 1977; Executive Order (EO) 11990 of 1977, Protection of Wetlands; Coastal Zone Management Act of 1972; North American Wetlands Conservation Act; Estuary Protection Act of 1968; EO 11988, Floodplain Management; and Fish and Wildlife Coordination Act of 1958, as amended.	They provide necessary habitat for various species of plants, fish, and wildlife; they serve as ground water recharge areas; they provide storage areas for storm and flood waters; they serve as natural water filtration areas; they provide protection from wave action, erosion, and storm damage; and they provide various consumptive and non-consumptive recreational opportunities.	The public values the wildlife and recreational functions that wetlands provide. Environmental organizations and the public support the preservation of marshes.

Resource	Institutionally Important	Technically Important	Publicly Important
Prime and Unique Farmland	Farmland Protection Policy Act of 1981; Food Security Act of 1985.	The 1981 Congressional report, *Compact Cities: Energy-Saving Strategies for the Eighties*, identified the need for Congress to implement programs and policies to protect farmland and combat urban sprawl and the waste of energy and resources that accompanies the conversion of farmland.	The public values the present economic significance or potential for future economic significance. The public values rural landscapes and local farming.
Aquatic Resources/ Fisheries	Fish and Wildlife Coordination Act of 1958; Endangered Species Act of 1973; Coastal Zone Management Act; Estuary Protection Act; Magnuson-Stevens Fishery Conservation and Management Act of 1976; Magnuson-Stevens Act Reauthorization of 2006.	They are a critical element of many valuable freshwater and marine habitats; they are an indicator of the health of the various freshwater and marine habitats; and many species are important commercial resources.	The public places high priority on their aesthetic, recreational, and commercial value.
Essential Fish Habitat (EFH)	Magnuson-Stevens Fishery Conservation and Management Act of 1996 (Public Law 104-297).	Federal and state agencies recognize the value of EFH. The Act states EFH is "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity."	The public places a high value on seafood and the recreational and commercial opportunities EFH provides.
Wildlife	Fish and Wildlife Conservation Act of 1980; Fish and Wildlife Coordination Act of 1958; Migratory Bird Treaty Act of 1918; Endangered Species Act of 1973; EO 13186, Migratory Bird Habitat Protection.	They are a critical element of many valuable aquatic and terrestrial habitats; they are an indicator of the health of various aquatic and terrestrial habitats; and many species are important commercial resources.	The public values the aesthetic, recreational, and commercial value of wildlife.
Threatened and Endangered Species	Endangered Species Act of 1973; Marine Mammal Protection Act of 1972; Migratory Bird Treaty Act of 1918, as amended.	USACE, USFWS, NMFS, NRCS, USEPA, LDWF, and LADNR cooperate to protect these species. The status of such species provides an indication of the overall health of an ecosystem.	The public supports the preservation of rare or declining species and their habitats.

Resource	Institutionally Important	Technically Important	Publicly Important
Noise	Noise Control Act of 1972; Occupational Safety and Health Standards.	Noise can adversely affect the physiological or psychological well being of people.	The public has concern for the potential annoyance and adverse effects of noise on wildlife and humans.
Air Quality	Clean Air Act of 1963; Louisiana Environmental Quality Act of 1983.	State and Federal agencies recognize the status of ambient air quality in relation to the National Ambient Air Quality Standards.	Virtually all citizens express a desire for clean air.
Hydrology and Water Quality	NEPA Act of 1969; Clean Water Act of 1977; Flood Control Act of 1944; Coastal Barrier Resources Act; Rivers and Harbors Act of 1899; River and Harbor and Flood Control Act of 1970; Watershed Protection and Flood Prevention Act; Submerged Land Act; Coastal Zone Management Act; Safe Drinking Water Act; Estuary Protection Act; Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and Executive Order 11988 Floodplain Management	This resource is technically significant because Civil Works water resources development projects typically impact (positively or negatively) the interrelationships and interactions between water and its environment.	This resource is publicly significant because the public demands clean water, hazard-free navigation, and protection of estuaries and floodplains.
HTRW	Engineer Regulation (ER) 1165-2-132, RCRA, Comprehensive Environmental Response, Compensation and Liability Act, Resource Conservation and Recovery Act	A phased and documented review to provide for early identification of HTRW potential at Civil Works project sites is required to avoid adverse impacts.	Due to the many potential adverse impacts of HTRW, the public is concerned about the identification and treatment of HTRW as early as practical in project planning.

Resource	Institutionally Important	Technically Important	Publicly Important
Socio-Economic Resources	NEPA of 1969, Estuary Protection Act, River and Harbors Acts, Clean Water Act, Watershed Protection and Flood Protection Act, Water Resources Development Acts.	The social and economic welfare of the nation may be positively or adversely impacted by the proposed action.	The public is concerned about the impact of water resources projects on health, welfare, economic, and social well-being.
Environmental Justice	Executive Order 12898 and the Department of Defense's Strategy on Environmental Justice of 1995,	The social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the project.	The public is concerned about the fair and equitable treatment of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions.
Cultural Resources	National Historic Preservation Act of 1966; Native American Graves Protection and Repatriation Act of 1990; Archeological Resources Protection Act of 1979.	State and Federal agencies document and protect sites because of their association or linkage to past events, to historically important persons, to design and construction values, and for their ability to yield important information about prehistory and history.	Preservation groups and private individuals support protection, restoration, enhancement, and recovery of historical resources.
Recreation Resources	Federal Water Project Recreation Act of 1965; Land and Water Conservation Fund Act of 1965.	Recreational resources provide high economic value to local, state, and national economies.	There is a high value that the public places on fishing, hunting, and boating, as measured by the large number of fishing and hunting licenses sold in Louisiana and the large per-capita number of recreational boat registrations in Louisiana.
Aesthetics	USACE ER 1105-2-100; NEPA of 1969; coastal Barrier Resources Act of 1990; Louisiana's National and Scenic River's Act of 1988; National and Local Scenic Byway Program.	Unique combinations of geological, botanical, and cultural features are an asset to a study area.	Environmental organizations and the public support the preservation of unique natural and cultural landscapes.

5.2.1 COASTAL VEGETATION AND WETLANDS

Common Plant Species in the Study Area

Approximately 50 percent of the study area is comprised of emergent herbaceous wetlands, including fresh, intermediate, brackish, and saline marsh (Table 5-1) (USGS 2006). The remaining wetlands consist primarily of woody wetlands (primarily baldcypress/tupelo swamps and bottomland hardwood forest), which comprise almost 14 percent of the study area (USGS

2006). Plant species commonly encountered in these and other habitats of the study area, including open water, scrub/shrub, and deciduous/mixed forests, are listed in Table 5-3. Some fresh and intermediate waterbodies contain submerged or floating aquatic vegetation, as shown in Table 5-3 for the "Open Water" habitat type.

Table 5-3. Common Plants of the Morganza to the Gulf Study Area

Habitat Type	Commonly Encountered Species	
Fresh Marsh	• American cupscale (*Sacciolepis striata)* • Alligatorweed, (*Alternanthera philoxeroides)* • Baldwin's spikerush (*Eleocharis baldwinii)* • Bulltongue (*Sagittaria lancifolia)* • California bulrush (*Schoenoplectus californicus)* • Cattail (*Typha* sp.) • Coastal arrowhead (*Sagittaria graminea*)	• Coastal water-hyssop (*Bacopa monnieri*) • Common reed (*Phragmites australis)* • Giant cutgrass (*Zizaniopsis miliacea)* • Maidencane (*Panicum hemitomon*) • Pennywort (Hydrocotyle spp.) • Saltmeadow cordgrass (*Spartina patens)* • Spikerush (*Eleocharis sp.)*
Intermediate Marsh	• Bulltongue • Cattail • Coastal arrowhead, • Common reed • Coastal water-hyssop • Deer pea (*Vicia ludoviciana)* • Fall panicum (*Panicum dichotomiflorum*)	• Olney's bulrush (*Scirpus americanus)* • Saltmeadow cordgrass (*Spartina patens)* • Seashore paspalum (*Paspalum vaginatum)* • Three-cornered grass (*Scirpus olneyi)* • Wild millet (*Echinochloa* spp.)
Brackish Marsh	• Camphorweed (*Heterotheca subaxillaris)* • Coastal water-hyssop • Deer pea • Leafy three-square (*Schoenoplectus robustus)*	• Three-cornered grass • Saltmeadow cordgrass, • Seashore saltgrass (*Distichlis spicata)*
Saline Marsh	• Black needlerush (*Juncus roemerianus*) • Leafy three-square • Saltgrass (*Distichlis spicata*)	• Saltmarsh cordgrass *(Spartina alterniflora)* • Saltmeadow cordgrass • Seashore saltgrass
Woody Wetlands	• American elm (*Ulmus Americana)* • Baldcypress • Bitter pecan *(Carya aquatica)* • Black willow *(Salix nigra)* • Boxelder *(Acer negundo)* • Chinese tallow-tree (*Triadica sebifera)*	• Drummond red maple (Acer rubrum drummondii) • Elderberry (*Sambucus* sp.) • Green ash (*Fraxinus pennsylvanica)* • Live oak (*Quercus virginiana*) • Sugarberry/Hackberry (*Celtis laevigata)* • Water oak (*Quercus nigra)*

Habitat Type	Commonly Encountered Species	
Open Water (Includes Submerged and Floating-Leafed Vegetation)	• American lotus (*Nelumbo lute)* • Common Salvinia (*Salvinia minima)* • Coontail (*Ceratophyllum* spp.) • Duckweeds (*Limna spp.*) • Elodea (*Elodea canadensis)* • Eurasian milfoil (*Myriophyllum spicatum)* • Fanwort (*Cabomba caroliniana)* • Hydrilla (*Hydrilla verticillat)* • Pondweeds *(Potamogeton spp.)*	• Southern naiad (*Najas guadalupensis)* • Water fern (*Azolla* spp.) • Water hyacinth (*Eichhoria crassipes)* • Water lettuce (*Pistia stratiote)* • Water meal (*Wolffia* sp.) • Water stargrass (*Heteranthera dubia)* • White water lily (*Nymphaea odorat)* • Wigeongrass (*Ruppia maritime)* • Wild celery (*Vallisneria americana*)
Scrub/Shrub	• Black willow • Buttonbush *(Cephalanthus occidentalis)* • Chinese tallow-tree • Drummond red maple	• Elderberry • Groundsel bush *(Baccharis halimifolia)* • Wax myrtle *(Myrica* sp.)
Deciduous/Mixed Forest	• American elm • Drummond red maple, • Green ash	• Live oak • Sugarberry/hackberry Sweet gum *((Liquidambar styraciflua)* • Water oak
Sources: Bahr *et al*. 1983; Chabreck and Condrey 1979; Connor and Day 1987; Gosselink 1984; Sasser *et al*. 1995; Sasser *et al*. 1996; Ritchie and Penland 1990; Ritchie *et al* 1995; Rogers *et al* 1990.		

Coastal Wetlands

Coastal Louisiana has lost an average of 34 square miles of land, primarily marsh, per year for the last 50 years. From 1932 to 2000, Coastal Louisiana lost 1900 square miles of land (Coalition to Restore Coastal Louisiana, 2011). This land is not only an important habitat for fish and wildlife; it provides an indispensable storm buffer for communities, transportation routes, and energy infrastructure. Coastal wetlands in the study area range from fresh marshes in the northern portion, to intermediate and brackish marshes in the central portion, and finally to saline marshes along the Gulf of Mexico (Figure 5-5). Salinity ranges for the four types of coastal wetlands are shown in Table 5-4.

Table 5-4. Typical Salinity Ranges for the Four Coastal Wetland Types

Wetland Type	Typical Range (Parts per thousand)
Fresh	0 – 0.5
Intermediate	0.5 - 5
Brackish	5 - 18
Saline	18 - 30

Source: Cowardin *et al*. 1979.

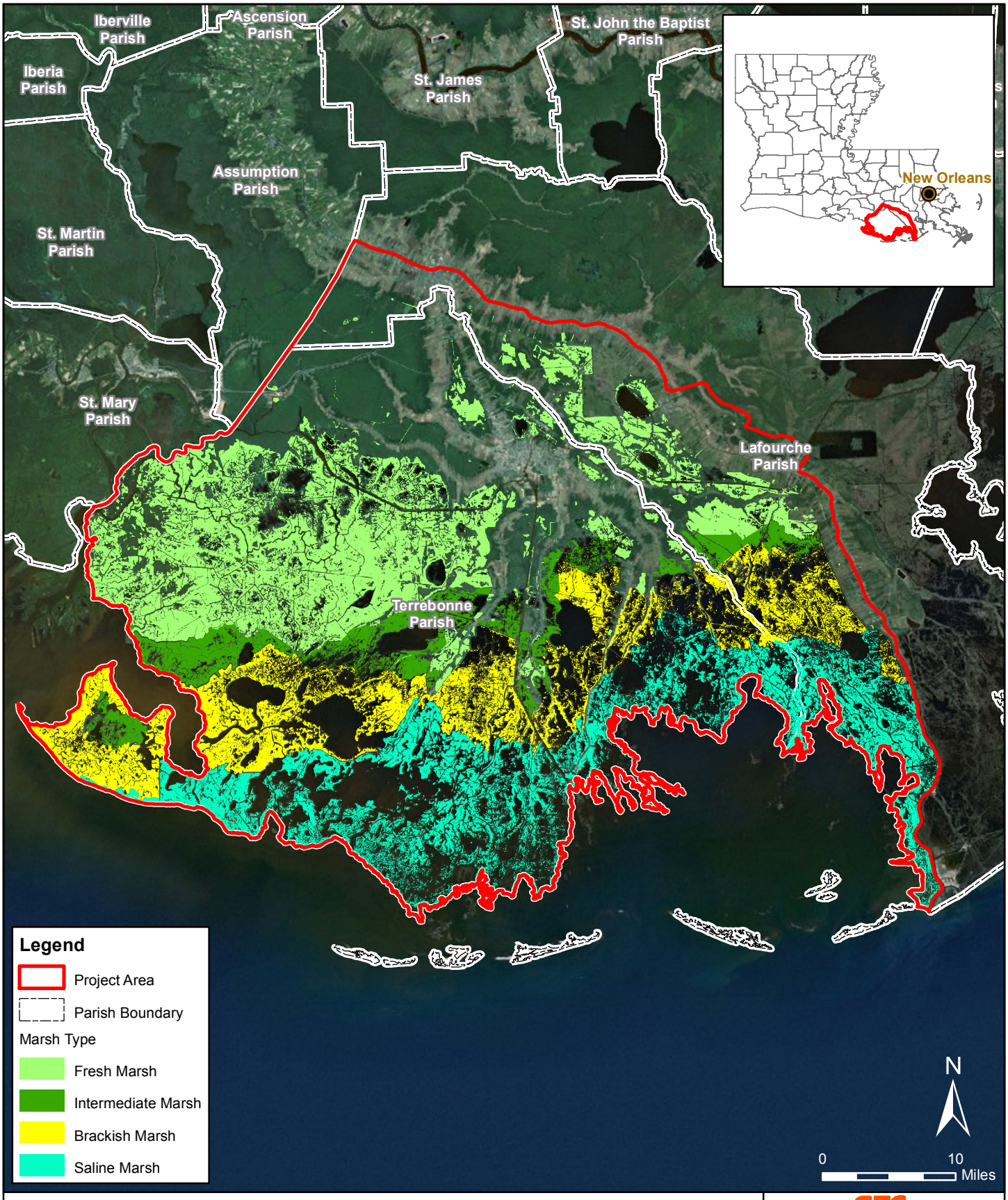


Figure 5-5. Marsh Types in Project Area

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

ESRI World 2D Imagery
Land Cover Data: Louisiana Gap Analysis Project

GEC Gulf Engineers & Consultants

Figure: 5-5
Date: June 2012
Scale: 1:635,000
Source: NRCS/GEC
Map ID: 273160010-2815

In order to document the quality of the habitat in the project area in terms of its suitability for fish and wildlife use, the Wetland Value Assessment (WVA) methodology was used (CWPPRA 2007). A description of the WVA analysis can be found in Appendix F, *Wetland Value Assessment*.

The WVA methodology has been approved for use in the Morganza to the Gulf project. On November 11, 2011, Corps of Engineers Headquarters approved the use of the Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier, and Swamp Models for use in coastal Louisiana. On February 28, 2012, Corps headquarters approved the Coastal Marsh Community Model for this project. On March 12, 2012, the Corps' National Ecosystem Planning Center of Expertise recommended single use approval for this project. Copies of these correspondences are located in Appendix F.

Rare Plant Species and Natural Communities

The Louisiana Natural Heritage Program describes rare, unique, and imperiled plant species and vegetative communities occurring in Louisiana. These plants and natural communities are nestled within the broader vegetative habitats and are important in that they contribute to the extensive diversity of the coastal ecosystem, enhance its productivity, and are essential to the stability of the bionetwork. The program lists 45 plant species or natural communities as occurring in Terrebonne and Lafourche parishes (Table 5-5).

Invasive Species - Vegetation

Invasive plant species are found in the project area. The most visible is the Chinese tallow tree, a successful invader of chenier habitats. It has affected plant community structure by becoming the most abundant woody species at many locations. It has the potential to invade surrounding marshes and convert them from herbaceous to woody plant communities (Neyland and Meyer 1997). Other important invasives include water hyacinth and giant salvinia (*Salvinia molesta*), both of which are present in the marshes and canals of South Louisiana. Both can form dense mats that cover entire bodies of water with a thick layer that blocks sunlight, thereby reducing photosynthesis, reducing dissolved oxygen, and contributing to fish kills.

Other invasive aquatic plants include the following (Louisiana Department of Wildlife and Fisheries (LDWF) 2005):

- Alligatorweed (*Alternanthera philoxeroides*)
- Brazilian waterweed (*Egeria densa*)
- Cogon grass (*Imperata cylindrical*)
- Common salvinia (*Salvinia minima*)
- Dotted duckweed (*Landoltia (Spirodela) punctata*)
- Eurasian water-milfoil (*Myriophyllum spicatum*)
- Hydrilla (*Hydrilla verticillata*)
- Parrot feather (*Myriophyllum aquaticum*)
- Peruvian watergrass (*Luziola peruviana*)
- Torpedo grass (*Panicum repens*)

Table 5-5. Rare Plant Species and Natural Communities of Terrebonne and Lafourche Parishes

Common Name	Scientific Name	State Rank*
Arrow-grass	*Triglochin striata*	S1
Arrow-grass	*Triglochin striata*	S1
Big Sandbur	*Cenchrus myosuroides*	S1
Big Sandbur	*Cenchrus myosuroides*	S1
Brackish Marsh	*Brackish Marsh*	S3, S4
Canada Spikesedge	*Eleocharis geniculata*	S1
Canada Spikesedge	*Eleocharis geniculata*	S1
Coast Indigo	*Indigofera miniata*	S1
Coastal Dune Grassland	*Coastal Dune Grassland*	S1, S2
Coastal Dune Shrub Thicket	*Coastal Dune Shrub Thicket*	S1
Coastal Ground Cherry	*Physalis angustifolia*	S1
Coastal Live Oak-Hackberry Forest	*Coastal Live Oak-Hackberry Forest*	S1, S2
Coastal Live Oak-Hackberry Forest	*Coastal Live Oak-Hackberry Forest*	S1, S2
Coastal Mangrove-Marsh Shrubland	*Coastal Mangrove-Marsh Shrubland*	S3
Coastal Mangrove-Marsh Shrubland	*Coastal Mangrove-Marsh Shrubland*	S3
Creeping Spike-rush	*Eleocharis fallax*	S1
Cypress-knee Sedge	*Carex decomposita*	S3
Cypress-Tupelo Swamp	*Cypress-Tupelo Swamp*	S4
Dune Sandbur	*Cenchrus tribuloides*	S2
Dune Sandbur	*Cenchrus tribuloides*	S2
Estuarine Submergent Vascular Vegetation	*Estuarine Submergent Vascular Vegetation*	S1, S2
Floating Antler-fern	*Ceratopteris pteridoides*	S2
Floating Antler-fern	*Ceratopteris pteridoides*	S2
Freshwater Marsh	*Freshwater Marsh*	S1, S2
Freshwater Marsh	*Freshwater Marsh*	S1, S2
Golden Canna	*Canna flaccida*	S4
Gregg's Amaranth	*Amaranthus greggii*	S3
Gulf Bluestem	*Schizachyrium maritimum*	S1
Hairy Comb Fern	*Ctenitis submarginalis*	S1
Marine Submergent Vascular Vegetation	*Marine Submergent Vascular Vegetation*	S1, S2
Marine Submergent Vascular Vegetation	*Marine Submergent Vascular Vegetation*	S1, S2
Millet Beakrush	*Rhynchospora miliacea*	S2
Millet Beakrush	*Rhynchospora miliacea*	S2
Rooted Spike-rush	*Eleocharis radicans*	S1
Salt Marsh	*Salt Marsh*	S3, S4
Sand Dune Spurge	*Chamaesyce bombensis*	S1
Sand Rose-gentian	*Sabatia arenicola*	S1
Sand Rose-gentian	*Sabatia arenicola*	S1
Scaevola	*Scaevola plumieri*	SH
Scaevola	*Scaevola plumieri*	SH
Scrub/Shrub Swamp	*Scrub/Shrub Swamp*	S4, S5
Sea Oats	*Uniola paniculata*	S2
Sea Oats	*Uniola paniculata*	S2
Swamp Milkweed	*Asclepias incarnata*	S2
Swamp Milkweed	*Asclepias incarnata*	S2

* State Element Ranks: S1 = critically imperiled in Louisiana because of extreme rarity; S2 = imperiled in Louisiana because of rarity; S3 = rare and local throughout the state or found locally in a restricted region of the state; S4 = apparently secure in Louisiana with many occurrences; S5 = demonstrably secure in Louisiana; SH = of historical occurrence in Louisiana; SZ = transient species in which no specific consistent area of occurrence is identifiable; B or N may be used as qualifier indicating whether the occurrence is breeding or nonbreeding; S?=rank uncertain.

Source: Louisiana Natural Heritage Program, June 2011 (http://www.wlf.louisiana.gov/wildlife)

- Uruguay waterprimrose (*Ludwigia grandiflora*)
- Water-lettuce (*Pistia stratiotes*)
- Wild taro (*Colocasia esculenta*)

5.2.2 PRIME AND UNIQUE FARMLAND

The Farmland Protection Policy Act of 1981 was enacted to minimize the extent that Federal programs contribute to the unnecessary and irreversible conversion of prime or unique farmland to non-agricultural uses. USDA's NRCS is responsible for designating prime or unique farmland protected by the act. Prime farmland, as defined by the act, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. Unique farmland is defined by the act as land other than prime farmland that is used for the production of specific high value food and fiber crops, such as citrus, tree nuts, olives, and vegetables.

Based on data accessed from the NRCS in 2011, approximately 128,144 acres, or 10.6 percent, of the total acreage in the study area meet the soil requirements for prime farmland (http://websoilsurvey.nrcs.usda.gov) (Figure 5-6). Unique farmland is not located in the study area. Prime farmland within the study area is limited to natural ridge tops and consists of the following soil associations: Cancienne silt loam, Cancienne silty clay loam, Commerce silt loam, Commerce silty clay loam, Grammercy silty clay loam, Schriever clay, Sharkey silty clay loam, Sharkey clay, and Vacherie silt loam. Not all of prime farmland in the study area is used for agriculture. NRCS soil surveys indicate nearly all prime farmland acreage in Terrebonne Parish is planted in crops, but only about half of the acreage in Lafourche Parish is agricultural. The crops grown on this land are mainly common bermudagrass, improved bermudagrass, soybeans, wheat, sugar cane, bahiagrass, and corn.

5.2.3 AQUATIC RESOURCES

Benthic Resources

The bottom estuarine substrate or benthic zone regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is called a *benthic effect*. Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries and trophic relationships that occur in aquatic ecosystems (Day *et al.* 1989). Benthic communities do not have a static structure and provide a residence for many sessile, burrowing, crawling, and even swimming organisms. Oysters and mussels from the epibenthic community provide commercial and recreational fisheries and create oyster reef habitats used by many marine and estuarine organisms.

Estuarine benthic organisms include: macrobenthic (e.g., molluscs, worms, large crustaceans); microbenthic (e.g., protozoa); and meiobenthic (e.g., microscopic worms and crustaceans) groups (Day *et al.* 1989). The benthic community stores organic matter and inorganic nutrients and is a site for many vital chemical exchanges and physical interactions. Primary consumer groups of the benthic habitat include: bacteria and fungi, microalgae, meiofauna, and microfauna

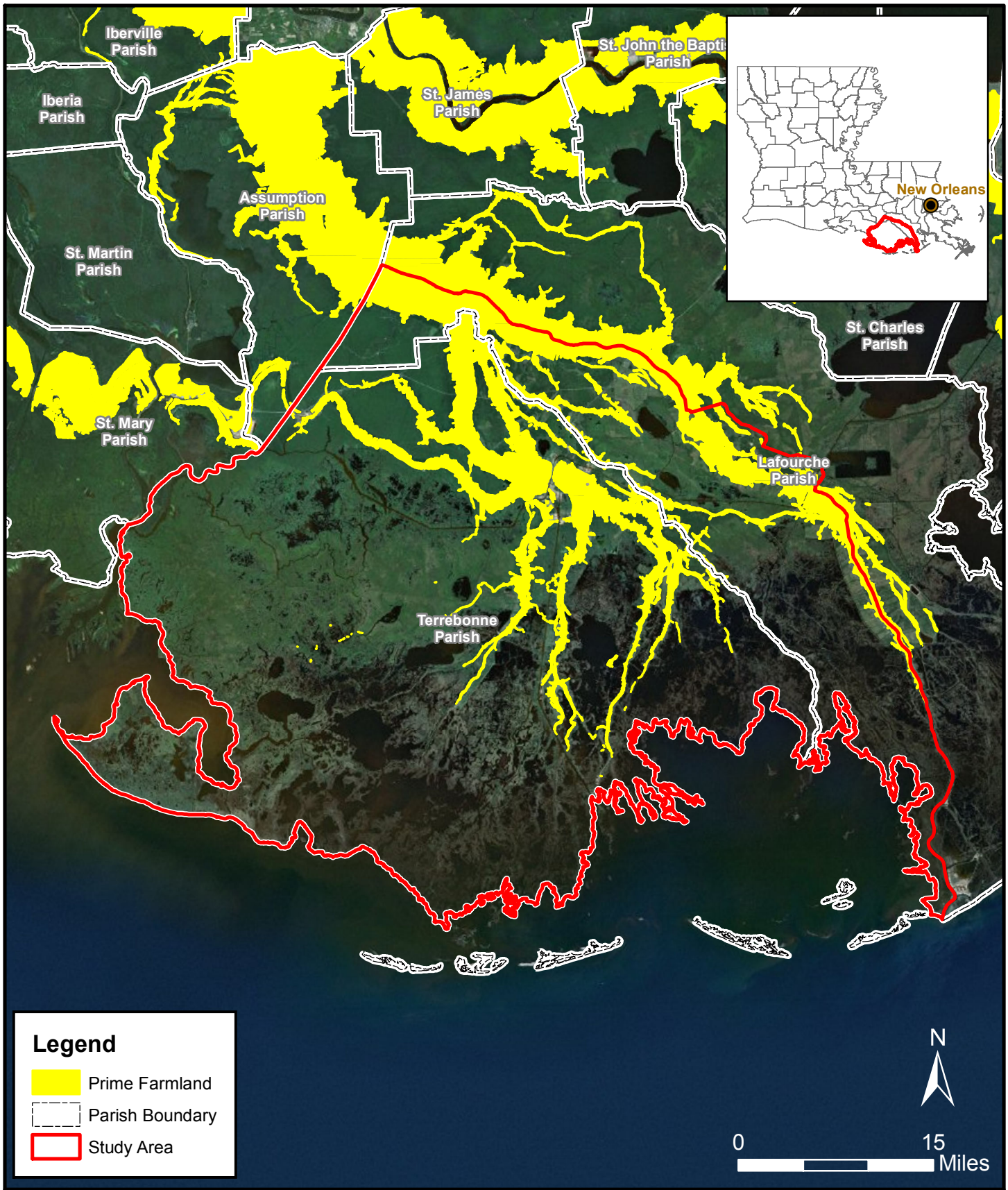


Figure 5-6. Prime Farmland

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

ESRI World 2D Imagery

Gulf Engineers & Consultants

Figure: 5-6
Date: June 2012
Scale:1:650,000
Source: ESRI/GEC
Map ID: 273160010-3004

(Mitsch and Gosselink 2000). Less than 10 percent of the above-ground primary production of the salt marsh is grazed by aerial consumers. Most plant biomass dies and decays and its energy is processed through the detrital pathway. A major link in the aquatic food web between plants and predators is formed by the conversion of plant material (formed in primary production) by benthic detritivores and herbivores to animal tissue (Cole 1975).

The salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary (Mitsch and Gosselink 2000). In some cases, exported marsh detritus is more important than the phytoplankton based production to the estuary. Detritus export and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish. Salt marshes have been shown at times to be both sources and sinks of nutrients, particularly nitrogen.

Plankton Resources

Plankton provides a major, direct food source for animals in the water column and in the sediments (Day *et al.* 1989). Plankton is responsible for at least 40 percent of the photosynthesis occurring on the earth and has an important role in nutrient cycling. Plankton productivity is a major source of primary food energy and is the major source of autochthonous organic matter in most estuarine ecosystems (Day *et al.* 1989).

Plankton communities have an important role in Louisiana coastal waters. There are three groups of plankton: bacterioplankton, phytoplankton, and zooplankton (Knox 2001). Bacterioplankton are microscopic bacteria important in the decomposition of organic material. Phytoplankton includes the primary producers of the water column and forms the base of the estuarine food web. Zooplankton provides the trophic link between bacterioplankton and phytoplankton and the intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fishes (Day *et al.* 1989).

Phytoplankton are tiny, single-cell algae that drift with the motion of water. Diatoms and dinoflagellates are the dominant phytoplankton groups; other important groups include green and blue-green algae. In Louisiana, eutrophic conditions can lead to noxious blue-green algae blooms. Some blue-green algae produce toxins, and large-scale blooms can lead to hypoxia and result in fish kills. These blooms tend to occur in fresh or oligohaline waters, up to approximately seven parts-per-thousand (ppt) salinity. In more saline environments, dinoflagellates have been associated with red tides, which are capable of killing fish and shellfish and can create public health problems through airborne respiratory toxins and shellfish contamination. Although phosphorus is typically the limiting nutrient attributed to excessive algal growth (blooms), phytoplankton production in coastal wetland systems is most likely to be nitrogen limited (Day *et al.* 2001).

Zooplankton includes small crustaceans, jellyfishes and siphonophores, worms and mollusks, and egg and larval stages of most benthic and nektonic animals (Rounsefell 1975). Zooplankton are consumed by a variety of estuarine consumers, but also is important in nutrient cycling. Although some members of the zooplankton community are euryhaline, others have distinct

salinity tolerances (Hawes and Perry 1978). Freshwater zooplankton is dominated by four major groups: protozoa, rotifers, cladocerans, and copepods.

Some seasonal patterns of zooplankton abundance in estuaries occur regionally, although there are no clear general patterns (Day *et al.* 1989). The zooplankton of many estuarine waterbodies is dominated by copepods. Copepods and cladocerans are frequently abundant in low salinity waters of Louisiana (Hawes and Perry 1978). Larval crustaceans can compose a large component of the zooplankton community.

5.2.4 FISHERIES

Fishery resources are a critical element of many valuable freshwater and marine habitats. They are an indicator of the health of various freshwater and marine habitats, and many species are important commercial resources.
In 2009, Louisiana's fishery landings were over 1,005 million pounds (over $284 million dockside value). This represented 12.7 percent of the 2009 U.S. landings in terms of pounds and 7.3 percent in terms of dollars. Fishery landings in 2009 at ports in or near the study area were: Dulac-Chauvin with 42.4 million pounds ($50.9 million dockside value) and Golden Meadow-Leeville with 25.6 million pounds ($27.4 million dockside value) (NMFS 2011).

The study area contains a variety of aquatic habitats, including ponds, lakes, bayous, canals, shallow open water areas, and embayments. Salinities in the area range from fresh water to saline. Fresh and intermediate waterbodies frequently contain submerged or floating aquatic vegetation; however, brackish and saline areas generally do not contain much submerged vegetation.

Fishes and macrocrustaceans in the study area are of three general types: freshwater, resident, and transient marine species. Freshwater species generally live in the freshwater portions of the area, although some species can tolerate low salinities. Resident species are generally smaller and do not commonly migrate very far. Marine transient species spend a portion of their life cycle in the estuary, generally spawning offshore or in high-salinity bays, and use coastal marshes as nursery areas (Herke 1971, 1995).

Salinity and submerged vegetation affect the distribution of fish and macrocrustaceans in coastal marshes. The most abundant species collected in freshwater and intermediate marsh areas adjacent to the project area were residents predominantly associated with submerged aquatic vegetation such as grass shrimp (*Palaemonetes* sp.), sheepshead minnow *(Cyprinodon variegatus)*, rainwater killifish *(Lucania parva)*, least killifish *(Heterandria formosa)*, inland silverside *(Menidia beryllina)*, sailfin molly *(Poecilia latipinna)*, and western mosquitofish *(Gambusia affinis)* (Rogers *et al.* 1992). The most abundant marine transient species collected near the project area included Gulf menhaden *(Brevoortia patronus)*, blue crab *(Callinectes sapidus)*, bay anchovy *(Anchoa mitchilli)*, and striped mullet *(Mugil cephalus)* (Rogers *et al.* 1992).

The most abundant species collected by otter trawling in Lake Barre included brown shrimp *(Farfantepenaeus aztecus)*, Atlantic croaker *(Micropogonias undulatus)*, blue crab, bay anchovy,

white shrimp *(Litopenaeus setiferus*), spot *(Leiostomus xanthurus)*, hardhead catfish *(Ariopsis felis)*, sand seatrout *(Cynoscion arenarius)*, brief squid *(Lolliguncula brevis)*, least puffer *(Sphoeroides parvus)*, Gulf menhaden *(Brevoortia patronus)*, gafftopsail catfish *(Bagre marinus)*, and Atlantic bumper *(Chloroscombrus chrysurus)* (Rogers *et al.* 1994, 1997).

The most abundant finfish species collected by LDWF otter trawls from 1998 to 2008 in the Lake Mechant area were bay anchovy, Atlantic croaker, spot, Gulf menhaden, and sand seatrout (USACE 2010). White shrimp, blue crab, and brown shrimp were also collected by otter trawls. LDWF gillnets in the Catfish Lake area frequently collected spotted seatrout *(Cynoscion nebulosus)*, Gulf menhaden, spot, Atlantic croaker, hardhead catfish, and black drum *(Pogonias cromis)*. The most abundant species collected by LDWF seines in Lake Boudreaux were bay anchovy, inland silverside, naked goby *(Gobiosoma bosc)*, Atlantic croaker, and Gulf killifish *(Fundulus grandis)*. Grass shrimp, brown shrimp, blue crab, and white shrimp were also commonly collected in the seines (USACE 2010).
Freshwater and intermediate marshes in and around the project area also provide habitat for freshwater recreational and commercial fisheries species. Freshwater species include largemouth bass *(Micropterus salmoides)*, yellow bass *(Morone mississippiensis)*, black crappie *(Pomoxis nigromaculatus)*, bluegill *(Lepomis macrochirus)*, redear sunfish *(L. microlophus)*, warmouth *(L. gulosus)*, blue catfish *(Ictalurus furcatus)*, channel catfish *(I. punctatus)*, buffalo *(Ictiobus* sp.*)*, freshwater drum *(Aplodinotus grunniens)*, bowfin *(Amia calva)*, and gar *(Lepisosteus* sp.*)*.

Marshes in the area support many commercially and recreationally important marine fish and shellfish species including red drum *(Sciaenops ocellatus)*, black drum, sheepshead *(Archosargus probatocephalus)*, striped mullet, southern flounder *(Paralichthys lethostigma)*, Gulf menhaden, sand seatrout, gray snapper *(Lutjanus griseus)*, Spanish mackerel *(Scomberomorus maculatus)*, white shrimp, brown shrimp, blue crab, eastern oyster *(Crassostrea virginica)*, and Gulf stone crab *(Menippe adina)*.

Brown and White Shrimp

The greatest percentage of shellfish landed in Louisiana in 2009 was brown and white shrimp. In Louisiana, nearly 34.5 million pounds of brown shrimp and 79.1 million pounds of white shrimp were landed in 2009, with a dockside value of $26.2 million and $94.1 million, respectively (NMFS 2011).

Brown and white shrimp spawn in the Gulf of Mexico. Postlarval shrimp are transported into estuarine waters and coastal wetlands. Brown shrimp generally enter estuaries from February to April (White and Boudreaux 1977); white shrimp enter from late spring to autumn (Baxter and Renfro 1967). White shrimp typically spawn in shallower Gulf waters; postlarval and juvenile white shrimp move farther inshore than brown shrimp (Turner and Brody 1983). Juvenile shrimp move from the estuaries into offshore waters where they become adults. Brown shrimp migrate from the estuaries to the Gulf from May to August (Lassuy 1983); white shrimp migrate offshore from September to December (Muncy 1984).

Blue Crab

The blue crab is another important Louisiana shellfish. In 2009, over 51.2 million pounds of blue crab was landed in Louisiana, with a dockside value of $36.4 million (NMFS 2011). Soft shell (postmolt) and peeler (pre-molt) blue crab landings in Louisiana made up a smaller percentage of the landings but had a higher price per pound (nearly 35 thousand pounds with over $93 thousand dockside value, and over 171 thousand pounds with $436 thousand dockside value, respectively) (NMFS 2011).

A significant recreational fishery for blue crab also exists; however, little data are available. Since the mid- to late-1950s, crab traps (or pots) have become the primary gear type used to capture hard crabs (Adkins 1972). Large numbers of blue crabs are also collected by commercial and recreational trawling. The number of crab captured by trawls is unknown, but may be quite high. One commercial shrimper trawling in the mouth of a deep bayou after a strong cold front reported catching eight to nine thousand pounds of crabs in one day (Adkins 1972).

Blue crabs are found throughout estuaries and in adjacent marine waters. Crabs mate during the warmer months in fresher waters (Darnell 1959). Sperm transferred to female crabs can remain viable for over a year and can be used for multiple spawnings (Perry and McIlwain 1986). Female crabs migrate southward to higher salinity waters after mating (Adkins 1972; Perry 1975). Spawning and larval development occur in the more saline waters (Darnell 1959).

Larval blue crab abundances peak during February and March (Adkins 1972); megalopae then enter fresher areas. Juvenile crabs prefer areas with soft, mud substrate and are most abundant from November to May, more frequently in the northern portions of estuaries. After 1 to 1.5 years, crabs move from shallow areas into larger bays and bayous as adults where they reside for at least one more year (Adkins 1972). Recruitment of blue crabs in some areas is highest during the late spring, early summer, and fall. Male and female crabs are distributed differently in relation to salinity. Adult male crabs may prefer lower salinity waters, whereas mature females prefer higher salinities (Perry and McIlwain 1986). Adult male crabs are frequently observed in rivers and lakes miles from the Gulf.

Eastern Oyster

The eastern oyster is an important resource in the Terrebonne Estuary. Over 14.7 million pounds of oysters were harvested in Louisiana in 2009, with a dockside value of more than $49.9 million (NMFS 2011). The central coast of Louisiana, including the Terrebonne Estuary, supplies 26 percent of Louisiana oyster landings (Keithly and Roberts 1988).

Oyster leases are primarily located in the southern portion of the project area. Oyster seed grounds near the project area are located in Caillou (Sister) Lake and Bay Junop at the southern end of Bayou du Large. Seed grounds are managed by the LDWF to produce a ready supply of seed oysters for placement on private leases for later harvest. Active oyster leases in the vicinity of the study area in 2009 are shown in Figure 5-7.

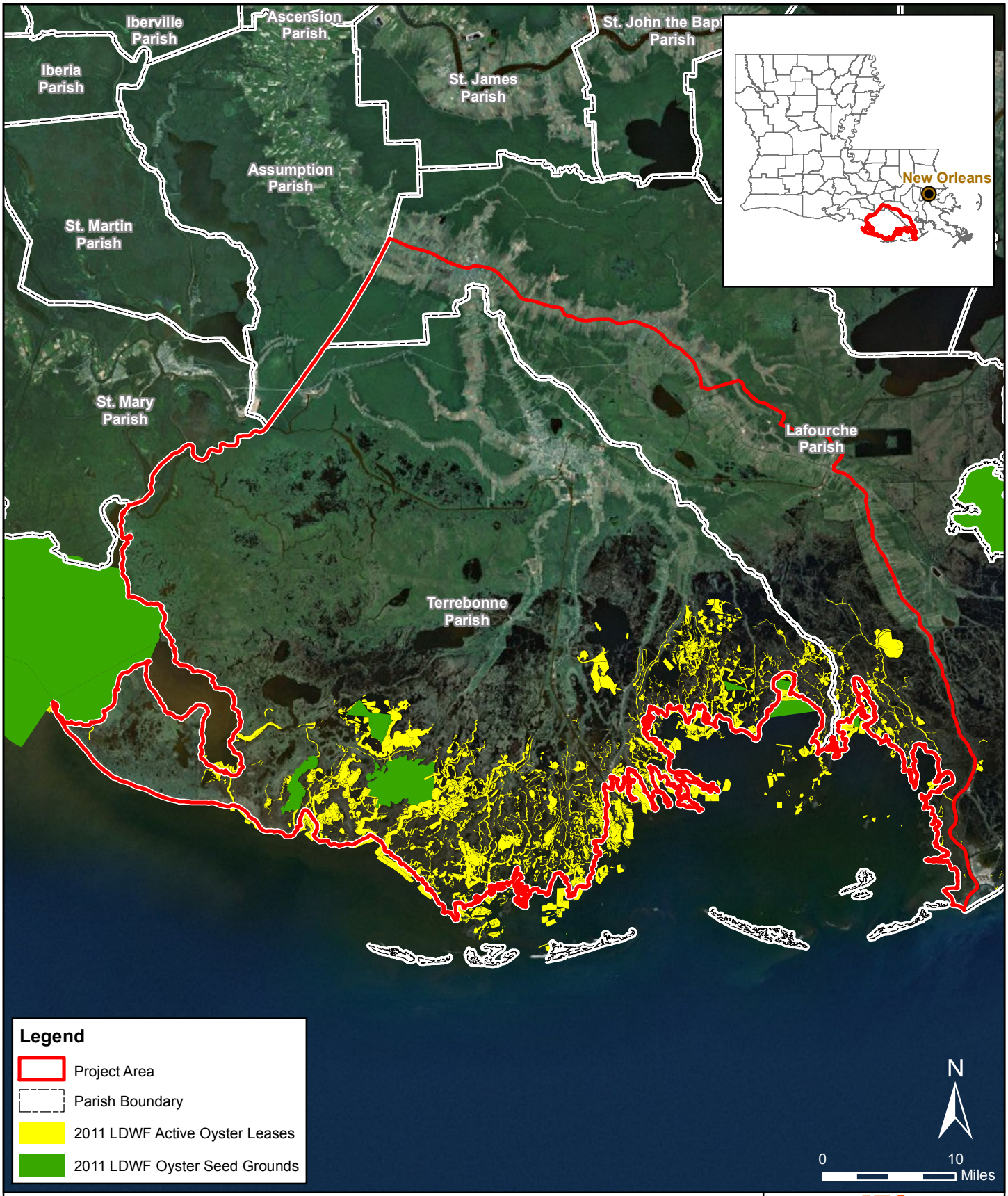


Figure 5-7. 2011 Louisiana Department of Wildlife and Fisheries Active Oyster Leases and Oyster Seed Grounds

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

ESRI World 2D Imagery

GEC Gulf Engineers & Consultants

Figure: 5-7
Date: June 2012
Scale: 1:636,789
Source: NRCS/GEC
Map ID: 273160010-2815

Salinity affects oyster distributions, and very low salinities can cause oyster mortalities, although the low salinity tolerance of oysters has been subject to debate. Adult oysters are typically found within a salinity range of 10 to 30 ppt in estuaries in the Gulf; however, oysters can tolerate 2 to 40 ppt (Stanley and Sellers 1986). The susceptibility of oysters to low salinities may depend on the previous condition of the oyster (fatness), the length of exposure time, and the water temperature (Gunter 1953). Lower temperatures are generally positively correlated with the quality or condition of the oysters (Owen and Walters 1950). Oyster abundance appears to increase one or two years after periods of increased freshwater inflow; low abundances may occur one to three years after declines in freshwater inflow (Buzan *et al.* 2009).

Salinity also affects the distribution of oyster predators and parasites. Higher levels of parasitism generally occur in higher salinity waters (Gauthier *et al.* 2007). Susceptibility to infection by the protozoan *Perkinsus mannus* in oysters is significantly and positively correlated with salinity (Chu *et al.* 1993; Chu and La Peyre 1993).

The southern oyster drill is an important predator of oysters. Oyster drill populations fluctuate due to environmental changes, such as changes in salinity or temperature (Brown *et al.* 2004). Oyster drills are typically found in the higher salinity portions of estuaries, where salinities are greater than 15 ppt (Butler 1954). However, the salinity at which mortality occurs fluctuates depending upon the salinity the oyster drills were accustomed to and how quickly the salinity declines (Butler 1985). Water temperatures below 12°C also have been found to limit oyster drill feeding (Butler 1985). Black drum *(Pogonias cromis)* also prey on oysters (Brown *et al.* 2003) and are likely to be more abundant in higher salinity areas in the northern Gulf of Mexico.

5.2.5 ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, or growth to maturity for species regulated under a Federal fisheries management plan.

Specific categories of EFH in estuaries include all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities), including the sub-tidal vegetation (sea grasses and algae) and adjacent inter-tidal vegetation (marshes and mangroves). The Gulf of Mexico Fishery Management Council (GMFMC), through the generic amendment of the Fishery Management Plans for the Gulf of Mexico, lists the following Federally managed species or species groups potentially found in coastal Louisiana: brown shrimp, white shrimp, Gulf stone crab, red drum, gray snapper, and Spanish mackerel (GMFMC 2005). Coastal wetlands provide nursery and foraging habitat that supports economically important marine fishery species such as spotted seatrout, southern flounder, Atlantic croaker, Gulf menhaden, striped mullet, and blue crab. These species serve as prey for other federally managed fish species such as mackerels, snappers, groupers, billfishes, and sharks. EFH encompasses all the wetlands and bays along the Louisiana coast.

The expected salinity zones in the project area and the abundance of these managed species are listed in Table 5-6. The EFH for life stages of these managed species are listed in Table 5-7. No Habitat Areas of Particular Concern (HAPCs) are located within or near the project site. An EFH assessment conducted previously for the project area is incorporated by reference (USACE 2002, http://www.mvn.usace.army.mil/prj/mtog/).

Table 5-6. Salinity Zones and Abundance of Federally Managed Species in Terrebonne/Timbalier Bays

Salinity Zone	Life Stage	Brown Shrimp	White Shrimp	Red Drum	Gulf Stone Crab
0 - 0.5 ppt	Adults		*R*	*R*	
	Eggs				
	Juveniles	*C to HA*	*R to C*	*R*	
	Larvae				
	Spawners				
0.5 - 5 ppt	Adults	*R*	*R*	*R to C*	*R to C*
	Eggs				
	Juveniles	*C to HA*	*C to A*	*C*	*R*
	Larvae	*R to A*	*R to C*	*R*	
	Spawners				
5 – 15 ppt	Adults	*R*	*R to C*	*R to C*	*R to C*
	Eggs				
	Juveniles	*C to HA*	*C to A*	*C*	*R*
	Larvae	*R to HA*	*R to A*	*R*	
	Spawners				

Relative Abundance: Blank (NP) - Not Present; R – Rare; C – Common; A – Abundant; HA - Highly Abundant (Variation in abundance due to seasonality)
Source: http://www8.nos.noaa.gov/biogeo_public/elmr.aspx
http://ccma.nos.noaa.gov/products/biogeography/gom-efh/ELMR.pdf

Table 5-7. Essential Fish Habitat for Life Stages of Federally Managed Species in Terrebonne/Timbalier Bays

Species	Life Stage	Essential Fish Habitat
Brown shrimp	Adults	Gulf of Mexico <110 m, silt sand, muddy sand
	Juvenile	Marsh edge, submerged aquatic vegetation (SAV), tidal creeks, inner marsh
	Larvae/Postlarvae	0 to 82 m; pelagic
White shrimp	Adults	Gulf of Mexico <33 m, Silt, soft mud
	Juvenile	Marsh edge, SAV, marsh ponds, inner marsh, oyster reefs
	Larvae/Postlarvae	Planktonic, soft bottom, emergent marsh

Species	Life Stage	Essential Fish Habitat
Red drum	Adults	Gulf of Mexico & estuarine mud bottoms, oyster reef
	Juvenile	SAV, estuarine mud bottoms, marsh/water interface
Gulf stone crab	Larvae/Postlarvae	Pelagic, oyster reef, soft bottom
	Juvenile	Sand/shell/soft bottom, oyster reef

EFH for the Red Drum Fishery Management Plan includes all estuaries: Vermilion Bay, Louisiana, to the eastern edge of Mobile Bay, Alabama, out to depths of 25 fathoms; Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; and Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council (SAFMC) between depths of 5 and 10 fathoms (GMFMC 2005).

EFH for the Shrimp Fishery Management Plan includes all estuaries; the US/Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms (GMFMC 2005).

EFH for the Stone Crab Fishery Management Plan includes all estuaries; the US/Mexico border to Sanibel, Florida, from estuarine waters out to depths of 10 fathoms; and from Sanibel, Florida, to the boundary between the areas covered by the GMFMC and the SAFMC from estuarine waters out to depths of 15 fathoms (GMFMC 2005).

5.2.6 WILDLIFE

Wildlife resources are a critical element of various aquatic and terrestrial habitats; they are indicators of the health of various aquatic and terrestrial habitats, and many species serve as important commercial resources. The project area provides habitat for many species of wildlife, including waterfowl, wading birds, neotropical and migratory birds, deer, furbearers, reptiles, and amphibians. The public places a high priority on the aesthetic, recreational, and commercial value of wildlife. Coastal wetlands provide habitats used for nursery, cover, feeding, roosting, shelter and other requirements. Wildlife resources are discussed in greater detail in the 2002 Morganza to the Gulf PEIS, which is incorporated herein by reference (USACE 2002).

Birds

Over 200 species of birds, including 35 species of waterfowl, have been reported in the Barataria-Terrebonne estuary (Condrey *et al.* 1995, Mitchell 1991). Species diversity decreases as the salinity increases; the greatest numbers of bird species occur in the freshwater swamps. Louisiana's coastal wetlands and marshes provide winter habitat for more than 50 percent of the duck population of the Mississippi Flyway. Waterfowl populations vary greatly from year to year. Waterfowl are primarily winter residents and migrate north in the spring and summer. In freshwater marsh, the American coot and blue-winged teal are the most prevalent species (Sasser

et al. 1982). Gadwall, American coot, mallard, and blue-winged teal are the most abundant species in salt and brackish marshes. Puddle ducks inhabit marshes with shallow (less than half a meter deep) ponds; they prefer pondweed, naiad, and duckweed in freshwater areas and widgeongrass in brackish marsh. Diving ducks, such as scaup, prefer deeper water and often dive more than 10 meters underwater to feed on invertebrates (Gosselink 1984).

Louisiana's coastal wetlands are an important habitat for millions of neotropical and other migratory avian species such as wading birds, shorebirds, rails, gallinules, and numerous songbirds. The coastal wetlands provide migratory birds an essential stopover habitat on their migration route.

A 2001 survey reported 197 shorebird colonies of wading birds and seabirds (representing 215,249 pairs of nesting birds) in coastal Louisiana (Michot *et al*. 2003). Species of wading birds likely to inhabit the project area include: great blue heron, little blue heron, tricolored heron, green heron, yellow crowned night heron, black crowned night heron, tri-colored heron, white-faced ibis, white ibis, roseate spoonbill, great egret, cattle egret, and snowy egret. These birds are generally carnivorous, with a diet consisting primarily of frogs, small fish, snakes, crawfish, worms, and insects found in shallow ponds and along bayous. Brackish marshes are their preferred feeding areas (Gosselink 1984). Colonies tend to be located in wooded and shrub swamps, which typically flood during the nesting season (Mitchell 1991).

Numerous species of seabirds and shorebirds inhabit shallow water areas and mudflats. Seabirds commonly nest on barrier and bay islands on shell, sand, or bare soil (Mitchell 1991). Seabirds likely to inhabit the project area include the brown pelican, white pelican, laughing gull, herring gull, and several species of terns. Shorebirds likely to utilize the project area include killdeer, willet, black-necked stilt, American avocet, dowitchers, common snipe, and various species of terns.

Other bird species common in the project area include red winged black bird, boat-tailed grackle, seaside sparrow, osprey, northern harrier, belted kingfisher, and marsh wrens. Game birds, excluding migratory waterfowl, likely to be present in the study area include the clapper rail, Virginia rail, sora, American coot, and common snipe. Raptor species that could be present in the study area include red tailed hawk, red-shouldered hawk, osprey, American kestrel, screech owl, northern harrier, Mississippi kite, great horned owl, and barred owl. Bald eagles are known to be present within the study area.

Species Recently Delisted as Threatened or Endangered

The brown pelican was removed from the USFWS endangered species list on December 17, 2009 (Federal Register, Volume 74, Number 220, November 17, 2009) due to successful recovery efforts. The brown pelican is still protected under the Migratory Bird Treaty Act.

Brown pelicans nest in colonies on small coastal islands in salt and brackish waters. Nesting islands are often chosen near channels where shipping and shrimping operations make fish easily available to nesting pairs (USACE 2004). They were reintroduced into Louisiana from Florida from 1968 to 1980, and nesting populations were established on North Island in the Chandeleur

Islands. In 2000, Chandeleur Island nesting populations were relocated to the mouth of Baptiste Collette Pass, but the birds returned to the Chandeleur Islands. Other nesting areas in Louisiana are Raccoon and Wine Islands in the Isles Dernieres barrier island system, Queen Bess Island in Barataria Bay, West Breton Island in Breton Sound, and most recently, Rabbit Island in Calcasieu Lake (USACE 2004). Additional information on the brown pelican can be found at http://www.fws.gov/endangered.

Bald eagles were removed from the USFWS endangered species list on August 8, 2007 (Federal Register, Volume 72, Number 130, July 9, 2007) because their populations recovered sufficiently. However, this species is still protected under the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, and the Lacey Act. The USFWS developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations regarding how to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance", which is prohibited by the Bald and Golden Eagle Protection Act. A copy of the NBEM Guidelines is available at: www.fws.gov/migratorybirds/issues/BaldEagle.

The bald eagle occurs in the Lafourche Parish portion of the study area. According to the USFWS Fish and Wildlife Coordination Act (FWCA) Report for the 2002 Morganza to the Gulf PEIS, at least 30 bald eagles nests (present and historical) have been documented in the study area (USACE 2002). This species prefers habitat near large rivers, lakes, and estuaries with large trees in fairly open stands required for roosting and nesting. In southeastern Louisiana, nests are often built in large bald cypress trees that are located near fresh to intermediate marshes or open water (USACE 2004). Additional information on bald eagles can be found at http://www/fws.gov/midwest/eagle/.

Reptiles

Species of reptiles that are likely to inhabit the project area include: American alligator (*Alligator mississippiensis*), alligator snapping turtle (*Cheldrya serpetina*), eastern box turtle (*Terrapene carolina*), water moccasin (*Agkistrodon piscivorus*), eastern mud snake (*Farancia abacura*), bullfrog (*Rana catesbeiana*), southern leopard frog (*Lithobates sphenocephalus*), and Gulf Coast toad (*Incilius valliceps*).

The alligator was removed from the USFWS endangered species list in 1987. Alligators are common in fresh to brackish bayous and lakes (Joanen and McNease 1972, Platt *et al*. 1989). Their diet consists of a broad range of prey including insects, crawfish, crab, birds, fish, muskrat, nutria, turtles, shrimp, and snails (Chabreck 1971). Marshes with salinities less than 10 ppt are preferred nesting sites (Gosselink 1984).

Fur Bearers

Coastal Louisiana has a long history of being an important fur producing area in North America. The nutria, mink, muskrat, raccoon, and river otter could be present in the project area. Louisiana's coastal marshes also provide habitat for important game species such as the whitetail deer (*Odocoileus virginianus*) and swamp rabbit (*Sylvilagus aquaticus*).

The muskrat (*Ondatra zibethicus*) is primarily found in brackish marshes. The muskrat eats one third of its weight per day (about 0.3 kg/day) (O'Neil 1949); this equates to about one percent of plant production. Nest-building and digging cause more marsh deterioration than feeding activities.

Invasive Species

In Louisiana, the nutria (*Myocastor coypus*) and feral hog (*Sus scrofa*) are the only two mammals considered invasive species. The nutria is also listed as an aquatic invasive species, see below. Nutria are large, herbivorous, aquatic mammals that inhabit fresh, intermediate, and brackish marshes and wetlands. Nutria are extremely prolific; in one year, a female can produce two litters and be pregnant for a third. Large numbers of nutria can be detrimental to wetland vegetation and exacerbate coastal land loss. During feeding, nutria graze on the base of plant stems and dig for roots and rhizomes in the winter. Grazing can strip patches of vegetation throughout the marsh and their digging overturns the marsh's upper layer. This can result in a loss of vegetation leading to a conversion of marsh habitat to open water called "eat-outs" (USGS 2000). Historically, demand for nutria fur held populations in check. After 1989, the price of the pelts plummeted and population numbers increased dramatically. In 2002, the Coastwide Nutria Control Program was approved under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). This program was designed to encourage nutria harvesting through monetary incentives.

Large populations of feral hogs are present in Louisiana. Feral hogs are the most prolific mammal in North America. Their reproductive rates can exceed four times that of native ungulate species. They damage habitats and impact native plant and animal species. Feral hogs contribute to soil erosion, leaching of minerals and nutrients, habitat destruction, native plant species destruction, exotic plant species introduction, habitat destruction, and changes in vegetative success rates. Native wildlife are impacted though direct competition for food and predation of native amphibians, reptiles, mammals, and ground-nesting birds. Feral hogs provide some economic and social benefits through hunting (USFWS 2009, 2010).

Aquatic invasive species likely to be in the project area are presented in Table 5-8.

Table 5-8. Aquatic Invasive Species Likely to be in the Project Area

Common Name	Scientific Name	Problems	Current Range
Nutria	*Myocastor coypus*	Feeds on vegetation causing erosion, burrows in banks of canals and bayous weakening levees, destroys habitat.	Distributed along the coastal areas of the Gulf states.
Silver carp	*Hypophthalmichthys molitrix*	Competes with native fish and shellfish, potential injuries to fishermen and boats.	States bordering Mississippi River, including Louisiana and the Barataria-Terrebonne system.
Bighead carp	*Hypophthalmichthys nobilis*	Alters phytoplankton and zooplankton communities.	States bordering Mississippi River, including Louisiana and

Common Name	Scientific Name	Problems	Current Range
			the Barataria-Terrbonne system.
Black carp	*Mylopharyngo don piceus*	Threatens native shellfish and mollusks, potential host of parasites and flukes.	Specimens identified in Louisiana but no known established populations in Louisiana.
Asian clam	*Corbicula fluminea*	Outcompetes native species, is a known fouling agent, can alter benthic substrate.	Southern Louisiana, including the Barataria-Terrebonne system. Also documented in 38 other states.
Zebra mussel	*Dreissena polymorpha*	Clogs industrial and municipal intake pipes.	In Louisiana, established in Mississippi River throughout the state. Present in the Barataria-Terrebonne system.
Apple snail	*Pomacea* spp.	Voracious eater of soft vegetation, causing devastating effects on crops such as rice.	In Louisiana, Plaquemines and Terrebonne parishes.
Australian spotted jellyfish	*Phyllorhiza punctata*	Impacts to Gulf of Mexico fisheries.	Caribbean and Gulf of Mexico, including the coastal waters of Louisiana and the Barataria-Terrebonne system.

Source: Barataria-Terrebonne National Estuary Program, 2011
http://www.btnep.org/subsites/Invasive/oldcontent/invasivesinla/aquaticanimals.aspx

5.2.7 THREATENED AND ENDANGERED SPECIES

Federally threatened (T) and endangered (E) species present in Terrebonne and Lafourche parishes are listed in Table 5-9. In a letter to CEMVN dated March 18, 2002, NMFS listed five federally protected whale species potentially occurring in the Gulf of Mexico off Louisiana, including the North Atlantic right whale (*Eubalaena glacialis*), the sei whale (*Balaenoptera borealis*), the finback whale (*Balaenoptera physalus*), the humpback whale (*Megaptera novaengliae*), and the sperm whale (*Physeter macrocephalus*). However, according to the NMFS letter, none of these species is expected to be found near the project area (Appendix A).

Table 5-9. Threatened and Endangered Species in Terrebonne and Lafourche Parishes

Species		Status	
Scientific Name	**Common Name**	**Federal**	**State**
Haliaeetus leucocephalus	Bald eagle	Delisted	E
Pelecanus occidentalis	Brown pelican	Delisted	E
Falco peregrinus	Peregrine falcon	Not listed	T/E
Charadrius melodus	Piping plover	T; Critical Habitat	T/E
Trichechus manatus	West Indian manatee	E	E
Acipenser oxyrinchus desotoi	Gulf sturgeon	T	T

Lepidochelys kempii	Kemp's ridley sea turtle	E	E
Dermochelys coriacea	Leatherback sea turtle	E	E
Eretmochelys imbricata	Hawksbill sea turtle	E	E
Caretta caretta	Loggerhead sea turtle	T	T
Chelonia mydas	Green sea turtle	T	E

Source: USFWS, June 2011 (http://www.fws.gov/endangered/); LDWF, June 2011 (http://www.wlf.louisiana.gov/wildlife).

Federal and State Listed Species In or Near the Study Area

To provide compliance with Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended, a Biological Assessment (BA) was prepared pursuant to the ESA and implementing regulation (50 CFR 402.14) (Appendix A). The BA provides an assessment of the effects of the project on the protected species in the vicinity of the project. Coordination with USFWS and NMFS is on-going.

According to the 2002 BA (Appendix A), the piping plover, the Gulf sturgeon, and Kemp's ridley sea turtle may occur in or near the study area. Four additional species of endangered or threatened sea turtles, including the hawksbill, leatherback, green, and loggerhead, were listed in the BA, but cited as unlikely to occur near the study area. Additional information on sea turtles located in the Gulf of Mexico can be found at http://www.nmfs.noaa.gov/. The bald eagle and the brown pelican were also listed as protected species in the study area in the 2002 BA. However, due to successful recovery efforts, both species were removed from the Federal list of threatened and endangered species. The wildlife section above provides more details about these species. Information on threatened and endangered species discussed in the BA, FWCA Report, and the Draft Feasibility Report and DPEIS, is incorporated herein by reference.

Piping plover The federally threatened piping plover breeds in northern latitudes and winters along the south Atlantic and Gulf coasts, including coastal Louisiana. Overwintering populations in Louisiana occur on intertidal beaches, sand flats, mud flats, algal flats, wash-over passes with sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting in Cameron, Jefferson (Grand Terre Island and Grand Isle), Vermilion, Lafourche, Plaquemines and St. Bernard parishes. Additionally, they occur on the Isles Dernieres barrier island chain in Terrebonne Parish. The piping plover begins arriving on the wintering grounds as early as late July and remains until late March or April (USACE 2010).

On July 10, 2001, the USFWS designated critical habitat for breeding and wintering piping plovers (Federal Register Volume 66, No. 132). The barrier islands south of the project area in the Gulf of Mexico have been designated as critical habitat for the piping plover. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. Additional information on the piping plover and their critical habitat can be found at http://www.fws.gov/plover/facts.html.

Gulf sturgeon The Gulf sturgeon, federally listed as a threatened species under both the USFWS and NMFS, is anadromous and occurs in many rivers, streams, and estuarine waters along the northern Gulf Coast between the Mississippi River and the Suwannee River in Florida.

In Louisiana, the Gulf sturgeon has been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain Basin, and adjacent estuarine areas. Spawning occurs in coastal rivers between late winter and early spring (i.e., March to May). Adults and sub-adults may be found in those rivers and streams until November, and in estuarine or marine waters during the remainder of the year. Sturgeons, less than two years old, appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. Habitat alterations such as those caused by water control structures that limit and prevent spawning, poor water quality, and overfishing have adversely affected the species (USACE 2010).
On March 19, 2003, the USFWS and the NMFS published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl and Bogue Chitto rivers, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, the Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. No critical habitat occurs within or in proximity to the project area. Additional information on the Gulf sturgeon can be found at http://www.fws.gov/endangered/ and http://www.nmfs.noaa.gov/.

Kemp's ridley sea turtle Kemp's ridley turtles inhabit shallow nearshore and inshore waters of the northern Gulf of Mexico, particularly in Louisiana. This small sea turtle is believed to be the most frequently encountered, if not the most abundant sea turtle, off the Louisiana coast (USACE 2004). Kemp's ridleys are often found in salt marsh waterbodies and have been collected in Louisiana from Lake Borgne, Barataria and Terrebonne Bays, and near Calcasieu Pass. Occurrence of these sea turtles in bays and estuaries along the Louisiana coast would not be unexpected, as many of their primary food items occur there. During winter, turtles in the northern Gulf of Mexico may migrate to deeper water. Hatchlings often become entrained in Gulf of Mexico eddies, where they are dispersed by oceanic surface currents and then enter coastal shallow water habitats when they reach about 20 cm in length (USFWS and NMFS 1992). Additional information can be found at http://www.fws.gov/endangered/ and http://www.nmfs.noaa.gov/.

5.2.8 NOISE

Noise is defined as unwanted sound and, in the context of protecting public health and welfare, implies potential effects on the human and natural environment. Noise is a significant concern associated with construction, dredging, and transportation activities and projects. Ambient noise levels within a given region may fluctuate over time because of variations in intensity and abundance of noise sources.

The USEPA has established noise guidelines recommending noise limits for indoor and outdoor noise activities. Under these guidelines, an average noise level over a 24-hour period of 70 A-weighted decibels (dBA) is listed as the threshold for hearing loss. An outdoor 24-hour average sound level of 55 dBA is recommended for residential areas. Additionally, the U.S. Department of Housing and Urban Development (HUD) has also developed a noise abatement and control policy codified in 24 CFR Part 51. According to HUD policy, noise at or below 65 dBA is acceptable in all situations, noise between 65 and 75 dBA is generally acceptable, and noise exceeding 75 dBA is unacceptable in all situations. Noise monitoring and impacts are typically evaluated by the local government.

The study area is primarily rural, but does include areas with urban and industrial development, including Houma, Thibodeaux, Raceland, and LaRose Metropolitan Statistical Areas (MSAs). Ambient noise in the area is generated by a broad range of sources, both natural and anthropogenic. Natural noise sources include climatic sources, such as thunder, wind, and precipitation. Potential sources of anthropogenic sound include commercial shipping, dredging and construction activities, agricultural activities, industrial activities, outdoor recreation (e.g. hunting and fishing), and commercial and residential waterborne and highway traffic. No ambient noise monitoring appears to have been conducted in the study area; consequently, no quantitative data on noise levels within the study area are available for analysis.

5.2.9 AIR QUALITY

Ambient air quality is a function of the size, distribution, and activities directly related to population in association with the resulting economic development, transportation, and energy policies of the region. Meteorological conditions and topography may confine, disperse, or distribute air pollutants. Assessments of air quality depend on multiple variables such as the quantity of emissions, dispersion rates, distances from receptors, and local meteorology. Due to the variable nature of these independent factors, ambient air quality is an ever-changing dynamic process.

The Clean Air Act Amendment of 1990 directed the USEPA to establish National Ambient Air Quality Standards (NAAQS) for all regulated air pollutants. Federal air quality standards have been established for six criteria air pollutants:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Ozone (O_3);
- Sulfur oxides (commonly measured as sulfur dioxide [SO_2]);
- Lead (Pb);
- Particulate matter no greater than 2.5 micrometers (µm) in diameter ($PM_{2.5}$); and
- Particulate matter no greater than 10 µm in diameter (PM_{10}).

The USEPA classifies air quality by Air Quality Control Region (AQCR). The Clean Air Act defines an AQCR as a contiguous area where air quality, and thus air pollution, is relatively uniform. AQCRs often correspond with airsheds and may cross parish and state lines. Each AQCR is treated as a unit for developing pollution control strategies to achieve National Ambient Air Quality Standards (NAAQS).

An AQCR or portion of an AQCR may be classified as attainment, nonattainment, or unclassified. A classification of "attainment" indicates that criteria air pollutants within the region are within NAAQS values; a "nonattainment" classification indicates that air pollution levels persistently exceed the NAAQS values; and a classification of "unclassified" indicates that air quality within the region cannot be classified (generally due to lack of data). A region designated as unclassified is treated as an attainment region.

The USEPA's AirData database contains measurements of air pollutant concentrations for the entire United States. The measurements include both criteria air pollutants and hazardous air pollutants as compared to the NAAQS specified by the USEPA. The AirData database was queried for air quality data in Terrebonne and Lafourche parishes for the interval 2002-2008 (the most recent year that data are available). The data show that air quality in these parishes for all criteria pollutants for the 2002-2008 period was better than the NAAQS at all monitoring sites, with the exception of 8-hour ozone in Lafourche Parish during the years 2003 to 2007.

The USEPA's *Nonattainment Areas for Criteria Pollutants* (Green Book) maintains a list of all areas within the United States that are currently designated nonattainment areas with respect to one or more criteria air pollutants. Terrebonne and Lafourche parishes are not listed as non-attainment areas in the Green Book, indicating they are currently classified as attainment areas.

Lafourche Parish was previously designated as non-attainment with respect to one-hour ozone NAAQS beginning in September 1978; however, because the parish met one-hour ozone NAAQS from 1997 to 2001, EPA approved the redesignation to attainment for one-hour ozone in December 2001. The parish has continued to meet one-hour ozone NAAQS since that time.

In 2004, EPA designated and classified areas for the new eight-hour ozone NAAQS and published the final Phase I rule for implementation of the eight-hour ozone NAAQS. Lafourche Parish was classified as unclassifiable/attainment for the eight-hour ozone NAAQS at that time. In 2006, the United States Court of Appeals vacated those portions of EPA's Phase I implementation rule that allow for regulation of eight-hour ozone non-attainment areas. In EPA's proposed reclassification of areas in January 2009, Lafourche Parish was not proposed as a non-attainment area for eight-hour ozone; however, in March 2009, the Louisiana Department of Environmental Quality recommended to EPA that the designation for Lafourche Parish be changed to a non-attainment status for eight-hour ozone due to recent exceedances of the NAAQS. Until the reclassification of areas is finalized, areas will remain classified in the Green Book according to the 2004 Subpart 1 portion of the Phase I rule. A revised maintenance plan for eight-hour ozone was submitted to EPA for Lafourche Parish in 2006 and approved by EPA in 2008, per Section 110 of the Clean Air Act, in an effort to maintain continued attainment status for the eight-hour ozone NAAQS through the year 2014.

The AirData database also provides annual summaries of Air Quality Index (AQI) values for counties or MSAs. The AQI is an approximate indicator of overall air quality because it takes into account all of the criteria air pollutants measured within a geographic area. The AQI summary values include both qualitative measures (i.e., days of the year having good air quality) and descriptive statistics (i.e., median AQI value). According to AQI summary for Terrebonne and Lafourche Parishes and for the Houma MSA for the interval 2002-2008, air quality in the majority of the study area (Terrebonne Parish /Houma MSA) is good, with minimal periods when air quality is classified as unhealthy. In the small portion of the study area that lies within Lafourche Parish, air quality is average to above average. Of the six criteria air pollutants, ozone and particulate matter of 2.5 µm or less are most likely to occur within the study area.

Land use in the study area is comprised primarily of coastal wetlands, agricultural/ sugar cane production, and urban areas, which include Houma, Thibodeaux, Raceland, and LaRose MSAs.

Due to its primarily undeveloped setting, air quality within the majority of the study area is above average. Temporary exceptions to this occur briefly when crop stubble is burned. Exceedances of eight-hour ozone NAAQS in recent years in Lafourche Parish are likely due to sources such as urban areas/vehicles, industrial activities, and burning of crop stubble.

5.2.10 HYDROLOGY

Storm Surge and Flooding

The highest flood stages and flood damages in the study area are influenced by storm surges and high tides due to tropical storms and hurricanes. Storm surges push seawater from the Gulf of Mexico and increase the salinity in the study area. The following tropical storms have been most influential in the study area in terms of significant storm surge flooding (Roth 2010):

- Hurricane Flossy, September 24, 1956: Storm surge reached five to eight feet across the southeastern Louisiana coast. The highest storm surge was 13 feet at the Ostrica Lock. Rain totals were excessive across southeast Louisiana, with a maximum of 16.7 inches at Golden Meadow.

- Hurricane Hilda, October 23, 1964: Hurricane Hilda caused extensive tidal and headwater flooding in the study area. Storm surge caused a flood depth of 7.8 feet in Cocodrie and 10 feet at Point Au Fer.

- Hurricane Betsy, September 9-10, 1965: Storm surge reached 15.7 feet in Grand Isle, Louisiana. The Mississippi River rose more than 10 feet at New Orleans and crested at 15.5 feet at Baton Rouge. The highest recorded rainfall was 12.2 inches in New Orleans.

- Hurricane Carmen, September 7-8, 1974: Storm surge reached four to six feet in Terrebonne and Lafourche parishes. The highest recorded storm surge was 11.6 feet in Cocodrie.

- Hurricane Danny, August 15-16, 1985: Hurricane Danny strengthened into a hurricane on August 15th just offshore of Louisiana. Storm surge of eight feet was seen along the coast of south-central Louisiana.

- Hurricane Juan, October 27-31, 1985: Storm surge reached eight feet at Cocodrie. Levees were overtopped in Lockport, Marrero, Oswego, and Myrtle Grove.

- Hurricane Andrew, August 26, 1992: Storm surge of 7.65 feet NGVD was recorded at Round Bayou at Deer Island and 6.8 feet at Morgan City.

- Tropical Storm Allison, June 4-11, 2001: Thibodaux recorded 29.9 inches of rainfall. Portions of Thibodaux, Lafayette, New Orleans, and Baton Rouge saw severe flooding.

- Hurricane Gustav, August 31-September 3, 2008: Storm surge of 9 – 10 feet was observed in southeast Louisiana. Heavy rains fell in south-central Louisiana. The highest recorded rainfall was 21 inches at Larto Lake.

Existing Hydrology

Anthropogenic changes within the study area have altered the natural hydrology. Canals, pipelines, roads, railroads, navigation channels, and levees have altered the natural flow patterns. The study area has 39 forced drainage systems, where excess stormwater is removed by drainage canals and pump stations. One of these canals, the HNC, has been implicated in higher salinity in the Houma area.

Some of the natural bayous in the study area include Bayou du Large, Bayou Grand Caillou, Bayou Terrebonne, Bayou Pointe aux Chenes, and Bayou Lafourche (Figure 3-1). These bayous and their natural levees were formed by overflows from the Mississippi River.

Historically, freshwater inflows within the study area were driven by the Atchafalaya River and Bayou Lafourche. The connection between Bayou Lafourche and the Mississippi River was in the process of naturally closing when construction of the levees along the Mississippi River closed off that connection. With the closure at Bayou Lafourche, the inflow of fresh water into the central and eastern portions of the project area was limited to local runoff. The natural ridge along Bayou Black restricts the flow along the northern boundary of the study area.

Today, flows within the study area are driven by stages in the lower Atchafalaya River. The major flow channels in the study area are the Atchafalaya River, the GIWW, and the HNC. High stages in the lower Atchafalaya River force flow northeast through the Avoca Island Cutoff into the GIWW and Bayou Penchant (Figure 3-1). Additional flow enters the GIWW through Bayou Boeuf. Water travels eastward along the GIWW, with a portion of this water leaving the GIWW through channels and bayous, such as Bayou Copasaw. At Houma, the GIWW intersects the HNC. At this point, the majority of flow travels down the HNC to the Gulf of Mexico. Most of the study area is influenced by tidal movement from the Gulf of Mexico.

Hydrologic Dynamics of the System

In addition to the anthropogenic changes that have influenced the natural hydrology, the study area continues to have land loss. RSLR affects study-area marshes by gradually inundating marshes, which eventually convert to open water due to the depth of submergence. Subsidence and eustatic sea-level rise are and will continue to be a very dynamic system.

5.2.11 WATER QUALITY

Clean Water Act Section 305(b) listings of study area subsegments, from 1996 to 2010, were reviewed to determine the most prevalent water quality issues present in the study area and to determine which water quality parameters should be summarized for the depiction of historical water quality for the study area. Between 1996 and 2010, the most common suspected cause of impairment was low dissolved oxygen, followed by fecal coliform, non-native aquatic plants,

total phosphorus, nitrate plus nitrite nitrogen, and nutrients. The most common suspected source of impairment was wastewater treatment package plants and other permitted small discharges, followed by introduction of non-native organisms, on-site treatment systems, total retention domestic sewage lagoons, unknown sources, and natural sources.
Historical water quality monitoring data were reviewed and summarized to determine water quality trends in the study area. Four (4) LDEQ long-term water quality monitoring stations exist in the study area. For dissolved oxygen, trends at all stations indicate that dissolved oxygen concentrations have improved between 1996 and 2010. Fecal coliform concentrations at all stations decreased over the same time period. Overall, mildly decreasing trends were observed for total phosphorus and Kjeldahl nitrogen at all stations. Nitrate plus nitrite levels showed very little change over the past thirty years. Overall, dissolved oxygen and fecal coliform levels have improved within the past thirty years.

Water and sediment samples were collected from a total of 12 sites between January 31 and February 2, 2011 to ensure proposed dredged material disposal activities associated with the proposed project do not have adverse environmental effects on the receiving aquatic environment. Evaluation of water and elutriate chemistry is typically performed to determine whether the proposed discharge of dredged material effluent exceeds State and/or Federal water quality criteria outside of the State enforced mixing zone, and therefore may result in toxicity to water column organisms. Water and elutriate chemistry data were compared with applicable State and Federal water quality criteria to determine whether results exceeded these criteria. In most cases during this study, values exceeding criteria are not quantified concentrations, but are instead estimates, as results were below the laboratory reporting limit (in other words, the concentration was below that which the laboratory could quantify with confidence).

For freshwater sites the only exceedances for quantified values were for copper, iron, lead, and mercury. These quantified elutriate concentrations, which are for exceedances of chronic water quality criteria, were within one order of magnitude of criteria. Estimated results below the laboratory reporting limit when calculated as one half of the laboratory reporting limit, exceeded acute criteria for cadmium, hexachlorobutadiene, and the pesticides p,p'-DDD, and toxaphene; and chronic criteria for cadmium, mercury, pesticides p,p'-DDD, p,p'-DDT, endrin, heptachlor, heptachlor epoxide, methoxyclor, and toxaphene.

For brackish sites, the only quantified concentration exceeding criteria was ammonia. Estimated results below the laboratory reporting limit, when calculated as one half of the laboratory reporting limit, exceeded acute criteria for copper, silver, hexachlorobutadiene and pesticides p,p'-DDD, beta-endosulfan, endrin, and toxaphene; , and chronic criteria for copper, mercury, silver, hexachlorobutadiene, and pesticides p,p'-DDD, p,p'-DDT, dieldrin, alpha-endosulfan, beta-endosulfan, endrin, heptachlor, heptachlor epoxide, methoxychlor, and toxaphene.
For marine sites, no exceedances of quantified values were reported. Estimated results below the laboratory reporting limit, when estimated as one half of the laboratory reporting limit, exceeded acute criteria for silver, hexachlorobutadiene , and pesticides beta-endosulfan, endrin, and toxaphene; and chronic criteria for mercury, silver, hexachlorobutadiene , and pesticides p,p'-DDT, 4123 dieldrin, alpha-endosulfan, beta-endosulfan, endrin, heptachlor, heptachlor epoxide, methoxychlor, and toxaphene.

In sediment quality samples at freshwater sites, concentrations of arsenic, copper, nickel, and zinc exceeded freshwater Lowest Effect Level (LEL) screening values at all freshwater sites, while the measured concentration of mercury exceeded the freshwater LEL screening concentration at one site. Results below the laboratory reporting limit exceeded sediment screening values at all freshwater sites for a variety of organic and inorganic constituents.

For brackish sites sediment screening values were exceeded for quantified or estimated concentrations of aluminum, antimony, arsenic, barium, cobalt, copper, manganese, nickel, zinc, and several organic compounds. Results below the laboratory reporting limit, when estimated as one half of the laboratory reporting limit, exceeded sediment screening values for a variety of organic and inorganic constituents.

For marine sites, sediment screening values were exceeded for quantified concentrations of aluminum, arsenic, barium, cobalt, copper, manganese, nickel, and butyl benzyl phthalate. Results below the laboratory reporting limit, when estimated as one half of the laboratory reporting limit, exceeded sediment screening values for a variety of organic and inorganic constituents.

Greater and more specific detail on water and sediment quality can be found in the engineering appendix to the PAC report.

5.2.12 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

The Final Phase I Environmental Site Assessment (ESA) for this project was conducted on 3 May 2011. The Phase I ESA identified 49 Recognized Environmental Conditions (RECs) in three areas of the proposed project right of way. The study identified 16 RECs in the area of the proposed Reach A, 22 RECs within the area of the proposed Reach B, and 11 RECs within the area of the proposed Reach C. In each of these reaches, several RECs consisted of groups of oil and gas wells. In reaches B and C, groups of gas pipelines were identified.

In Reach A, the Phase I ESA identified a Small Quantity Generator within the Federal Resource Conservation and Recovery Act (RCRA-SQG), numerous above-ground storage tanks (ASTs) and pipelines connecting to the tanks, 26 steel drums, some apparently abandoned, another group of six empty 55-gallon steel drums, some nuisance dumping including household appliances, 30 former and present oil and gas wells within Reach A, and 36 former and present oil and gas wells within 500 feet of Reach A. All of the RECs identified could be easily avoided or removed. None of the identified RECs in Reach A would be likely to alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large.

In Reach B, the Phase I ESA identified 31 above-ground storage tanks (ASTs), numerous discarded 5-gallon drums, one marked and buried petroleum pipeline, some nuisance dumping, two ERNS facilities (ERNS, Emergency Response Notification System, is a database of oil and hazardous substances spill reports), 17 former and present oil and gas wells within Reach B, 19 former and present oil and gas wells within 500 feet of Reach B, 19 gas pipelines, and one old dump. All of the identified RECs could be easily avoided or removed. None of the identified

RECs in Reach B would be likely to alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large.

In Reach C, the Phase I ESA identified 11 above-ground storage tanks (ASTs), one discarded 55-gallon plastic drum, one petroleum pipeline, 14 former and present oil and gas wells within Reach C, 19 former and present oil and gas wells within 500 feet of Reach C, and 15 gas pipelines. All of the identified RECs could be easily avoided or removed. None of the identified RECs in Reach C would be likely to alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large.

In summary, existing or potential RECs were identified in and near the project, but there is a very low probability that HTRW would alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large. No further study of HTRW is recommended for this project, and the work may proceed as scheduled. If the project location or methods change, the HTRW probability may need to be re-investigated.

5.2.13 SOCIOECONOMICS

Population and Housing

Both Lafourche and Terrebonne parishes have experienced a steady increase in population over the last three decades. Table 5-10 shows recent historical population figures for Lafourche and Terrebonne parishes as well as communities in the study area. Between 2000 and 2010, Lafourche Parish increased from a population of 89,974 to 96,318, a gain of 6,344 residents. During the same period, Terrebonne Parish's population increased from 104,503 to 111,860, an increase of 7,357. Not all communities within Lafourche and Terrebonne parishes experienced population growth, however. For example, Table 5-10 shows that among the communities within the project boundaries, Lockport, Raceland, Chauvin, Dulac, and Montegut all experienced population decline during the 2000-2010 period. In contrast, communities within the two parishes that experienced population growth during this period include Thibodaux, Gray, Houma, and Schriever.

Housing trends in Lafourche and Terrebonne parishes have paralleled the parishes' growth in population. For example, between 2000 and 2010, Lafourche Parish added an additional 3,537 housing units (from 35,045 to 38,582) and Terrebonne Parish added an additional 3,959 housing units (from 39,928 to 43,887).

Within the project boundaries, the total population in 2010 was 113,642. This includes the entire parish of Terrebonne and the portion of Lafourche Parish to the south and west of Bayou Lafourche. The total housing units included within the project boundaries in 2010 was 44,566.

Table 5-10. Population Trends

Location	1980	1990	2000	2005-2009*	2010
Lafourche Parish	82,483	85,860	89,974	92,852	96,318
Lockport	2,424	2,503	2,630	2,634	2,578
Raceland	6,302	5,564	10,367	11,085	10,193
Thibodaux	15,810	14,125	14,320	14,276	14,566
Terrebonne Parish	94,393	96,982	104,503	108,277	111,860
Chauvin	3,338	3,375	3,075	2,925	2,912
Dulac	-	3,273	2,556	1,159	1,463
Gray	-	4,260	4,972	5,358	5,584
Houma	32,602	30,495	32,124	32,572	33,727
Montegut	-	1,784	1,710	1,474	1,540
Schriever	-	4,958	5,905	6,211	6,853

* The 2005-2009 American Community Survey population figures are based on data collected over the 2005-2009 period and represent an estimate of the average population over the 5-year period.
Sources: U.S. Census Bureau, 1980, 1990, 2000, 2010 Decennial Censuses;
2005-2009 American Community Survey.

Employment, Businesses, and Industrial Activity

In addition to commercial fishing and markets supporting recreational fishing and hunting, economic activities in the project area include the harvest of sugar cane, oil and gas production, the transport of these resources, the construction and maintenance of oil rigs, and commercial activities supporting the local communities. Table 5-11 summarizes selected business, industrial, and agricultural data for Lafourche and Terrebonne parishes as reported by the Bureau of the Census. In both parishes, education, health, and social services industries employ the largest number of workers, followed by retail trade.

The city of Houma, located in Terrebonne Parish, originally developed as a market center for fish, wildlife, and agricultural production; however, with the discovery of oil and gas and the technology to extract them from surrounding wetlands and waterbottoms, employment and income opportunities increased. By far the most important crop harvested has been sugar cane.

During the 1980s, however, the reduced demand for oil and gas and the availability at more competitive prices in other countries caused severe unemployment and out-migration in the area. During the 1990s the increased demand of oil, water resources, fish and wildlife for both commercial and recreational purposes, and national economic trends, appear to have contributed to the gradual economic recovery of the area. The economic and population gains witnessed in the city of Houma over the last two decades are largely the result of the sustained boom in the oil and gas industry.

Table 5-11. Number of Workers Employed in Selected Industries, 2000 and 2005-2009*

Industry	Lafourche Parish		Terrebonne Parish	
	2000	2005-2009	2000	2005-2009
Education, health, and social services	7,841	8,342	7,988	8,853
Retail trade	5,193	4,875	5,362	6,284
Construction	2,970	3,904	3,248	3,909
Manufacturing	4,928	4,500	3,437	4,466
Agriculture, forestry, fishing and hunting, and mining	3,066	3,730	4,916	5,623

* The 2005-2009 American Community Survey industry figures are based on data collected over the 2005-2009 period and represent an estimate of the average industry characteristics over the 5-year period.
Sources: U.S. Census Bureau, 2000 Decennial Census; 2005-2009 American Community Survey.

Table 5-12 summarizes employment and income data for Lafourche and Terrebonne parishes as reported by the Bureau of the Census. As shown in the table, employment and income conditions in the two parishes improved between 2000 and the 2005-2009 period. Both parishes witnessed a decline in unemployment and an increase in both per capita personal income and median household income. For example, the estimated average median household income for Lafourche Parish in the 2005-2009 period was $46,196, up from $34,910 in the year 2000. Median household income in Terrebonne Parish increased from $35,235 to $47,338 during this same period.

Table 5-12. Employment and Income Characteristics, 2000 and 2005-2009*

Employment/Income	Lafourche Parish		Terrebonne Parish	
	2000	2005-2009	2000	2005-2009
Number of people employed	37,207	41,095	41,406	47,610
Unemployment rate	5.9%	3.9%	5.9%	5.3%
Per capita personal income	$15,809	$ 22,578	$16,051	$ 22,513
Median household income	$34,910	$ 46,196	$35,235	$ 47,338

* The 2005-2009 American Community Survey employment and income figures are based on data collected over the 2005-2009 period and represent an estimate of the average employment and income characteristics over the 5-year period.
Sources: U.S. Census Bureau, 2000 Decennial Census; 2005-2009 American Community Survey.

Public Facilities and Services

Public and quasi-public facilities and services in the project area include medical facilities, schools, police stations/sheriff's offices, and fire stations. According to 2010 ESRI data, there are two hospitals, two nursing homes, and three health care service facilities within the portion of Lafourche Parish included in the study area, and 15 medical care facilities (e.g., hospitals, medical centers, home health care services, and nursing homes) in Terrebonne Parish. Lafourche Parish has seven police stations/sheriff's offices and a juvenile justice facility located within the study area and Terrebonne Parish has four police stations/sheriff's offices, according to 2010 ESRI data. There are 23 fire stations located within the study area—five in Lafourche Parish and 18 in Terrebonne Parish. Public and quasi-public facilities and services in the project area also include an extensive network of pumps and levees for flood protection, and a series of navigation canals, including the GIWW, the HNC and Bayou Lafourche.

Transportation

Several major highways are located within the study area. For example, in Terrebonne Parish, Highways 315, 661, 57, 56, and 55 run in a north-south direction through the project boundaries while Highways 24, 90, 182, 309, 311, 316, 3040, 659, 660, and 58 run in an east-west direction. In Lafourche Parish, Highway 24 runs in an east-west direction through the project boundaries. In addition, numerous smaller highways and local streets are located throughout the project boundaries.

A series of navigation canals, including the HNC and the GIWW, are also located within the study area as well as the Port of Terrebonne. The HNC is Houma's twenty-six mile direct waterway route to the Gulf of Mexico from the Intracoastal Waterway. The GIWW is a navigable inland waterway which passes through the heart of Houma-Terrebonne in an east-west direction. The Port of Terrebonne, located in Houma roughly 26 miles north of the Gulf of Mexico at the convergence of the HNC and GIWW, is classified as a medium draft Port and has 400 acres of leasable, waterfront acres. The port is connected (via the HNC and GIWW) to ports and docks along the U.S. gulf coast and other markets.

The Houma-Terrebonne Airport and Industrial Park is also located within the study area. The airport provides easy access to the Gulf of Mexico and to the Central and South American markets.

Community and Regional Growth

Desirable community and regional growth with respect to the proposed hurricane protection project is considered growth that responds to the needs of the local communities and region, and is consistent with National Economic Development (NED) guidelines. The construction of the Mississippi River Bridge at Luling and the Interstate Highway 310 (I-310) has expanded the potential for community and regional development between the New Orleans MSA and the Houma MSA.

According to U.S. Census data, between 2000 and the 2005-2009 period, the following trends were observed in Lafourche Parish: population increased from 89,974 to 92,852, per capita personal income increased from $15,809 to $22,578, and employment increased from 37,207 to 41,095. During the same period, population in Terrebonne Parish increased from 104,503 to 108,277, per capita personal income increased from $16,051 to $22,513, and employment increased from 41,406 to 47,610.

Tax Revenues and Property Values

If hurricanes significantly impact businesses, industries, farms, and property values, and impact local employment and income, the tax base created by these activities could be impacted as well. Reduction in the flood risk from the surges associated with tropical events is the primary objective of projects similar to those proposed, and can have a commensurate positive impact on property values. Conversely, the lack of hurricane protection in areas most sensitive to storm damage could limit the growth of property values. In 2009, the Corps of Engineers identified a total of 52,041 residential and nonresidential structures within the project study area: 45,778 residential structures and 6,263 nonresidential/commercial structures.

According to the U.S. Census Bureau, the average median value of owner-occupied homes in Lafourche Parish between 2005-2009 was estimated to be $107,300 (compared with the state average of $121,300). The average median value of owner-occupied homes in Terrebonne Parish during this same period was estimated to be $112,800.

Community Cohesion

Community cohesion is the unifying force of a group due to one or more characteristics that provide commonality. These characteristics may include such commonality as race, education, income, ethnicity, religion, language, and mutual economic and social benefits. Community cohesion is the force that keeps group members together long enough to establish meaningful interactions, common institutions, and agreed upon ways of behavior. It is a dynamic process, changing as the physical and human environment changes. The changes brought about by water resource developments can impact community cohesion in different ways. For example, changing a right-of-way may divide a community; it may cause the dislocations of a significant number of residents; or it may require the relocation of an important local institution, such as a church or community center. On the other hand, a water resource development such as construction of a hurricane levee can represent an important public works project heavily supported by the local community.

The presence of social institutions such as libraries, places of worship, and schools provide residents an opportunity for civic participation and engagement which increases community cohesion. The study area is comprised of settled communities with stable complements of places of worship, schools, and community interaction. According to 2010 ESRI data, the portion of Lafourche Parish included in the study area has one library, seven places of worship, and 16 schools. The 2010 ESRI data also show that there are six libraries, 34 places of worship, and 45 schools located within the study area in Terrebonne Parish.

Environmental Justice

Environmental Justice (EJ) is institutionally significant because of Executive Order 12898 of 1994 (E.O. 12898) and the Department of Defense's Strategy on Environmental Justice of 1995, which direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2000 are those whose income are $22,050 for a family of four and are identified using the Census Bureau's statistical poverty threshold. The Census Bureau defines a "poverty area" as a census tract with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. This resource is technically significant because the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the proposed actions. This resource is publicly significant because of public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions.

A potential disproportionate impact may occur when the percent minority in the study area exceeds 50 percent and/or percent low-income exceeds 20 percent of the population. In addition, a disproportionate impact may occur when the percent minority and/or percent low-income are meaningfully greater than those in the reference community. For purposes of this analysis, all census tracts within the project footprint are defined as the EJ study area. Lafourche Parish and Terrebonne Parish are considered as reference communities of comparison.

The methodology, consistent with E.O. 12898, to accomplish this EJ analysis includes identifying low-income and minority populations within the project area using up-to-date economic statistics, aerial photographs, U.S. Census Bureau 2005-2009 American Community Survey (ACS) estimates, as well as conducting community outreach activities such as public meetings. The newly released ACS estimates provide the latest socioeconomic community characteristic data released by the U.S. Census Bureau and are based on data collected between January 2005 and December 2009.

The Morganza to the Gulf project area is located in south-central coastal Louisiana and encompasses portions of Lafourche and Terrebonne parishes. Table 5-13 shows the percent minority and percent low-income for all census tracts within the project area. Census Tracts 7 and 13 exceed the 50 percent minority threshold. In addition, both census tracts exceed the 20 percent low-income threshold. Census Tract 7 is located within the city limits of Houma near the Houma Terrebonne Airport. While included in the project area, Census Tract 7 is not located near project boundaries and therefore is not likely to be affected by construction activities. Census Tract 13 is located south of Houma and extends southwardly to the Gulf of Mexico. The census tract is sparsely populated south of Dulac where construction activities are expected to occur. All residents, irrespective of minority status or income level, are expected to be similarly impacted by construction activities. In addition to Census Tracts 7 and 13, Census Tracts 6, 11,

and 12.02 also exceed the 20 percent low-income threshold. Census Tract 6 is located within the city limits of Houma, north of Census Tract 7 and is similarly located away from construction activities. Census Tract 11 includes the census-designated place of Montegut and the sparsely populated areas extending southwardly toward the Gulf of Mexico. Construction activities are expected to occur within Census Tract 11, however, all residents, irrespective of income level, are expected to be similarly impacted by construction activities. Census Tract 12.02 is located to the west of Census Tract 11 and includes the census-designated place of Chauvin. Construction activities are expected to occur within Census Tract 12.02, however, all residents, irrespective of income level, are expected to be similarly impacted by construction activities.

Table 5-13. Minority and Low-income Characteristics

Census Tracts by Parish	Percent Minority	Percent Low-income
Lafourche		
Census Tract 216.02	14.0%	7.3%
Total Parish Average	19.9%	15.4%
Terrebonne		
Census Tract 1	27.5%	15.4%
Census Tract 3	22.0%	19.5%
Census Tract 5	25.7%	17.3%
Census Tract 6	37.3%	27.4%
Census Tract 7	59.7%	39.4%
Census Tract 8	26.7%	11.6%
Census Tract 9	41.4%	13.4%
Census Tract 11	22.7%	21.0%
Census Tract 12.01	8.0%	6.1%
Census Tract 12.02	7.8%	28.7%
Census Tract 13	53.4%	33.1%
Census Tract 14	38.4%	15.5%
Census Tract 17	17.3%	1.5%
Total Parish Average	28.6%	16.9%

Source: U.S. Census Bureau, 2005-2009 American Community Survey.

Additionally, approximately 230 members of the state recognized Biloxi-Chitimacha tribe are located in Isle de Jean Charles, which is outside of the southern boundary of the project alignment in Terrebonne Parish. While this raises a potential EJ issue, with respect to alternative protection alignments, neither of the alternatives to the No Action Alternative authorized for study under the PAC represents a separate alignment that includes this community. Providing hurricane risk reduction for these residents has been determined in previous Corps of Engineers analyses to be cost prohibitive.

5.2.14 CULTURAL RESOURCES

Cultural Resources surveys have been conducted in lower Terrebonne Parish since 1926. The most recent and synthesized of these are Weinstein and Kelley (1992) and Brown *et al*. (2000). Very recently, new studies have begun with updated project alternatives and alignments, and a probability model and cultural resources investigation is underway at this time (Moreno *et al*. 2011). Numerous earthen mounds and shell middens have been located and recorded. Prehistoric settlement in lower Terrebonne Parish dates as early as the Marksville Period (A.D. 1 – 400) and includes mound sites, hamlets, and shell middens. Societies in the project area subsisted on marsh resources such as clams, fish, mammals, birds, and reptiles, while shellfish were also utilized as a food source and to provide a base on which to settle. By the Coles Creek Period (A.D. 700 - 1200), settlements in the region may have been organized as major mound sites surrounded by satellite villages and seasonal camps. Villages were concentrated on stable levee surfaces or at the confluence of distributaries. Both year-round occupation and seasonal movement have been suggested for the inhabitants of the area. During Plaquemine times (A.D. 1200 – 1700), the settlement pattern suggests a complex social hierarchy, with large ceremonial sites composed of multiple mounds surrounding a central plaza, and smaller villages and hamlets scattered throughout the area. Non-mound sites that have been located are on elevated natural levees and seem to have focused on the cultivation of crops. The majority of known prehistoric sites located in the vicinity of the project area date to this late prehistoric period, and suggest a significant occupation of the region.

The early historic period in southeast Louisiana is marked by increasing settlement and European dealings with Native American tribes. Early French writings describe a native cultural landscape of small tribal groups and shifting alliances. The most is known about the Chitimacha Indians, a federally recognized Native American tribe that claims ties to much of south Louisiana as its ancestral homeland, and is currently clustered around Charenton in St. Mary Parish. In addition to the many ancient Chitimacha village locations recorded in State Records, the Chitimacha Indians remember, respect, and maintain numerous traditional cultural properties within south Louisiana.

Although it is generally accepted that the Houma Indians were located near the confluence of the Red and Mississippi rivers during the early historic period, some historic accounts suggest that they were virtually wiped out by fighting and other causes of death during the years at the end of the 17th century and the beginning of the 18th century. By the middle of the 20th century, the Houma had grown and were settled in Terrebonne and Lafourche parishes. Descendents of these people are organized today as the United Houma Nation, but are not federally recognized as a Native American tribe.

After early European exploration of the area, the French began colonization efforts in the early 18th century. Settlement was sparse until the Acadians began arriving circa 1765, and their influence persisted throughout the Antebellum Era. The Civil War left the project vicinity relatively unaffected, but after the Civil War, all of south Louisiana had a hard task of recovery following the abolition of slave labor and war-related destruction of levees and other aspects of infrastructure. New plantations and new economies began to develop. By the late 19th century, small communities were emerging along the bayous. Population fluctuations took place as

blacks, the predominant population before the Civil War, migrated outward to seek more opportunities.

The growth of the sugar industry was a boom to the area, and in 1917 the first commercial gas well struck near Montegut. Numerous oil and gas fields dot the region today. The shrimping industry grew as innovations occurred that allowed greater catches to be more easily retrieved and distributed. Canal systems and the GIWW have made a large portion of the project vicinity navigable by water, which has aided in the distribution of all resources. Today, the project vicinity is a vital economic area with diverse productive strategies and diverse peoples.

The most recent studies have identified a few known cultural resources that overlap portions of the currently proposed alignment and will receive further investigations to avoid or mitigate impacts to cultural resources. Within Reach A, 16TR193 is a prehistoric scatter that could not be relocated as of 1986. Within Reach E, site 16TR71 is a prehistoric scatter overlain by historic material. Site 16TR261 overlaps a portion of Reach H, and most likely has been destroyed. Site 16LF108 is the remnant of a prehistoric scatter located within Reach K that was reported as probably destroyed by modern land use. Other portions of the currently proposed alignment have been assessed by factors of soil and past landform, as high or low probability to contain cultural resources.

5.2.15 RECREATION

The recreational resources study area includes southern portions of Lafourche and Terrebonne parishes (south of Houma). It is included in Region 3 of the Louisiana State Comprehensive Outdoor Recreation Plan (SCORP). Major bodies of water located in the study area include Lake Boudreaux, Lake Felicity, Bayou Terrebonne, Bayou Pointe aux Chenes, Bayou du Large, and many others including numerous oil field canals. The Pointe aux Chenes Wildlife Management Area (WMA) and Mandalay National Wildlife Refuge (NWR) are located within the study area. The Lower Atchafalaya Basin and the Wisner Wildlife Management areas are also located in the vicinity. Most of the study area is comprised of brackish and saline marshes with some forested wetlands and uplands. Recreational facilities include camps, marinas, boat launch ramps, and small neighborhood parks.

The study area is comprised of a series of narrow ridges along bayous that extend toward the Gulf of Mexico through coastal swamps and marshes. The more significant ridges along navigable bayous have historically supported the development of small communities and provide key points of access to the vast coastal wetland resources of the study area. These extensive wetland resources, comprised of swamp and marsh habitat, have traditionally supported substantial consumptive and non-consumptive recreational uses. Primary consumptive recreational uses have included both freshwater- and saltwater-based activities. Freshwater-based consumptive uses include freshwater fishing, crawfishing, hunting for waterfowl, as well as hunting for deer or small game along natural ridges and in wooded swamp lands. Primary saltwater-based activities have included saltwater fishing, recreational shrimping, and crabbing. Non-consumptive activities have included recreational boating, water skiing, birdwatching, hiking, and camping.

Like much of coastal southeast Louisiana, much of the study area has experienced substantial coastal erosion, loss of wetlands, and increasing salinity levels. These conditions are due to numerous factors, such as extensive oil and gas exploration via a maze of canals and pipelines, subsidence, and coastal storm surges. Although the study area has traditionally provided excellent saltwater fishing, in recent years, because of the increased salinity levels, anglers have been able to catch saltwater species much farther inland than in the past. As fresh and intermediate marshes, cypress trees, and SAV in the area have disappeared, waterfowl habitat has become less abundant, and, consequently, duck hunting opportunities have decreased.

Unlike most of coastal Louisiana, the far western portion of the study area, due to the influence of the Atchafalaya River, has been relatively stable or experiencing some limited accretion of deltaic lands. Salinity levels are relatively stable in this area, and freshwater fishing opportunities in the area are excellent. The floating marshes traditionally have provided quality habitat for waterfowl and waterfowl hunting.

The study area includes the 4,212-acre Mandalay NWR and the 35,000-acre Pointe aux Chenes WMA (Figure 3-1). The Mandalay NWR is located approximately six miles southwest of Houma, Louisiana, which is approximately 55 miles southwest of New Orleans. The refuge was established in 1996 in Terrebonne Parish, Louisiana, is accessible only by boat and has a beautiful freshwater marsh with ponds, levees and man-made canals. The Mandalay NWR alone is visited annually more than two-thousand times. The most prominent recreational activities within the study area are consumptive uses: fishing and waterfowl hunting. Limited consumptive recreation uses include recreational crabbing, shrimping, and crawfishing. Natural ridges are also utilized for deer and small game hunting. Non-consumptive recreational activities attract far fewer participants and include birdwatching, hiking, wildlife observation, boating and photography.

Pointe aux Chenes WMA, situated in the center of the study area, is located in Terrebonne and Lafourche parishes approximately 15 miles southeast of Houma (Figure 3-1). The WMA, which is owned by LDWF, includes about 35,000 acres.

The topography of the area is mostly marsh, varying from nearly fresh to brackish interspersed with numerous ponds, bayous, and canals. Game species hunted are waterfowl, deer, rabbit, squirrels, rail, gallinule, and snipe. Inland saltwater fish species, crabs, and shrimp are available in the more brackish water. Fishing success is excellent due to the proximity of the Timbalier and Terrebonne Bay watersheds. Freshwater fisheries may be caught in the more northern portions of the management area. Recreational fishing in the study area occurs almost entirely in boats. The physical characteristics of the shoreline in the study area, especially the presence of wetlands, limit access to shore fishing. Non-consumptive forms of recreation are boating, nature study, camping (a tent-camp ground is available along Highway 665, north of the Headquarters area), and picnicking.

Access to the interior is typically limited to boat travel due to the lack of roads. Boat launches into the interior of the area are available on Island Road and on Highway 665, south of the Headquarters area. The terrain is mostly marsh; the only timber stands are located on the Point Farm Unit of the area or areas adjacent to natural bayous and older oil and gas canals.

Management practices employed to increase productivity of the marshes for furbearers, waterfowl, alligators, and fish are mainly directed towards water control through the use of variable crested weirs and levees.

Recreational resources are publicly significant because of the high value that the public places on fishing, boating, and hunting as measured by the large number of fishing and hunting licenses and the large number of recreational boat registrations obtained in area parishes. This is particularly important, as many of the predominant recreational activities in the study area are only accessible by boat.
Forty-two boat launches are located in the study area and provide access to recreational opportunities. The Pointe aux Chenes marina, an unnamed launch near the WMA offices, and a boat launch on Iles de Jean Charles Road are located within LDWF's Pointe aux Chenes WMA.

Factors contributing to the high proportion of boating activity for fishing include the high quality of the recreational fishery, especially an abundance of red fish and trout. Pleasure boating occurs to a lesser degree than boat fishing. One indicator of the amount of recreational fishing that occurs in the study area is the number of recreational boats registered in the two parishes. In 2010 within the parishes of Lafourche and Terrebonne, there were about 26,000 registered boats, 50,000 resident fishing licenses, and nearly 18,000 resident hunting licenses issued by the State of Louisiana.

Tables 5-14 through 5-16 below show the number of fishing licenses, hunting licenses, and boat registrations, respectively, within the study area. The fishing and hunting license and boat registration data are provided by the Louisiana Department of Wildlife and Fisheries (http://www.wlf.louisiana.gov/education/economics/).

Table 5-14. Fishing Licenses Sold in the Vicinity of Project Area - Fiscal Year 2010

Parish	Resident-Freshwater	Resident - Saltwater	Non-Resident Freshwater	Non-Resident Saltwater
Terrebonne	27,025	26,872	3,698	5,709
Lafourche	23,066	22,424	3,270	5,653

Table 5-15. Boat Registrations in the Vicinity of the Project Area - Fiscal Year 2009

Parish	Boat Registrations
Terrebonne	14,672
Lafourche	11,733

Table 5-16. Hunting Licenses Sold in the Vicinity of the Project Area - Fiscal Year 2010

Parish	Resident	Non-Resident	Resident Duck Only	Non-Resident Duck Only
Terrebonne	9,095	537	2,585	58
Lafourche	8,638	118	2,006	26

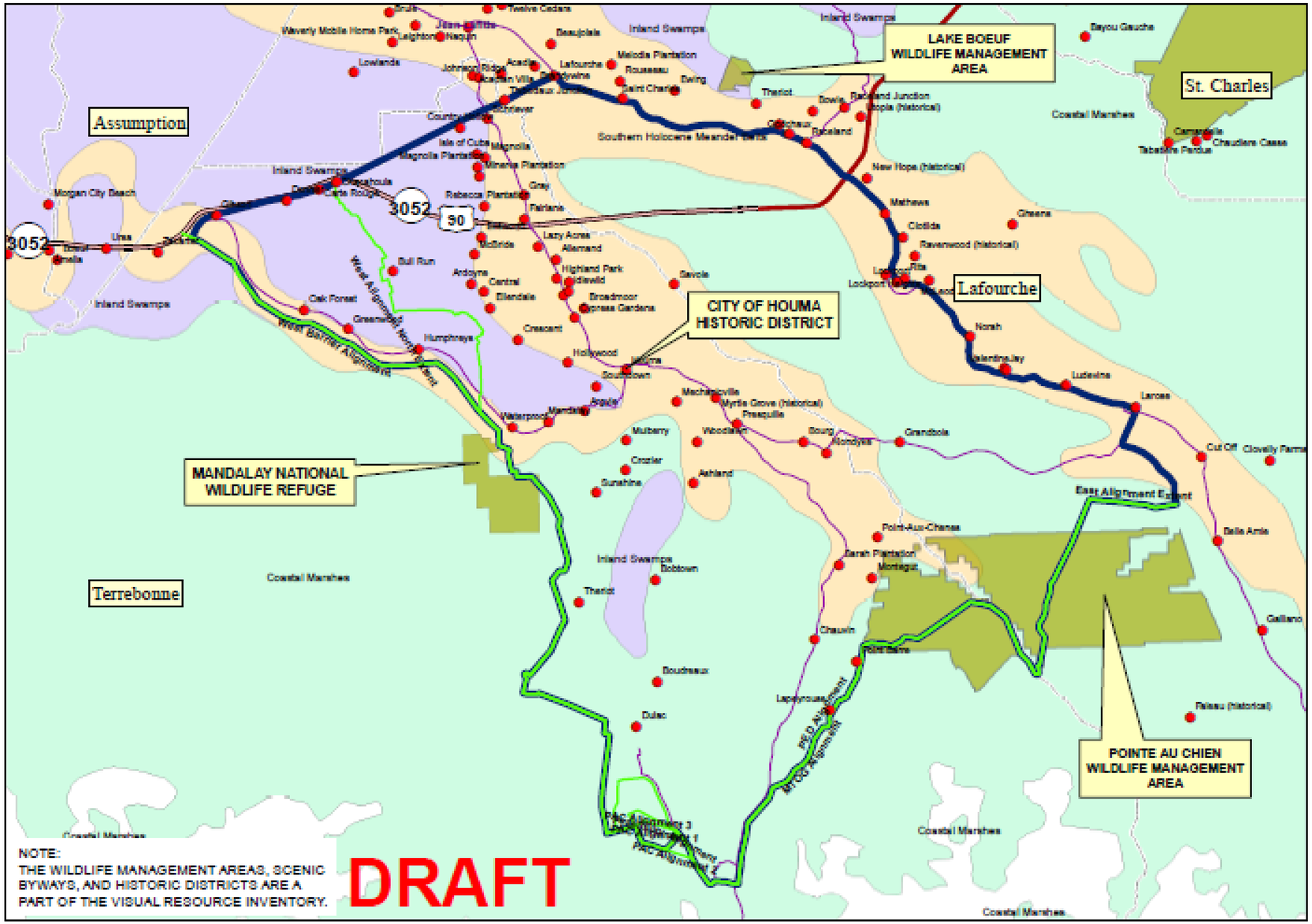
5.2.16 AESTHETICS

Ecoregions

Ecoregion information has been identified for the study area. The information was adapted from Daigle *et al*. 2006. The study area's natural landscape visual characteristics are derived from its Mississippi Alluvial Plain setting; this ecoregion extends from southern Illinois, at the confluence of the Ohio River with the Mississippi River, south to the Gulf of Mexico (Figure 5-8). The Mississippi River watershed drains all or parts of thirty-one states, two Canadian provinces, and approximately 1,243,000 square miles before the river finally reaches the Gulf. The Mississippi Alluvial Plain is mostly a broad, flat alluvial plain with river terraces, swales, and levees providing the main elements of relief. Winters are mild and summers are hot, with temperatures and precipitation increasing from north to south. Bottomland deciduous forest covered the region before much of it was cleared for cultivation. The ecoregion contained one of the largest continuous wetland systems in North America. The widespread loss of forest and wetland habitat, however, has impacted wildlife and reduced bird populations, although it is still a major bird migration corridor. Today, constructed levees restrict the river from overflowing, opening large areas for extensive agricultural use. Almost the entire region is in cropland. In Louisiana, cotton, corn, soybeans, pasture, and rice are major crops in the northern and central parts and sugar cane, soybeans, and pasture are dominant in the southern part. Between the levees that parallel the Mississippi River is a corridor known as the "batture lands." The batture lands are hydrologically connected to the Mississippi River, are flood-prone, and contain remnant habitat for "big river" species (e.g., pallid sturgeon) as well as river-front plant communities. The sub-ecoregions Southern Holocene Meander Belts, Inland Swamps and the Deltaic Coastal Marshes and Barrier Islands further define the study area's landscape visual characteristics.

The Southern Holocene Meander Belts ecoregion stretches from just north of Natchez, Mississippi south to New Orleans, Louisiana. The ecoregion is a flat to nearly flat floodplain containing the meander belts of the present and past courses of the Mississippi River. This ecoregion has a long growing season, warmer annual temperatures and more precipitation than its northern Mississippi Alluvial Plain counterparts. The ecoregion contains minor species such as live oak, laurel oak, and Spanish moss that are generally not found in the more northerly regions. The bottomland forests have been cleared and the region has been extensively modified for agriculture, flood control, and navigation. The levee system is extensive throughout the region. Soybeans, sugar cane, cotton, corn, and pasture are the major crops, with crawfish aquaculture common.

Figure 5-8. MORGANZA TO THE GULF
ECO-REGIONS IN SOUTHERN LOUISIANA



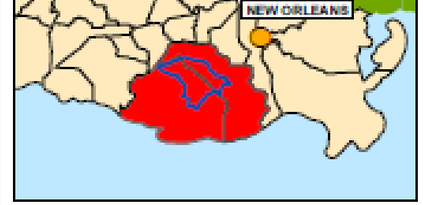
LEGEND

- Communities
- MTOG Alignments
- MTOG-Boundary
- Wetlands Cultural Byway
- Louisiana Highways
- US Highways
- Interstate Highways
- USFWS National Refuges
- Louisiana Parishes

Eco-Regions

- Coastal Marshes
- Inland Swamps
- Southern Holocene Meander Belts

LOCATION MAP - MISSISSIPPI ALLUVIAL PLAIN



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N W E S

December, 2011

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The Inland Swamps ecoregion marks a transition, ranging from the fresh waters of the Southern Backswamps at the northern extent of the intratidal basins to the fresh, brackish, and saline waters of the Deltaic Coastal Marshes and Barrier Islands ecoregion. It includes a large portion of the Atchafalaya Basin. Swamp forest communities are dominated by bald cypress and water tupelo. In areas where freshwater flooding is more prolonged, the vegetative community is dominated by grasses, sedges, and rushes.

This region contains one of the largest bottomland hardwood forest swamps in North America. The levees in place on either side of the Mississippi River have diverted much of the river flow from its natural tendency to flow into the Atchafalaya Basin. Large concrete structures prevent diversion into the Atchafalaya River, and flow from the Red River is also controlled.

Brackish and saline marshes dominate the Deltaic Coastal Marshes and Barrier Islands ecoregion. The region supports vegetation tolerant of brackish or saline water including salt-marsh cordgrass, marshhay cordgrass, black needlerush, and coastal saltgrass. Black mangrove occurs in a few areas, and some live oak is found on Grand Isle and along old natural levees. The wetlands and marshes act as a buffer to help moderate flooding and tidal inundation during storm events. Lack of sediment input, delta erosion, land subsidence, and rising sea levels threaten the region.

Landscape Similarity Zones

Seven landscape similarity zones have been identified for the study area (Figure 5-9). The zones are described in the paragraphs below.

Urban 1: This zone encompassing the city of Houma is within the Southern Holocene Meander Belts ecoregion. The area is characterized by the water resources that are the visual core of the area including Bayous Terrebonne and Black and the Intracoastal Waterway. This zone includes spaces that are prominent and contain landmarks or places of assembly that have national and regional importance including the Houma Historic District located in its downtown area. Development patterns are typical of tract-type subdivisions along with older residential areas adjacent to the urban center and multi-family complexes. The area contains commercial facilities including restaurants and retail establishments and community facilities such as neighborhood parks, schools and athletic fields. The density of development limits vegetation in some areas, and typical views are limited in the downtown areas to the nearby streetscape due to multi-story commercial, residential, and municipal buildings. Visual access to adjacent areas is wider along the roads and waterways and the less densely developed areas as one transitions out of the downtown area. The Wetlands Cultural Scenic Byway provides viewsheds along LA 182 and LA 56.

Residential: This zone primarily is within the Deltaic Coastal Marshes and Barrier Islands ecoregion. The area's terrain is flat and follows the meandering bayous. The residential area is characterized by the development that was driven by its proximity to the Gulf of Mexico's fisheries. Low-density rural development, typically limited to road frontage lots, is prevalent. Small scale commercial seafood related industry is prevalent as one travels LA 57 to Dulac and

the Wetlands Cultural Scenic Byway's LA 56 to Cocodrie. The zone includes small retail facilities including restaurants and food stores and community facilities such as neighborhood parks, schools, and athletic fields. Visual access to the area is wider along roads and waterways and the less densely developed areas.

Industrial: This zone primarily is within the Southern Holocene Meander Belts ecoregion and adjacent to Morgan City's urban area. Although residences and commercial facilities can be located within this zone, maritime industrial uses, including resources for petroleum and natural gas exploration, predominate. There is little canopy cover, but views are typically diverted to the industrial development that lines LA 182 and Bayou Cocodrie. Terrain is typically flat. Regional access to the area is from U.S. Route 90.

Agricultural: This zone is within the Southern Holocene Meander Belts ecoregion. This area is marked primarily by flat, mostly open land associated with various bayous sometimes with vegetation along the edges or between fields helping to define the space. Isolated small citrus orchards are found within these areas. Associated low-density, rural development along road frontages and at the various crossroads is included in this zone. The zone includes small retail facilities including restaurants and food stores and community facilities such as neighborhood parks, schools, and athletic fields. Panoramic views are possible but may be limited by the interspersed pockets of forest vegetation. The Wetlands Cultural Scenic Byway provides viewsheds along LA 182 from Houma to Gibson and along LA 56 south of Houma.

Nonforested Wetlands: This zone is within the Deltaic Coastal Marshes and Barrier Islands ecoregion. The terrain is mostly marsh interspersed with numerous lakes, ponds, bayous, and canals. Man made features include petroleum and natural gas wells, and the Gulf-Intracoastal Waterway. Public recreation access areas include Mandalay NWR and Pointe aux Chenes WMA. Physical access to most of the area is limited to boat travel that allows for panoramic viewsheds of the area. The Wetlands Cultural Scenic Byway provides viewsheds along its southern spurs from Houma to Cocodrie along LA 56 and then to Dulac on LA 57.

Forested Wetlands: This zone is within the Inland Swamps ecoregion. The terrain is mostly bottomland hardwood and Bald Cypress communities. Water resources include Lake Palourde in the area north of Morgan City and numerous canals in the area south of Houma. Man made features include petroleum and natural gas wells and the HNC. Lake End Park provides visual access to Lake Palourde. LA 315 and LA 57 provide viewsheds to the area south of Houma as one travels to Theriot and Dulac. Physical access to most of the area is limited to boat travel. Viewsheds may be limited by the interspersed pockets of forest vegetation.

Visual Resource Inventory

The following visual resources scenic character has been recognized by national or state designations. There may be additional visual resources not identified including public parks and recreation areas. Specific project details used for the resource's environmental impact analysis may identify other visual resources.

Houma Historic District: The Houma Historic District consists of the city's central business district and two related residential areas including 118 buildings. The Houma Historic District Terrebonne Parish Courthouse Square, surrounded by mature live oak trees, is the historic district center. Most of the commercial buildings are located along Main Street, which parallels Bayou Terrebonne. In its central portions, Main Street has a two story scale consisting mainly of typical early-twentieth century commercial buildings with commercial space downstairs and residential space above. Historic residences of the district are primarily shotgun houses, bungalows, or cottages (see Figure 5-9).

Mandalay NWR: Mandalay NWR is located approximately 6 miles southwest of Houma, Louisiana. Access to the interior is limited to boat travel. The 4,416 acre refuge is a stopping point for migratory birds. Recreation use includes wildlife observation and photography. The refuge also provides opportunities for environmental education and interpretation.

Pointe aux Chenes WMA: Pointe aux Chenes WMA is approximately 15 miles southeast of Houma. This area includes about 35,000 acres. Access to the interior is limited to boat travel. The only timber stands are located on the Point Farm Unit of the area, or areas adjacent to natural bayous and older oil and gas canals. Recreation use includes nature study, camping, and picnicking.

Wetlands Cultural Scenic Byway: The Wetlands Cultural Scenic Byway is 204.1 miles in length and has two interconnected loops and three spurs; the spurs are primarily contained within the study area. The eastern spur extends along LA 182 between Houma and Gibson allowing access to Houma's Downtown National Historical District and Mandalay National Wildlife Refuge. Two southern spurs descend from Houma to Cocodrie along LA 56 with a side route on LA 57 to Dulac. These route segments are shown in Figure 5-9.

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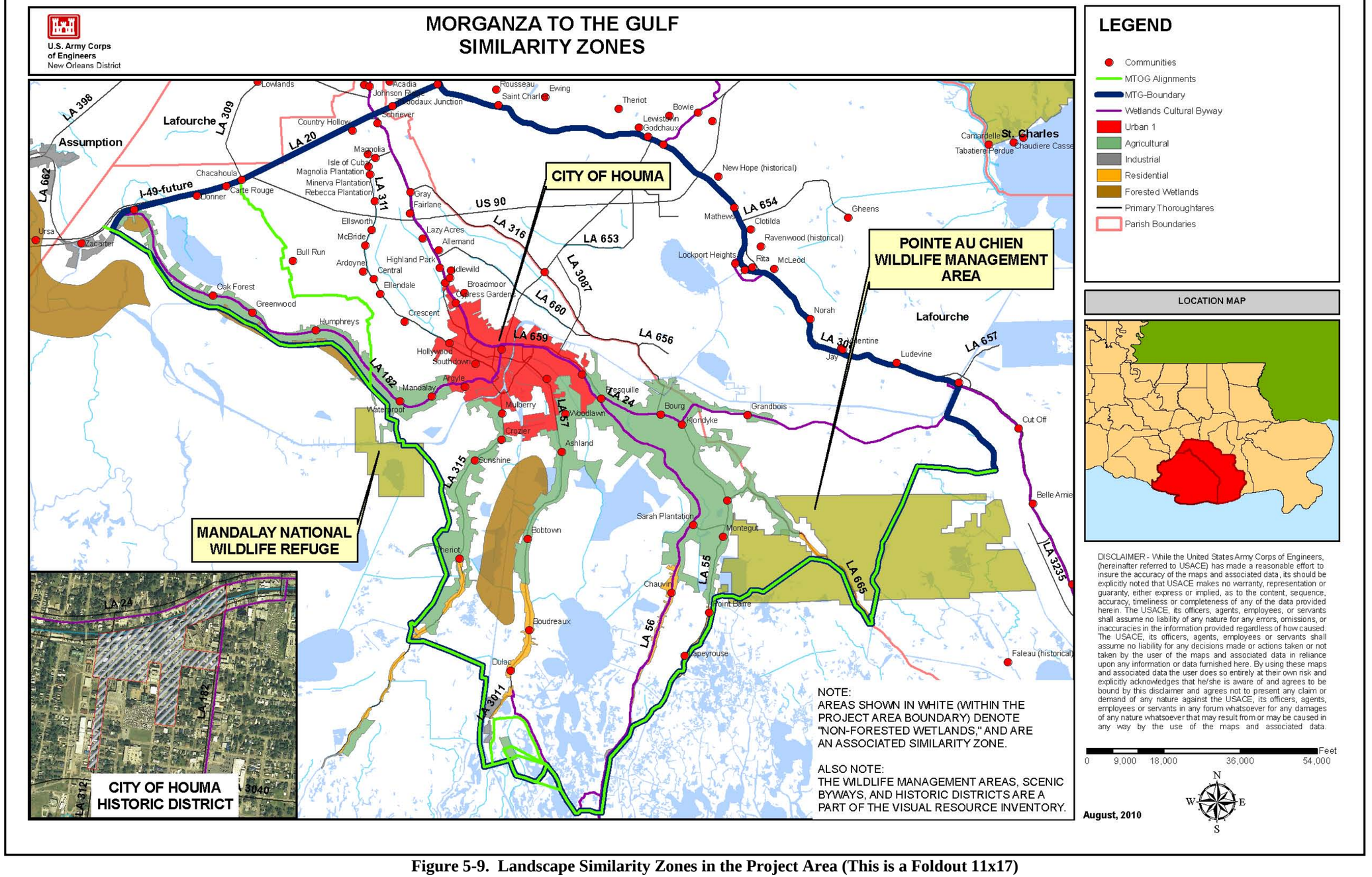

Figure 5-9. Landscape Similarity Zones in the Project Area (This is a Foldout 11x17)

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6. ENVIRONMENTAL CONSEQUENCES

6.1 Introduction

This section describes the direct, indirect, and cumulative effects of each alternative on the significant resources in the project area. Impacts are compared to the No Action Alternative, also known as the "future-without project condition".

Direct impacts are those effects that are caused by the proposed action and occur at the same time and place (Section 1508.8(a) of 40 CFR Parts 1500-1508). For example, the placement of earthen materials to create acres of marsh habitat would be a direct impact. Indirect impacts are those effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (Section 1508.8(b) of 40 CFR Parts 1500-1508). For example, shoreline protection features reduce the long-term rate of erosion to interior wetlands.

Cumulative impacts are the effects on the environment that result from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from actions that individually are minor, but collectively result in significant actions taking place over time (Section 1508.7 40 CFR Parts 1500-1508). For example, the incremental impacts of emergent wetland creation at several localized areas could significantly modify an entire basin's habitat diversity.

Although this RPEIS is programmatic in nature, the following features of the action alternatives have sufficiently detailed designs to be fully assessed in this RPEIS, and would not require additional NEPA documentation. These features, termed "Constructible Features", include levee reaches F1, F2, G1; the HNC Lock Complex; and the Bayou Grand Caillou Floodgate (Figure 4-10). The remaining components of the project are termed "Programmatic Features." Section 4 provides more details about these project features. Where the project affects constructible features differently from programmatic features, descriptions of effects on constructible features are broken out separately. Otherwise, if no differences are evident, the effects of both programmatic and constructible features are combined. Programmatic features will require additional NEPA investigations before construction occur.

Three features of the 1% AEP Alternative were added after it was chosen as the TSP, including the Lockport to Larose Ridge Reach and the Larose Section C-North Variant Reach. Because these features were a late addition to the TSP, their design, cost estimates, and environmental impacts analyses are not to the same level of detail as the features in the Morganza Barrier Reach and Reaches A through L. Despite the addition of the Lockport to Larose Ridge and Larose Section C-North Variant reaches to the 1% AEP Alternative, it remains the TSP; even with the added costs of these additional reaches, the 1% AEP Alternative's net benefits exceed those of the 3% AEP and No Action alternatives.

The period of impact analysis begins when project construction is completed and generally extends 50 years for USACE projects. Year 2035 is when the proposed project is expected to

provide the stated level of risk reduction. Therefore, the 50-year period of analysis for comparison of alternatives is from 2035 to 2085.

The USACE has determined that the TSP is consistent, to the maximum extent practicable, with the State of Louisiana's Coastal Resources Program.

A summary of environmental consequences is displayed in Table 4-4. A description of each alternative and the plan formulation process is provided in Section 4.0 *Alternatives*.

Several LCA projects authorized by WRDA 2007 are located within the Morganza study area, including but not limited to: (1) Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock (2) Modification of Davis Pond Diversion and (3) Land Bridge between Caillou Lake and Gulf of Mexico. By letters dated August 20, 2012 and October 16, 2012, CPRAB has notified the Corps that it desires to suspend study and design on these projects. The decision of CPRAB to suspend these projects results in some degree of uncertainty regarding implementation of these projects as part of the authorized Federal LCA.

Several CWPPRA projects have been built or may be built in the area. The CWPPRA program plans projects to have a 20 year project life. The present authorization will end in 2019 and there is uncertainty with respect to if the program will be reauthorized and funded. For more information on the program go to http://lacoast.gov.

6.2 Coastal Vegetation and Wetlands

6.2.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

An overview of future-without-project vegetated wetlands in the study area is summarized below. Much of the information is derived from the 2000 FWCA Report.

Under the No Action scenario, fresh marshes near the Atchafalaya River and Bayou Penchant would likely expand in the future from increasing amounts of fresh water, nutrients, and sediments as the Atchafalaya River Delta matures (Figure 3-1). In the northeastern portion of the study area, seasonal freshwater inflow via the GIWW is expected to increase. Tidal action in this portion of the study area may increase gradually as the buffering effect of marshes to the south is lost. Consequently, use of this area by estuarine-dependent fishes and shellfish tolerant of freshwater conditions will likely increase.

Throughout most of the rest of the study area, substantial losses of vegetated wetlands are expected. Salinity regimes would likely move northward, converting fresh and intermediate marshes into brackish marshes. High subsidence rates and erosion associated with predominant southeasterly winds and periodic tropical storms may convert most of the marshes between Bayou Terrebonne and Bayou Pointe au Chien to open water within 20 to 40 years.

Wetland loss has been most severe in the central portion of the Penchant Subbasin near Jug Lake (Figure 3-1). Under the No Action scenario, losses in this area are expected to continue due to

subsidence and insufficient sediment accretion. Brackish and saline marshes are expected to become dominated by large lakes and bays with little, if any, submerged aquatic vegetation (SAV).

The overall habitat value and acreage of remaining wetlands would decline with the No Action Alternative. WVA analyses predicted that much of the vegetated wetland acreage in the study area would be lost of over the 50-year period of analysis. Several of the sub areas could lose all emergent wetlands before the end of the 50-year period of analysis.

Vegetated wetlands in the study area may be improved under the No Action Alternative through LCA, CWPPRA, and other Federal, state, and local restoration programs. For example, the LCA project, *Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock* would redistribute existing freshwater to prevent, reduce, and/or reverse future wetland loss and sustain productive fish and wildlife habitat in Terrebonne Parish (USACE 2010).

6.2.2 1% AEP ALTERNATIVE

To determine the impacts of the project, an interagency Habitat Evaluation Team (HET) was formed to use Wetland Value Assessment (WVA) methodology to assess the quality of wetlands of the area and make a determination of the effects of various aspects of the project on future conditions. A description of the WVA methodology, analysis, and assumptions made by the HET may be found in Appendix F, *Wetland Value Assessment.* Mitigation requirements to compensate for wetland impacts determined through WVA methodology are provided in Section 6.19.

Direct Impacts

Table 6-1 provides wetland acreages lost from the direct impacts of the 1% AEP Alternative on wetland types based on low, intermediate, and high RSLR scenarios. Affected wetland types include bottomland hardwood forest; swamp; fresh, intermediate, brackish, and salt marshes; and shallow open water. See the Clean Water Act Section 404(b)(1) evaluation in Appendix C.

Table 6-1. Direct Effects (Acres) of the 1% AEP Alternative on Wetlands

Feature	Low RSLR Scenario			Intermediate RSLR Scenario			High RSLR Scenario		
	Tidal Wetland	Force Drain Wetland	Total Wetland	Tidal Wetland	Force Drain Wetland	Total Wetland	Tidal Wetland	Force Drain Wetland	Total Wetland
Constructible Features	645	26	671	644	26	670	643	26	669
Programmatic Features (Total alignment – Constructible features)	3,413	31	3,444	3,412	31	3,443	3,405	31	3,436
Total Impact	4,058	57	2,996	4,056	57	2,993	4,048	57	4,105

Source: Appendix F, *Wetland Value Assessment*.

Programmatic Features: As shown in Table 6-1, the construction of levees and other structures associated with the programmatic aspects of the 1% AEP would result in the loss of approximately 3,443 acres of wetlands through their conversion to uplands and open water under the intermediate SLR scenario. It should be noted that the amount of impacts from programmatic features could decrease as the plans are refined. The levee and borrow footprints might be expected to decline rather than increase during detailed planning. The HET used an estimate of levee and borrow pit widths to determine direct impacts. It is likely that many of the marsh borrow pit areas would not be usable; thus, material will have to be hauled from upland sites. Finally, some of the borrow pit material from the top layer would not be suitable for levee construction and could be used for marsh restoration. Quantification of these impact decreases was not possible, so the worst-case scenario is presented here. Future NEPA documents will assess the environmental effects of detailed plans and refinements.

Because of the susceptibility of disturbed areas to the establishment of invasive plants (Fox & Fox 1986, Rejmanek & Richardson 1996, Wiley 2007), levee construction and other habitat modifications may be conducive to the introduction of such invasive plant species as the Chinese tallow tree, giant salvinia, and water hyacinth. It is anticipated that an aggressive maintenance program by the local sponsor would control the introduction of such invasives to levees and other project features.

Constructible Features: The constructible components of the 1% AEP Alternative would result in the loss of brackish (414.12 acres), intermediate marshes (230.11 acres), and non tidal marsh (26.39 acres) with their conversion to uplands and open water. Table 6-1 summarizes the acres affected by the project's constructible features.

Indirect Impacts

It was determined by the HET after viewing hydraulic and hydrodynamic models that minor indirect impacts to wetlands could take place due to change in fishery access. A system wide hydrodynamic model and structure-specific models verified that water control features would have no significant impact on salinities that would indirectly impact project-area wetlands. Mitigation requirements are presented in Section 6.19.

Cumulative Impacts

When combined with LCA, CWPPRA, and other Federal, state, and local restoration efforts, the net effects would be beneficial to wetland resources of the study area.

6.2.3 3% AEP ALTERNATIVE

Direct Impacts

Programmatic Features: The types of impacts associated with the programmatic features of the 3% AEP Alternative would be similar to those of the 1% AEP Alternative. However, because the footprint of the levee system would be smaller, the amount of wetlands converted to uplands would be somewhat lower. Table 6-2 presents the direct wetland impacts resulting from the 3%

AEP Alternative. Although mitigation estimates are provided in Section 6.19, further WVA analysis would be performed when refined plans and specifications are completed and additional NEPA documentation is accomplished.

Constructible Features: The constructible components of the 1% AEP Alternative would result in the loss of brackish (327.25 acres), intermediate marshes (194.23 acres), and non tidal marsh (26.39 acres) with their conversion to uplands and open water. Table 6-2 presents the acres and AAHUs of direct wetland impacts resulting from the 3% AEP Alternative. Mitigation requirements are presented in Section 6.19.

Table 6-2. Direct Effects (Acres) of the 3% AEP Alternative on Wetlands.

Feature	Low SLR Scenario			Intermediate SLR Scenario			High SLR Scenario		
	Tidal Wetland	Force Drain Wetland	Total Wetland	Tidal Wetland	Force Drain Wetland	Total Wetland	Tidal Wetland	Force Drain Wetland	Total Wetland
Constructible Features	522	14	536	521	14	535	520	14	534
Programmatic Features	2,662	17	2,679	2,661	17	2,678	2,653	17	2,670
Total Impact	3,184	31	3,215	3,182	31	3,213	3,173	31	3,240

Source : Appendix F, *Wetland Value Assessment.*

Indirect Impacts

It was determined by the HET through WVA modeling that no indirect impacts to wetlands would take place.

Cumulative Impacts

Cumulative effects associated with the implementation of the 3% AEP Alternative would be similar to those of the 1% AEP Alternative.

6.3 Prime and Unique Farmland

Preliminary coordination with NRCS was undertaken to assist in identifying the effects of the proposed project on prime and unique farmlands. Continuing coordination will be accomplished, and the results of that coordination included in the Final PEIS.

6.3.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Under the No Action Alternative, hurricane and tropical storm tidal surges would continue to cause damage to prime farmland located throughout Terrebonne and Lafourche parishes. Additionally, due to continuing land loss in the project area, levees protecting prime farmland would become increasingly vulnerable to storm damage.

6.3.2 1% AEP ALTERNATIVE

Construction of the levee, structures, and other features in the proposed right of way for reaches from the Barrier Alignment through Reach L would potentially impact approximately 359 acres of prime farmland (Figure 6-1). Construction of the mitigation areas for these reaches would potentially impact approximately 53 acres of prime farmland. Preliminary drawings of the Lockport to Larose Ridge and Larose Section C-North Variant footprints show that approximately 262 and 51 acres of agricultural land would be impacted, respectively. According to a review of NRCS data, some of the impacted farmland is classified as prime farmland and would be impacted (Figure 6-1). In compliance with the Farmland Policy Protection Act, coordination with the NRCS is on-going.

Remaining prime and unique farmlands would be protected from most storms. Indirect effects could include storm protection thereby promoting additional development that could take place on prime and unique farmlands. This alternative, combined with local levee projects that might convert prime farmlands, would cause adverse cumulative impacts to prime farmlands in the project area.

6.3.3 3% AEP ALTERNATIVE

Construction of the levee, structures, and other features in the proposed right of way would potentially impact approximately 234 acres of prime farmland. Construction of the mitigation areas would potentially impact approximately 32 acres of prime farmland (Figure 6-2). Fewer remaining prime and unique farmlands would be protected from storms than the 1% AEP Alternative. Indirect and cumulative effects associated with the implementation of the 3% AEP Alternative would be similar to those of the 1% AEP Alternative.

Indirect and cumulative effects of this alternative are similar to those of the 1% AEP Alternative.

6.4 Aquatic Resources

6.4.1 BENTHIC RESOURCES

No Action Alternative (Future Without Project Conditions)

Without protection from storm surge and associated erosion and saltwater intrusion, and without renewed inputs of freshwater, sediment, and nutrients, the project area is likely to convert from a predominately estuarine habitat to a predominately marine habitat. The benthic community that supports the estuarine system would be adversely affected. The species richness of the benthic community typically declines as in the transition from ocean waters into fresher areas. Consequently, it is expected that marine benthic community species diversity would increase in the project area as marsh loss continues. Wetland habitat in the study area may be improved under the No Action Alternative through LCA, CWPPRA, and other Federal, state, and local restoration programs.

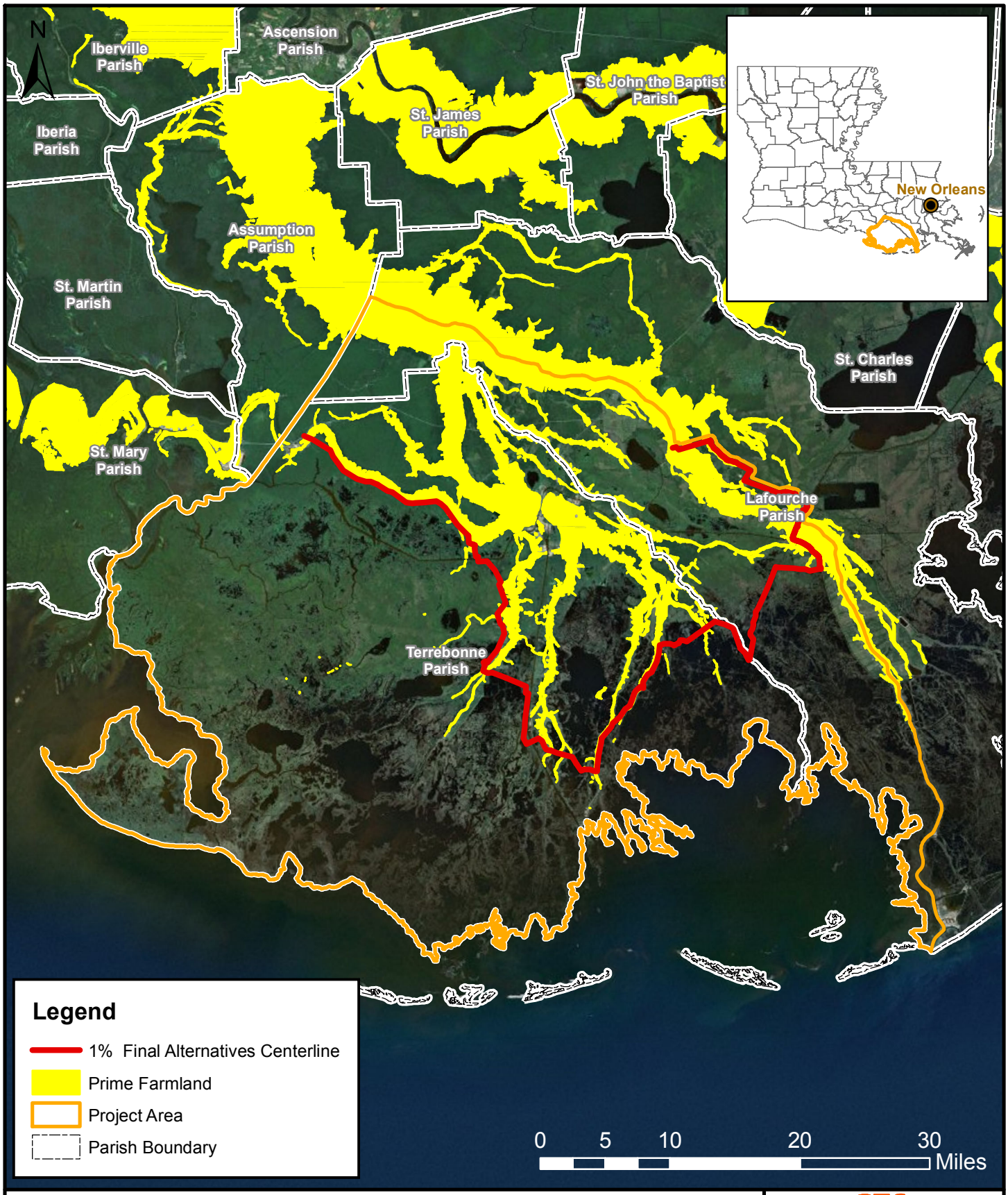


Figure 6-1. 1% AEP Alignment and Prime Farmland

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

ESRI World 2D Imagery

GEC Gulf Engineers & Consultants

Figure: 6-1
Date: June 2012
Scale:1:650,000
Source: ESRI/GEC
Map ID: 273160010-2948

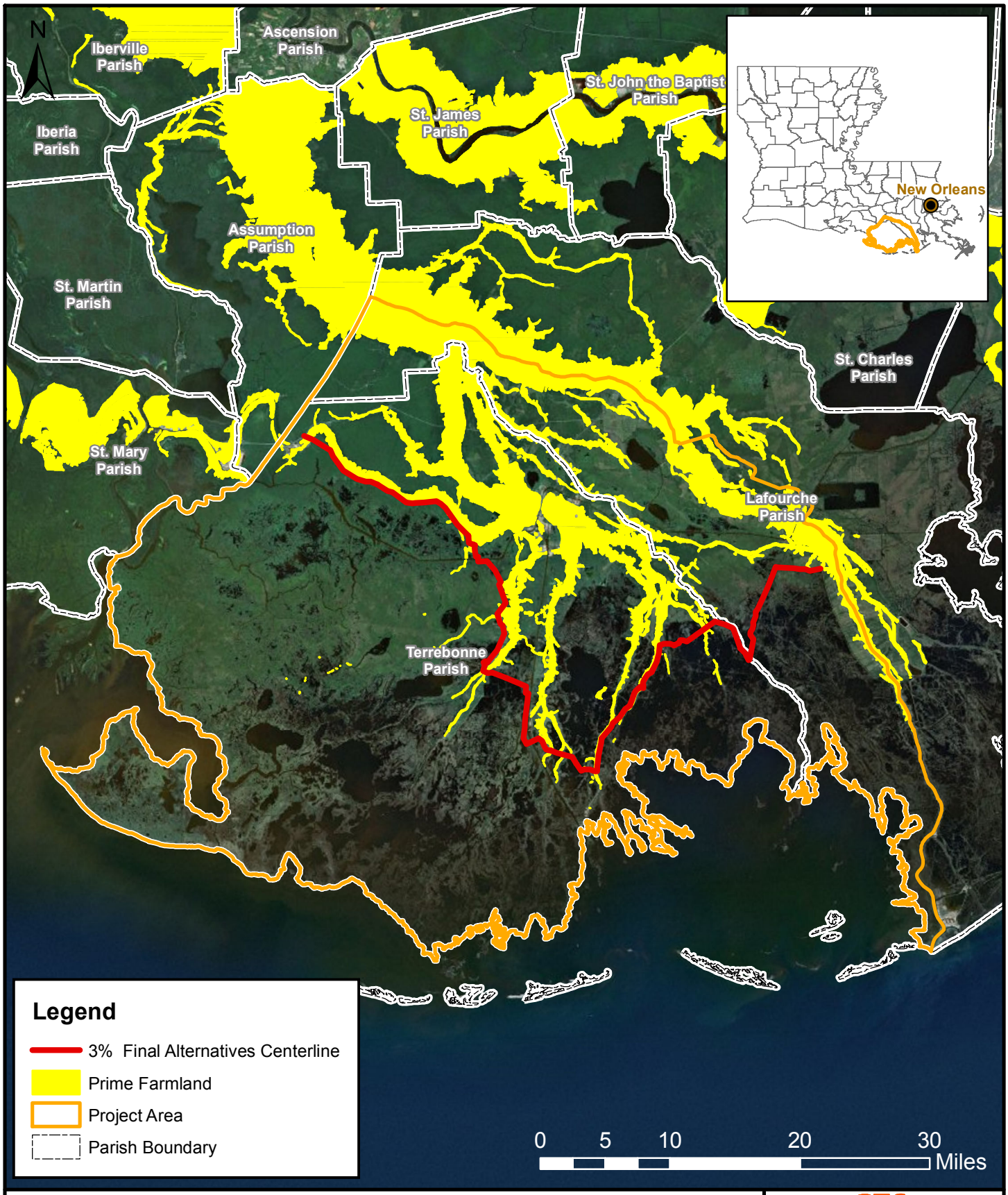


Figure 6-2. 3% AEP Alignment and Prime Farmland

Morganza to the Gulf of Mexico, Louisiana
Revised Programmatic Environmental Impact Statement

ESRI World 2D Imagery

GEC Gulf Engineers & Consultants

Figure: 6-2
Date: June 2012
Scale:1:650,000
Source: ESRI/GEC
Map ID: 273160010-2948

1% AEP Alternative

Direct Impacts: Direct effects on benthic habitat include covering and smothering of benthic organisms in association with levee construction and similar activities in wetlands and aquatic habitats. Borrow material removed from aquatic and wetland habitats would result in a temporary loss of the benthic organisms followed by re-colonization from adjacent areas, however, because of a change in depth and other habitat characteristics, the structure of the benthic community may be altered.

Benthic communities would be covered with earthen materials at mitigation sites. However, this would be a short-term effect, and benthic communities would recover. Shallower depths and the potential for mitigation sites to support aquatic vegetation are likely to change the relative abundance and species composition of benthic communities.

Indirect Impacts: Introduction of freshwater flows from proposed features that change salinity regimes are likely to change benthic abundance, species composition, and species distribution. Maintaining existing habitat characteristics would prevent conversions of benthic communities to those of higher salinity habitats.

Cumulative Impacts: Cumulative impacts would primarily be related to the incremental impact of all past, present, and future actions affecting benthic resources. The incremental effects of the project would enhance aquatic resources when combined with other Federal, state, local, and private restoration efforts. Cumulative impacts would include the shifting of benthic abundance, species composition, and species distribution toward those characteristic of fresher habitats. The project would provide long-term significant benefits to aquatic organisms and the fisheries that depend on them.

3% AEP Alternative

Direct, indirect, and cumulative impacts associated with the 3% AEP would generally be similar to the 1% AEP but would affect a smaller area.

6.4.2 PLANKTON RESOURCES

No Action Alternative (Future without Project Conditions)

The No Action Alternative would result in the persistence of existing conditions including the continued degradation and eventual loss of wetlands. This loss of wetlands would eventually result in a decrease of available nutrients and detritus, which could lead to the conversion of primarily estuarine-dependent plankton species assemblages to more marine and open water plankton species assemblages. Wetland losses in the study area may be ameliorated under the No Action Alternative through Federal, state, and local restoration programs.

1% AEP Alternative

Direct Impacts: During construction of project features, there would be short-term minor adverse impacts to plankton populations due to increases in turbidity, low dissolved oxygen, and introduction of sediments into shallow open water areas. There would be a permanent loss of some shallow water habitat as it is filled and converted to levees and other project features.

Indirect Impacts: Increases in freshwater flows and associated nutrients from proposed features would be expected to change plankton abundance and species composition. Maintaining existing habitat characteristics would prevent conversions of plankton communities to those of higher salinity habitats.

Cumulative Impacts: Cumulative impacts would primarily be related to the incremental impact of all past, present, and future actions affecting plankton resources. The incremental effects of the project would enhance plankton resources when combined with other Federal, state, local, and private restoration efforts. Marsh restoration efforts would result in greater resources for phytoplankton and zooplankton due to export of dissolved organic compounds and detritus. Cumulative impacts would be the shifting of plankton community abundance, species composition, and species distribution toward those characteristic of fresher habitats. The project would provide long-term significant benefits to aquatic organisms and the fisheries that depend on them.

3% AEP Alternative

Direct, indirect, and cumulative impacts of the 3% AEP Alternative would generally be similar to those of the 1% AEP, but would affect a smaller area.

6.5 Fisheries

6.5.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITION)

Impacts to fisheries under the No Action Alternative are expected to be less significant than indirect impacts that could result from the continued loss of coastal marsh and habitat supportive of estuarine and marine fishery species (LCWCRTF and WCRA 1998; USACE 2010). Coastal marshes provide protection and an abundant food source and are critical to the growth and production of species including blue crab, white shrimp, brown shrimp, Gulf menhaden, Atlantic croaker, red drum, spotted seatrout, black drum, sand seatrout, spot, southern flounder, and striped mullet. Future commercial fishery harvests could be adversely impacted by the high rates of marsh loss throughout the study area.

As marshes subside and higher salinity waters expand farther inland, the area of nearshore habitat would increase; this expansion would benefit marine species. However, according to Coast 2050 projections for the study area and vicinity, food available for marine species, particularly estuarine-dependent species, would likely diminish. Therefore, marine species are

expected to remain relatively stable in the future, unless the food availability declines in response to wetland habitat loss (LCWCRTF and WCRA 1998).

Brackish and saline marshes in the Timbalier Subbasin, in the central and eastern portions of the study area (Figure 5-2), are expected to convert to large lakes and bays, likely reducing habitat quality with little, if any, SAV. The conversion of marsh to open water could create temporary new oyster habitat. As surrounding marshes erode, oyster reefs would become increasingly vulnerable to storm damage (USACE 2010).

In the western portion of the study area, the influence of the Atchafalaya River is expected to gradually increase, more detail on which can be found in the engineering appendix to the PAC report. This increasing freshwater influence would shift production of estuarine-dependent fishery resources to species that are more tolerant of fresh water and low salinities, such as white shrimp, blue crab, Gulf menhaden, and red drum. Brown shrimp habitat quantity and quality would likely decrease in these areas. Areas suitable for oyster production would shift toward the southeast.

Restoration efforts in the State through programs such as LCA and CWPPRA have improved fisheries habitat and are likely to continue. Changes in fishing technology, fishing pressure, and fishing regulations may be necessary to maintain sustainable commercial fisheries (USACE 2010).

6.5.2 1% AEP ALTERNATIVE

Direct Impacts

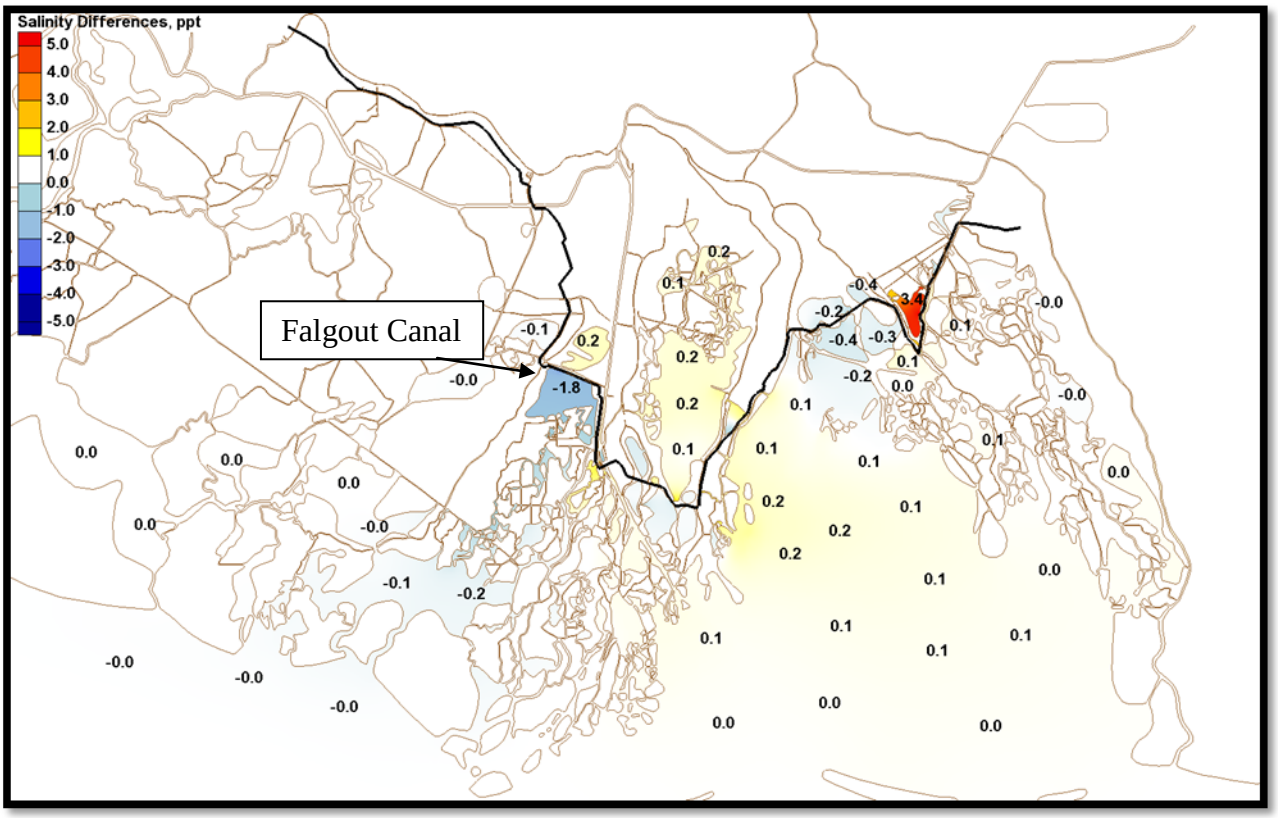
Programmatic Features: Construction of the 1% AEP Alternative, including the levee, structures, and other features in the proposed right of way would directly and permanently convert wetland and open water habitat to uplands and project features. This habitat conversion would be influenced by relative sea level rise and the time when the project feature is constructed. The direct impacts of the 1% AEP alternative on wetland and open water habitats based on low, intermediate, and high relative sea level rise scenarios are summarized in Table 6-1.

Impacts in the construction footprint and construction activities using earthen materials to create wetland mitigation areas along the proposed right of way could include the elimination of fishery habitat and direct mortality or injury of fisheries species due to burial or increased turbidity.

Construction activities using earthen materials to create wetland mitigation areas along the proposed right of way could cause oyster mortality due to burial, turbidity, or sudden salinity changes. Sessile and slow-moving aquatic invertebrates would be disturbed by the dredge or excavation activities or buried by the placed material. Construction activities would temporarily increase turbidity, water temperatures, and biological oxygen demand (BOD), and decrease dissolved oxygen. These temporary conditions would likely displace more mobile fisheries species from the construction area. Non-mobile benthic organisms could be smothered. These

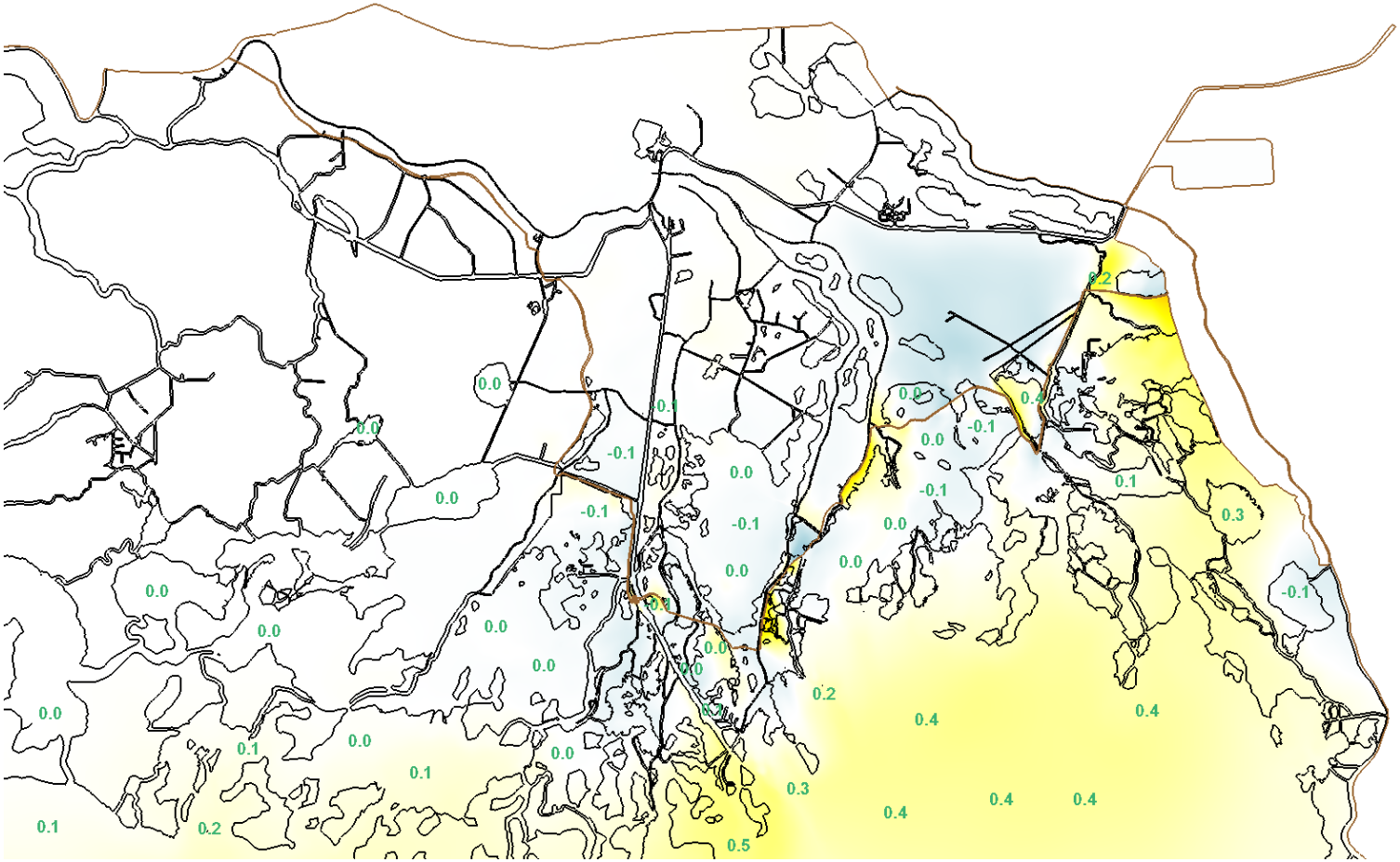
impacts would be minimized, as much as practicable, through implementation of appropriate Best Management Practices.

Direct impacts to fisheries resources would also result from changes in salinity levels and water exchange in the project area. According to modeled salinity values, the 1% AEP Alternative would cause minimal global salinity changes (less than 1 ppt) under normal operating conditions (all environmental and floodgates on navigable waterways open, including the HNC lock complex), compared to the No Action Alternative. Impacts to water exchange inferred from the minimal changes to salinity would likely be minimal as well. The largest changes would occur in the marsh area south of Falgout Canal (Figure 6-3). This area would be newly connected to Falgout Canal through the installation of environmental control structures consisting of two sets of nine box culverts with sluice gates, allowing for new freshwater inflow to this area. The largest benefit would occur during the winter months; minimal freshening would occur during the summer months. Average salinity increases greater than 1.0 ppt would occur in the marshes between Bayou Pointe aux Chenes and Grand Bayou between reaches J-1 and K (red/orange-shaded area shown in Figure 6-3).



Source: McAlpin *et al*. 2012.

Figure 6-3. Average annual salinity differences (ppt) between No Action and Future with Project Condition (structures open)



Source: e-mail McAlpin 11-20-12.

The slight changes in salinities would likely have minor effects on the distribution of fish and shellfish species. Marine species assemblages and the young of species that prefer higher salinities such as brown shrimp and spotted seatrout could shift slightly Gulfward from areas freshened by water control structures. The young of species such as Gulf menhaden, blue crab, white shrimp, and red drum that commonly use low to medium salinity areas and SAV habitats and freshwater species, such as crayfish, freshwater catfish, largemouth bass, and other Centrarchids could slightly benefit in areas where salinities slightly decrease from implementation of the 1% AEP Alternative. Conversely, in areas where salinities slightly increase, the young of species that prefer higher salinities could move slightly inland.

Reductions in salinity due to the project would likely have minor effects on oysters. Expected slight decreases in salinity in the marshes south of Falgout Canal would likely have little effect on oyster leases and seed grounds south of this area (Figure 5-7).

Organism access to marsh and open-water areas would be impeded by some features included in this alternative and would be enhanced by others. Fishery access impacts by feature are summarized in Table 6-3. Features with a potentially beneficial influence on fish access include environmental control structures along Falgout Canal in Reach B. In some areas, the proposed levee would restrict fish access to floodgates on navigable waterways and environmental structures only.

Table 6-3. Levee/Flood Gate Structures and Potential Fishery Access Impacts

Levee/Flood Gate Structures	Existing Fishery Access	Fishery Access with Project Implementation
Barrier Alignment Reach		
Levee	Fishery access is limited to canals and bayous due to existing uplands and development along Bayou Black	Fishery access would be blocked except through culverts and floodgates on navigable waterways.
Environmental control structures (seven sets of six 6'x6' box culverts with sluice gates)	Small bayous and canals currently open for fishery access	Minimal impacts under normal operating conditions (environmental structures open)
Bayou Black Canal Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Shell Canal West Stop Log Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Shell Canal East Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Elliot Jones Canal Stop Log Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Humphreys Canal Stop Log Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach A		
Levee	Fishery access exists but may be limited to trenasses through marsh habitat	Fishery access would be blocked except through culverts and floodgates on navigable waterways.
Environmental Control Structures (one set of box culverts with sluice gates)	Fishery access exists	Minimal impacts under normal operating conditions (environmental structures open)

Levee/Flood Gate Structures	Existing Fishery Access	Fishery Access with Project Implementation
Minors Canal Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
GIWW West of Houma Sector Gate with Sluice Gates	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach B		
Levee	Fishery access is limited to Marmande Canal, Pipeline Canal, and Falgout Canal due to existing uplands along Thibodaux Canal	Fishery access through Pipeline Canal would be blocked but maintained on Marmande Canal and Falgout Canal through floodgates on navigable waterways
Marmande Canal Stop Log Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Falgout Canal Sector Gate with Sluice Gates	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach E		
Levee	Fishery access blocked along Falgout Canal	Fishery access would be improved by placement of culverts in levee
Environmental Control Structure (two sets of box culverts with sluice gates)	Fishery access blocked along Falgout Canal	Beneficial impacts to water flow and fish access under normal operating conditions (environmental structures open)
Bayou Du Large Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach F		
Levee	Small bayous and canals currently open for fishery access to HNC	Fishery access to the HNC would be blocked except through floodgates on navigable waterways
Bayou Grand Caillou Sector Gate with Sluice Gates	Fishery access exists	Minimal impacts under normal operating conditions (structures open)
Houma Navigational Canal Sector Gate, Lock, and Sluice Gates	Fishery access exists	Minimal impacts under normal operating conditions (structures open)
Reach G		
Levee	Fishery access to Four Point Bayou, Deep Bayou, Sweetwater Pond, and other open-water areas exists	Fishery access blocked except through floodgates on navigable waterways and culverts
Environmental Control Structures (three sets of box culverts with sluice gates)	Fishery access exists	Minimal impacts under normal operating conditions (environmental structures open)
Bayou Four Points Stop Log Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach H		
Levee	H-1: Fishery access is blocked along Grassy Bayou H-2, 3: Open fishery access to bayous, marshes, and open-water areas exists	H-1: Fishery access would be improved by placement of culverts in levee H-2, 3: Fishery access blocked except through floodgates on navigable waterways and culverts
Environmental Control Structures (two sets of box culverts with	Fishery access is blocked along Grassy Bayou	Beneficial impacts to water flow and fish access under normal operating conditions

Levee/Flood Gate Structures	Existing Fishery Access	Fishery Access with Project Implementation
sluice gates)		(environmental structures open)
Bayou Petit Caillou Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Placid Canal Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Bush Canal Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach I		
Levee	Fishery access is limited to canals due to existing uplands along Bayou Terrebonne	Minimal impacts to fishery access
Bayou Terrebonne Sector Gate	Fishery access exists	Existing structure would be replaced with new sector gate. Minimal impacts under normal operating conditions (structure open)
Humble Canal Sector Gate	Fishery access exists	Existing structure would be replaced with new sector gate. Minimal impacts under normal operating conditions (structure open)
Reach J		
Levee	Fishery access exists to bayous, marshes, and open-water areas	Fishery access blocked except through floodgates on navigable waterways and culverts
Environmental Control Structures (three sets of box culverts with sluice gates)	Fishery access exists	Minimal impacts under normal operating conditions (environmental structures open)
Bayou Pointe Aux Chenes Sector Gate	Fishery access exists	Minimal impacts under normal operating conditions (structure open)
Reach K		
Levee	Fishery access is limited to canals due to existing uplands along the Cutoff and Grand Bayou canals	Fishery access would be improved by placement of culverts in levee
Environmental Control Structures (two sets of box culverts with sluice gates)	Fishery access exists	Minimal impacts under normal operating conditions (environmental structures open)
Reach L		
Levee	Open fishery access to bayous, marshes, and open-water areas in the immediate area	Fishery access would be closed except through floodgates on navigable waterways and environmental structures
Environmental Control Structure (one set of box culverts with sluice gates)	Fishery access exists	Minimal impacts under normal operating conditions (environmental structures open)
Grand Bayou Sector Gate with Sluice Gates	Fishery access exists	Minimal impacts under normal operating conditions (structures open)
Larose Section C-North Variant		
Levee	Fishery access is limited to canals due to existing uplands	Minimal impacts to fishery access
Larose Floodgate	A floodgate is already in place.	No impacts under normal operating

Levee/Flood Gate Structures	Existing Fishery Access	Fishery Access with Project Implementation
	Fishery access is open when the structure is open.	conditions (structure open)
Lockport to Larose Ridge		
Levee	Some fishery access exists	Fishery access would be closed except through environmental structures
Environmental Control Structures (two sets of box culverts with sluice gates)	Some fishery access exists	Minimal impacts under normal operating conditions (environmental structures open)

Constructible Features: Direct impacts associated with constructible features of the project would be similar in nature to those associated with the programmatic features. However, because the constructible features are located in a much smaller area, the impacts would be greatly reduced. Direct impacts are summarized in Table 6-1.

Indirect

Programmatic Features: Improved marsh habitats and increased SAV could benefit juvenile fishes, shrimp, crabs, and other species by increasing food and cover. Portions of the project area expected to benefit from improved marsh habitat as a result of the 1% AEP Alternative would be expected to better maintain most of its current ability to support GMFMC-managed species (including white and brown shrimp and red drum), as well as other estuarine-dependent species (including spotted seatrout, Gulf menhaden, striped mullet, and blue crab) preyed upon by other GMFMC-managed species (such as mackerels, red drum, snappers, and groupers) and highly migratory species (such as billfish and sharks). Potential increases in SAV could increase the habitat available to escape predation for juveniles of some species. Despite some areas of adverse impacts on wetland habitat, an overall improvement in marsh habitats and increased SAV would benefit fisheries.

Constructible Features: Indirect impacts associated with constructible features of the project would be similar in nature to those associated with the programmatic features.

Cumulative

When combined with LCA, CWPPRA, and other Federal, state, and local restoration efforts, the net benefit associated with the 1% AEP Alternative would have an incremental benefit on fisheries resources. Fish and shellfish populations would benefit from the cumulative habitat benefits of the 1% AEP Alternative and restoration programs in the study area.

6.5.3 3% AEP Alternative

Direct Impacts

Programmatic Features: Direct impacts of the 3% AEP would generally be similar to the 1% AEP Alternative but fewer acres would be affected. Construction of the programmatic

features of the 3% AEP Alternative would directly and permanently convert marsh habitat and open water habitat to uplands and project features. Acreages affected are listed in Table 6-2.

Constructible Features: Direct impacts to fish and shellfish from activities associated with constructible features of the 3% AEP Alternative would be the similar to those of the 1% AEP Alternative. Table 6-2 provides acreages and AAHUs associated with habitat conversion.

Indirect

Programmatic Features: Indirect impacts of the 3% AEP Alternative would generally be similar to those of the 1% AEP Alternative.

Constructible Features: Indirect impacts to fish and shellfish from activities associated with constructible features of the 3% AEP Alternative would be the same as those of the 1% AEP Alternative.

Cumulative

Cumulative impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

6.6 Essential Fish Habitat (EFH)

6.6.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Continued land loss, conversion of habitats, sea level change, and increased storm intensity in the project area are expected to lead to a net decrease in the habitat most supportive of estuarine and marine species. Under the No Action alternative, the conversion of categories of EFH, such as estuarine marsh and SAV, to marine water column and mud, sand, or shell substrates is expected to continue. Over time, emergent marsh would be converted to open water. Decreases in the quality of EFH in the project area would reduce the area's ability to support federally managed species.

Population reductions of directly affected species, such as brown and white shrimp, would indirectly affect species dependent on shrimp for food. As marsh, barrier islands, and other EFH are directly lost, less protection would be available to the remaining EFH. These areas would be more susceptible to storm, wind, and wave erosion. A decrease in species productivity would result as populations are stressed by habitat displacement and reduction.

EFH in the study area may be improved under the No Action Alternative through LCA, CWPPRA, and other Federal, state, and local restoration programs.

6.6.2 1% AEP ALTERNATIVE

Direct Impacts

Programmatic Features: Construction of the 1% AEP Alternative, including the levee, structures, and other features in the proposed right of way would directly and permanently convert wetland and open water habitat to uplands and project features. This habitat conversion would be influenced by relative sea level rise at the time when the project feature is constructed. The direct impacts of the 1% AEP alternative on wetland and open water habitats based on low, intermediate, and high relative sea level rise scenarios are summarized in Table 6-1.

Impacts in the construction footprint and construction activities using earthen materials to create wetland mitigation areas along the proposed right of way could include the elimination of EFH and increased turbidity.

Construction activities using earthen materials to create wetland mitigation areas along the proposed right of way could bury EFH substrates or temporarily change environmental conditions, including turbidity and salinity, in the water column. These impacts would be minimized, as much as practicable, through implementation of appropriate Best Management Practices. The project would increase SAV and adjacent intertidal marsh vegetation (marsh creation areas) in some areas and decrease vegetation in other areas (levee construction areas).

Constructible Features: Direct impacts associated with constructible features of the project would be similar in nature to those associated with the programmatic features. However, because the constructible features are located in a much smaller area, the impacts would be greatly reduced. Direct impacts are summarized in Table 6-1.

Indirect Impacts

Programmatic Features: Indirect effects to EFH from the construction of levee, structures, and other features include loss of habitat function and changes in hydrologic patterns. Aquatic habitats support various life stages of fish species and their prey, including spawning, breeding, feeding, and growth to maturity. The levee, structures, and other features in the proposed right of way could limit or eliminate organism access to some EFH and enhance access in other areas. However, these impacts are expected to be minor. The project would increase SAV and adjacent intertidal marsh vegetation (marsh creation areas) in some areas and decrease vegetation in other areas (levee construction areas). Changes in hydrologic patterns could alter water chemistry composition through suppressed mixing of fresh and saltwater, decreased sediment and nutrient delivery, and degraded water quality through thermal loading. Based on the minimal modeled changes to salinity, the impacts to water exchange are also expected to be minimal.

Constructible Features: Indirect impacts associated with constructible features of the project would be similar in nature to those associated with the programmatic features. However, because the constructible features are located in a much smaller area, the impacts would be greatly reduced.

Cumulative

The incremental effects of the proposed project would contribute to effects associated with other coastal projects, including LCA, CWPPRA, and other Federal, state, and local restoration programs. The overall cumulative effects of these projects would be the maintaining of EFH along a greater portion of the Louisiana coastline, thereby reducing any adverse effects of local disturbances on EFH.

6.6.3 3% AEP Alternative

Direct Impacts

Programmatic Features: Direct impacts of the 3% AEP would generally be similar to the 1% AEP Alternative but fewer acres would be affected. Construction of the programmatic features of the 3% AEP Alternative would directly and permanently convert marsh habitat and open water habitat to uplands and project features. Acreages affected are listed in Table 6-2.

Constructible Features: Direct impacts to EFH from activities associated with constructible features of the 3% AEP Alternative would be the similar to those of the 1% AEP Alternative. Table 6-2 provides acreages and AAHUs associated with habitat conversion.

Indirect

Programmatic Features: Indirect impacts of the 3% AEP Alternative would generally be similar to those of the 1% AEP Alternative.

Constructible Features: Indirect impacts to EFH from activities associated with constructible features of the 3% AEP Alternative would be the same as those of the 1% AEP Alternative.

Cumulative

Cumulative impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

6.7 Wildlife

6.7.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Throughout most of the study area, wildlife abundance is expected to decline. This projection is based primarily on the ongoing conversion of marsh to open water and the gradual subsidence of forested habitat (LCWCRTF and WCRA 1998). However, wildlife habitat is expected to improve in those areas receiving increased fresh water as the Atchafalaya River Delta matures.

The abundance of seabirds, wading birds, shorebirds, raptors, and other birds using marsh and open water habitats is expected to decrease in deteriorating wetland areas. Waterfowl populations, such as puddle ducks, diving ducks, and coots; and migratory species, such as rails

and gallinules, are expected to decline in eastern and central Terrebonne Parish. Furbearer and alligator populations are expected to decrease in deteriorating wetlands of the Terrebonne-Timbalier Bay area and near lakes Mechant and de Cade (Figure 3-1).

The abundance of raptors and other birds using hardwood forests is expected to decrease as a result of expected subsidence, increasing water levels, and decreasing diversity in forested communities. Squirrel, rabbit, and white-tailed deer numbers are expected to decline as well.

The fresh marshes near the Atchafalaya River and Bayou Penchant would likely expand from increasing amounts of fresh water, nutrients, and sediments as the Atchafalaya River Delta matures. Habitat quality for waterfowl and alligators would remain high throughout most of this area. Brown pelican and bald eagle numbers are projected to increase in areas presently occupied (LCWCRTF and WCRA 1998, USACE 2010).

Wildlife habitat in the study area may be improved under the No Action Alternative through LCA, CWPPRA, and other Federal, state, and local restoration programs. For example, the LCA project, *Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multipurpose Operation of Houma Navigation Lock* would redistribute existing freshwater to prevent, reduce, and/or reverse future wetland loss and sustain productive fish and wildlife habitat in Terrebonne Parish (USACE 2010).

6.7.2 1% AEP ALTERNATIVE

Direct Impacts

Programmatic Features: Construction of the 1% AEP Alternative, including the levee, structures, and other features in the proposed right of way would directly and permanently convert wetland and open water habitat to uplands and project features. This habitat conversion would be influenced by relative sea level rise and the time when the project feature is constructed. Table 6-1 summarizes the direct impacts of the 1% AEP alternative on wetland and open water habitats based on low, intermediate, and high relative sea level rise scenarios. Affected wetland habitats include bottomland hardwood forest; swamp; and fresh, intermediate, brackish, and salt marshes. Greater detail may be found in Appendix F, *Wetland Value Assessment.*

Construction activities using earthen materials to create wetland mitigation areas along the proposed right of way would also result in unfavorable conditions for wildlife nesting, foraging, and other activities. However, displacement associated with the creation of the mitigation areas would be temporary; wildlife habitat would be enhanced in these areas once wetland habitat is established in the future. Table 6-1 lists acres of wetland habitat would be created in the mitigation areas.

Wildlife species using the marsh and open water habitat in the proposed right of way could easily avoid disturbances associated with construction activities. Birds would have ample alternative locations available for use. Mammals or reptiles that may inhabit the proposed construction areas would likely react to disturbances by relocating to adjacent marsh or open water habitats.

Once the levee is constructed, it would provide additional upland habitat that may be valuable to some terrestrial wildlife species, such as snakes, lizards, terrapins, and rodents.

In order to minimize any potential impacts to nesting bald eagles that may be found in the project area, project implementation would follow the National Bald Eagle Management Guidelines. The guidelines recommend:

- maintaining a specified distance between the activity and the nest (buffer area),
- maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers), and
- avoiding certain activities during the breeding season.

On-site personnel would be informed of the possible presence of nesting bald eagles within the project boundary, and would identify, avoid, and immediately report any such nests to the proper authorities. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation would be performed to determine whether the project is likely to disturb nesting bald eagles.

Constructible Features: Direct impacts associated with constructible features of the project would be similar in nature to those associated with the programmatic features. However, because the constructible features are located on a much smaller area, the impacts would be greatly reduced. Table 6-1 summarizes the direct impacts.

Indirect

Programmatic Features: Indirect impacts to wildlife resources resulting from the 1% AEP Alternative would include the creation, restoration, and protection of wetland habitat used by wildlife species for nesting, rearing of young, resting, and foraging activities. Despite some areas of adverse impacts on wetland habitat, an overall increase in wetland acreage and quality in the study area would benefit birds, game mammals, furbearers, reptiles, and amphibians. The invasive nutria would also likely benefit.

Constructible Features**:** Indirect impacts associated with constructible features of the project would be similar in nature to those associated with the programmatic features.

Cumulative

When combined with LCA, CWPPRA, and other Federal, state, and local restoration efforts, the net benefit associated with the 1% AEP Alternative would have an incremental benefit on wildlife resources. Populations of migratory avian species, such as neotropical songbirds and waterfowl, could improve as critical migratory habitat is restored, protected, and enhanced. Game animals, furbearers, reptiles, amphibians, and invasive species would also benefit from the cumulative habitat benefits of the 1% AEP Alternative and restoration programs in the study area.

6.7.3 3% AEP ALTERNATIVE

Direct Impacts

Programmatic Features: Direct impacts of the 3% AEP would generally be similar to the 1% AEP Alternative but with fewer acres affected. Construction of the programmatic features of the 3% AEP Alternative would directly and permanently convert marsh habitat and open water habitat to uplands and project features. Acreages affected are listed in Table 6-2.

Constructible Features: Direct impacts to wildlife from activities associated with constructible features of the 3% AEP Alternative would be the similar to those of the 1% AEP Alternative. Table 6-2 provides acreages and AAHUs associated with habitat conversion.

Indirect

Programmatic Features: Indirect impacts of the 3% AEP Alternative would generally be similar to those of the 1% AEP Alternative.

Constructible Features: Indirect impacts to wildlife from activities associated with constructible features of the 3% AEP Alternative would be the same as those of the 1% AEP Alternative.

Cumulative

Cumulative impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

6.8 Threatened and Endangered Species

6.8.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Under the No Action Alternative, the project area is expected to continue to lose estuarine wetland habitats used by fish and wildlife species for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The loss and deterioration of wetland habitat over time may adversely affect listed species that may be found in the project area, including: the piping plover, Gulf sturgeon, and Kemp's ridley sea turtle. Adverse effects to protected species habitat in the study area may be mediated under the No Action Alternative through LCA, CWPPRA, and other Federal, state, and local restoration programs.

6.8.2 1% AEP ALTERNATIVE

A Biological Assessment (Appendix A) prepared by the CEMVN assessed the impacts of the project on the following threatened/endangered species:

- Gulf sturgeon

- Kemp's ridley sea turtle
- Loggerhead sea turtle
- Green sea turtle
- Leatherback sea turtle
- Hawksbill sea turtle
- Piping plover
- Finback whale
- Humpback whale
- Right whale
- Sei whale
- Sperm whale

The BA associated with the 2002 feasibility report concluded, "Neither of the two action alternatives would have adverse impacts upon threatened and endangered species provided work areas do not expand to the south of the study area. . ."

As part of the ESA Section 7 consultation process also associated with the 2002 feasibility report, the NMFS concluded, by letter of March 18, 2002 (Appendix H), ". . .the proposed action is not likely to adversely affect any listed species under NMFS' purview for any of the plan alternatives."

It should be noted that the alternatives examined in the 2002 feasibility report are similar, but not exactly the same, as the two action alternatives in this RPEIS and associated PAC report. Section 7 consultation will be updated prior to the issuance of the Final RPEIS.

Direct

No direct impacts on threatened or endangered species would result from implementation of the 1% AEP Alternative.

Indirect

Implementation of the 1% AEP Alternative would partially offset the loss of coastal habitats thereby benefiting threatened and endangered species dependant on these habitats.

Cumulative

The incremental effects of the proposed project would contribute to beneficial effects associated with other coastal projects, including LCA, CWPPRA, and other Federal, state, and local restoration programs. The overall cumulative effects of these projects would be the maintaining of coastal habitats along a greater portion of the Louisiana coastline, thereby reducing any adverse effects of local disturbances on threatened or endangered species.

6.8.3 3% AEP ALTERNATIVE

Direct, indirect, and cumulative effects would be similar to those described for the 1% AEP Alternative.

6.9 Noise

6.9.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

The No Action Alternative would not increase ambient noise levels in the project area. Therefore, no effects to noise are expected to result due to selection of this alternative.

6.9.2 ACTION ALTERNATIVES

Direct and Indirect

Depending on the distance of people and property to construction areas, heavy machinery associated with construction of the 1% and 3% AEP alternatives could result in nuisance noise. One construction activity, pile driving, may cause temporary noise impacts above 70 dB. Because of the proximity of some of the project features to developed areas, there are a number of residential and commercial properties that could be exposed to adverse impacts from construction noise. Noisy construction activities, such as pile driving, would likely be limited to daylight hours. To protect construction workers from hearing impairment, regulations for Occupational Noise Exposure (29 CFR Part 1910.95) under the Occupational Safety and Health Act of 1970, as amended, would be followed. This section mandates that noise levels emitted from construction equipment be below 90 dB for exposures of eight hours per day or more.

Localized and temporary noise impacts would likely result in wildlife and fishery resources temporarily leaving construction areas during construction activities. The animals could easily relocate to areas of less noise during such times. If it is determined that a key species of concern is present, then the team would follow feasible administrative and/or engineering controls, determine and implement appropriate buffer zones, and implement construction activity windows.

Cumulative

Cumulative impacts to noise levels resulting from implementation of the action alternatives would be related to the potential short-term disruption of fish and wildlife species and similar impacts by other Federal, state, local and private restoration activities, as well as by other human-induced noise disruptions to these organisms. However, during noise-producing activities, these organisms may re-locate to numerous other locations in the project area. Long-term adverse cumulative impacts due to noise levels would not be expected with implementation of the action alternatives.

6.10 Air Quality

6.10.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Selection of the No Action Alternative would not affect air quality.

6.10.2 ACTION ALTERNATIVES

Direct

Direct impacts to ambient air quality would be temporary and localized, resulting primarily from the emissions of construction equipment and from fugitive dust or airborne particulate matter from earthwork and unpaved roads accessed for the project. These effects to air quality would be temporary, and air quality would return to pre-construction conditions shortly after the completion of construction activities. Earthen materials used for wetland mitigation areas would remain wet and would not become airborne. Neither action alternative would cause violations of the NAAQS.

Indirect

Potential indirect impacts would be related to very minor air quality improvements from maintaining/improving vegetated wetlands provided by the project. Marshes can have a positive impact on air quality by removing gaseous and particulate air pollutants. While the generation of methane from bacterial decomposition of organic matter in marshes can contribute to greenhouse gas effects and resultant climate change, the effects from the proposed project are considered negligible.

Cumulative

A minor beneficial cumulative effect to air quality in the project area may occur as a result of the numerous marsh restoration projects in the project area (see Section 3.0 Related Projects). The reestablishment of marshes may have a positive impact on air quality by removing gaseous and particulate air pollutants.

6.11 Hydrology

Material in this section was extracted and summarized from the engineering appendix to the PAC report.

6.11.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

The Morganza to the Gulf hurricane and storm surge reduction project study area has existing local levees that are protecting areas of their communities from tidal influences from the Gulf of Mexico. These levees have been designed and constructed by the communities and are not a part

of the Corps' federal or non-federal levee programs. The local levees vary in elevations, compositions, top width, and side slopes and are scattered throughout the study area.

Stability of the local levee systems is questionable. The results of a stability analysis revealed that the local levee systems probability of failure due to stability or under seepage was relatively low for still water elevations reaching to the top of the levee. However, geotechnical analysis of the existing levee system revealed that the levees were not high enough to have stability problems from a geotechnical standpoint.
Historical data were used to investigate the levee performance during past flooding events when the levees experienced significant loading. In the past four years these levees have experienced significant loading due to two hurricanes that both occurred in 2008. Hurricanes Gustav (August 2008) and Ike (September 2008) produced storm surge elevations that reached the local levee alignment in this study area. Some of the levees failed during Ike.

6.11.2 ACTION ALTERNATIVES

Direct and Indirect Impacts

A system wide model was used to determine the impacts of the project on hydrology and salinity. The system wide model verified that water control features would have no significant impact on salinities in the project area. The validated model (McAlpin 2012) for calendar year 2004 was modified to include three levee system configurations and was used to compare the existing without-project conditions to with-project conditions. All three plan configurations represent operation during non-tropical storm conditions. During tropical storm conditions, all structures would be closed. A comprehensive analysis was performed on the water surface elevations, discharges, and salinity to obtain an approximate indication of the resulting behavior of the system if the proposed changes were to occur. The environmental structures consist of collections of culverts, and the floodgates on navigable waterways consist of different configurations of sluice and sector gates. The three conditions or "plans" are described below.

Plan 1 - All structures in the open position. The purpose of modeling this condition is to determine the scale of hydrodynamic and salinity impacts of the Morganza project under everyday non-storm conditions. Plan 1 possesses minimal global salinity changes with the largest changes occurring in the marsh area south of Falgout Canal. This area is newly connected to Falgout Canal allowing for a new freshwater inflow to this area which in turn reduces the salinity (about 3 ppt) with the largest benefit occurring during the winter months and minimal benefit occurring during the summer months. Globally, the salinity changes tend to be less than 1 ppt.

Plan 2 - All floodgates on navigable waterwasy in the open position with all environmental structures in the closed position. This condition would never occur under the current structure operation plan, but was modeled to isolate the effects of the environmental control structures. The structure operation plan for storm surge is to leave all structures open during everyday non-storm conditions and to close them during high water levels due to storm conditions. Plan 2 has minimal global salinity changes (less than 2 ppt) with some increased salinity possible in local areas newly cutoff by the proposed levee system. Plan 2 has some areas that possess no

connection to the remainder of the domain (due to closed environmental structures) and therefore would remain stagnant with constant water levels and salinity.

Plan 3 - All structures in the open position with the exception of the HNC structure and lock in the closed position. This condition represents operation of the HNC lock complex for salinity control and would occur whenever certain salinity criteria are met at designated monitoring stations. Plan 3 has noticeable salinity changes along the HNC. Salinity increases along the southern portion (~4 ppt) and lowered north of the HNC structure. The Falgout Canal and Lake Boudreaux areas would be freshened as the closed HNC structure forces the freshwater flow to divert along other avenues, thereby freshening the surrounding areas.

Sensitivity simulations demonstrated the importance of the two GIWW structures. Reducing the size of the western structure reduces the freshwater inflow able to enter the Morganza levee system and thereby increases the salinity in the study area. Conversely, reducing the size of the eastern GIWW at Larose structure reduces the amount of freshwater able to leave the system and therefore decreases the salinity in the study area. While navigational concerns require certain structure sizes for these two areas, those simulations exhibit the type of control the new levee system would provide operators. Through proper management of the planned structures a number of different salinity results, both beneficial and not, can be accomplished. The results indicate that if structures are properly operated, the proposed levee system would have a minimal effect on the global salinity values.

Cumulative Impacts

It is anticipated that this project, acting in concert with other storm surge/levee projects in coastal Louisiana, would provide cumulative benefits by enhancing safety and aid in protecting the lives and property of coastal communities.

6.12 Water Quality

6.12.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Without the proposed Morganza to the Gulf project, the study area would continue to be affected by natural and man induced activities that would have beneficial and detrimental impacts to water quality. Some of these activities include: other Federal, state, local, and private restoration efforts such as CWPPRA, USACE ecosystem restoration projects, various NRCS programs (e.g., Coastal Wetlands Restoration Program), and LDNR projects; state and local water quality management programs; national level programs to address hypoxia in the northern Gulf of Mexico; the continued erosion/subsidence of the coast; oil and gas development; industrial, commercial, and residential development; and Federal, State, and municipal navigation and flood damage reduction projects.

An assessment of water quality impacts associated with the flooding of structures during tropical storms and hurricanes is dependent upon flooded structure types, densities, and the materials contained by these structures likely to be released into floodwaters. For flooded areas containing a high density of residential structures, floodwaters would be expected to have characteristics

similar to urban runoff, which in general contains elevated biochemical oxygen demand and suspended and dissolved solids, pathogens, oil and grease, other automotive and household chemicals, pesticides, fertilizers, and heavy metals. For areas dominated by commercial structures/facilities, impacts cannot be generalized as easily, and would be in part dependent upon materials in storage likely to be released.

In 2005, hurricanes Katrina and Rita flooded significant portions of New Orleans, an urban area with a high density of residential and commercial development. During the dewatering of flooded areas in New Orleans, the USGS collected water samples within Lake Pontchartrain and its outlets to assess the quality of Lake Pontchartrain as affected by floodwaters (USGS 2007). Overall, samples were found to contain contaminants commonly present in urban runoff, including elevated nutrients, metals, and organics. With the exceptions of nickel, copper, and silver, no concentrations in water samples collected by the USGS exceeded EPA marine water quality criteria.

In comparison to New Orleans, the Morganza to the Gulf of Mexico Hurricane Protection project study area is less densely populated. Therefore, in general, it is anticipated that under without project conditions, water quality associated with flooded structures would resemble a diluted version of waters sampled in Lake Pontchartrain and its outlets by the USGS following hurricanes Katrina and Rita.

6.12.2 1% AEP ALTERNATIVE

Direct Impacts

As the proposed project entails construction of approximately 98 miles of levee, it would have significant direct impacts for areas within the proposed footprint that currently consist of wetlands and open water. These areas would be converted into upland habitat and would no longer provide for water quality. As coastal wetlands are known to benefit water quality, for example, as a source or sink for constituents, these benefits would no longer exist within the proposed levee footprint. These wetland losses and their effects, however, would be mitigated through wetland restoration actions.

In addition, direct impacts resulting from construction activities are anticipated. The excavation and placement of borrow material for levee fill, as well as dredging and dredged material placement activities associated with flotation access channel construction, would result in localized increases in turbidity and suspended solids, at both the dredging and placement sites. Sediment chemistry for sample sites representative of adjacent borrow indicate the presence of low level contamination in some sediments proposed for use as levee fill. Because the method of excavation and placement (mechanical dredging) minimizes water column impacts from placement activities, and includes dewatering, it is not anticipated that the use of adjacent borrow for levee fill would have significant impacts on the receiving aquatic environment. In addition, because adjacent borrow material is expected to have characteristics similar to sediments present at the proposed placement sites, no significant changes in sediment quality at the placement sites are anticipated.

Construction of structures (i.e., floodgates, tidal exchange structures, and the locks) would result in localized increases in turbidity associated with runoff of construction materials. To minimize construction related impacts, it is anticipated that a Stormwater Pollution Prevention Plan (SWPPP) shall be implemented for construction activities. SWPPPs shall be prepared in accordance with good engineering practices emphasizing storm water Best Management Practices and complying with Best Available Technology Economically Achievable and Best Conventional Pollutant Control Technology. The SWPPP shall identify potential sources of pollution, which may reasonably be expected to affect storm water discharges associated with the construction activity. In addition, the SWPPP shall describe and ensure the implementation of practices which are to be used to reduce pollutants in storm water discharges associated with the construction activity and to assure compliance with the terms and conditions of this permit.

A Clean Water Act Section 404(b)(1) evaluation is included in Appendix C. An application for a state Water Quality Certificate is provided in Appendix I.

Indirect Impacts

The proposed hurricane risk reduction project could have significant indirect impacts on study area water quality, the extent to which is largely unknown. Based on historical water quality information for the study area, it is clear that a majority of the water quality problems within the study area occur on the protected side of the proposed levee alignment. Although proper management of tidal exchange structures can minimize changes in flow and water level between the flood and protected side of the proposed levee alignment, it is a legitimate concern that the proposed alignment will cause significant alteration of hydrology and hydraulics in the study area, such that water exchange between the protected and flood sides of the proposed levee alignment is significantly inhibited, and that localized areas of stagnation behind the levee alignment may occur. If these conditions present themselves, the levee alignment would serve as a barrier between relatively free of contamination Gulf of Mexico waters and impaired waters, further exacerbating water quality conditions on the protected side of the alignment. Moreover, the potential expansion of developed areas as a result of the project could lead to additional point and nonpoint discharges within the hurricane risk reduction system, which would further degrade water quality on the protected side of the proposed alignment. Also, as sea level rise increases water levels in the study area, the frequency with which tidal structures are closed would be expected to increase, causing further stagnation for waters on the protected side of the proposed levee alignment.

The proposed project could also prevent the introduction of mineral sediments from the flood side to the protected side. Mineral sediments are known to stimulate the growth of marsh vegetation, and input of mineral sediments associated with tropical activity can raise ground elevations, helping marshes to keep pace vertically with sea level rise. A lack of sediment input to the protected side of the proposed levee system could lead to the conversion of marsh substrate to predominantly organic substrate, creating a situation similar to that which occurs in areas subject to river water influx without mineral sediment input. Current examples include portions of the Penchant Basin which receives Atchafalaya River water input, and the marsh area beyond Big Mar which receives river water input via the Caernarvon Freshwater Diversion. This lack of sediment input could make marshes more vulnerable to erosional forces, leading to a

further reduction in water quality on the protected side of the proposed levee alignment. A major potential benefit of the project is that it would provide for the protection of marshes on the flood side of the proposed levee alignment, potentially extending the lifespan of these marshes. However, the marshes just outside of the hurricane risk reduction system are expected to be subjected to an increase in wave energy as a result of the proposed project, which could lead to the accelerated loss of unprotected marsh vegetation. This detracts from rationale for utilizing the topmost organic sediment layer of adjacent levee borrow areas for marsh construction on the flood side of the proposed levee alignment. All of these impacts to wetlands habitat would affect water quality.

Further protection of structures within the study area from flooding would reduce water quality impacts as they relate to these structures. However, it should be noted that in some areas outside of the proposed levee alignment, storm surge elevations would be higher for future with project conditions than for future without project conditions, due to amplification of storm surge along the proposed alignment. This could in turn increase the severity of flooding and wave energy on structures outside the proposed alignment, resulting in greater water quality impacts in association with these structures. However, these impacts are generally anticipated to be less than those that would occur in the study area without the proposed alignment, and would again be expected to be a dilute rendition of waters sampled in Lake Pontchartrain and its outlets by the USGS following hurricanes Katrina and Rita.

Cumulative Impacts

The proposed project, combined with other coastal activities (such as those included in the discussion of future without project conditions) would cumulatively impact study area water quality. In addition, it is foreseeable that the proposed project may impact the attainment of state water quality standards in the study area, leading to changes in regulation of point and nonpoint source discharges within the area, particularly on the protected side of the proposed hurricane risk reduction alignment.

6.12.3 3% AEP Alternative

Direct, indirect, and cumulative impacts associated would be similar to those of the 1% AEP Alternative.

6.13 Hazardous, Toxic, and Radioactive Waste (HTRW)

6.13.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

An HTRW investigation has revealed evidence of existing or potential RECs that may have adversely impacted environmental conditions in the project area. The No Action Alternative is not anticipated to affect or contribute to HTRW in the area.

6.13.2 ACTION ALTERNATIVES

Consistent with ER 1165-2-132, an HTRW investigation that included site visits of the project area was conducted, excluding the Lockport to Larose Ridge and the Larose Section C-North Variant reaches. The investigation identified existing or potential RECs in and near the project area, but it is unlikely that HTRW would alter the project design or alignment, adversely affect the project area, personnel working on the project, or the public at large. If the project location or methods change, an additional HTRW investigation may be needed. Should HTRW concerns arise at anytime during the project, CEMVN will coordinate with the appropriate Federal and state authorities to implement an approved response action. The removal of HTRW is a responsibility of the Non-Federal Sponsor, by virtue of the Project Partnership Agreement (PPA).

A Phase 1 Environmental Site Assessment (ESA) was completed in the area of the Lockport to Larose Ridge and the Larose Section C-North Variant reaches in 2010. However, because no site visit was conducted, the assessment did not fully comply with ASTME 1527-05 standards. The assessment found that some of the area is heavily industrialized and includes numerous businesses that are considered Small Quantity Generators and a few Large Quantity Generators. However, none of these sites have any recorded spills or discharges that would affect the proposed project. Numerous small discharges, mainly of diesel fuel, were recorded in the Emergency Response Notification System (ERNS), but none of these were of a magnitude that would affect the project area in a significant way. Based upon this limited investigation, there do not appear to be any Recognized Environmental Conditions (RECs) in or near the two eastern reaches that would affect the project, construction personnel working on the project, the public, or the natural environment within the project area. However, a site visit was not made for this programmatic feature. Therefore, before right of entry for construction is requested a fully compliant Phase I Environmental Site Assessment will need to be completed within six months of the start of construction. This updated phase I and site visit will occur during investigation of the supplemental NEPA document for this reach.

6.14 Socioeconomics

6.14.1 POPULATION AND HOUSING

No Action Alternative (Future Without Project Conditions)

The No Action Alternative would not provide risk reduction to the residents living within the study area. A catastrophic flood would result in severe negative impacts to residents and cause significant damage to residential structures. Additionally, residents in these communities would not be able to benefit from discounted flood insurance premiums offered by the National Flood Insurance Program (NFIP) should the flood insurance rate maps (FIRMs) be updated to reflect increases in flood risk over time due to sea level rise. There would be no direct impact resulting in the displacement of population or housing under this alternative. However, since this alternative fails to provide risk reduction to the residents living within the study area, the actual and perceived risks to population under this alternative would be higher than under the proposed

alternative. Indirect impacts under the No Action Alternative include a higher potential for permanent displacement of population and housing as compared to the proposed alternative as residents relocate to areas with higher levels of flood protection. Cumulative impacts under the No Action Alternative include the potential for a constriction in population/housing growth as compared to the proposed action as residents move to areas with lower flood risks.

1% AEP Alternative

Direct Impacts. Direct impacts of the Barrier Alignment through Reach L reaches to population and housing under this alternative include the displacement of approximately 10 housing units which are located within the project footprint. The Lockport to Larose Ridge Reach is located in an unpopulated area; therefore, direct impacts to population and housing are not expected. Construction of the Larose Section C-North Variant Reach would displace some residents because it is in a developed area. A more detailed examination of impacts would be conducted in a future NEPA document before construction would occur.

Indirect and Cumulative Impacts. Indirect impacts include increased protection from flooding for residents and residential structures in the study area for 1% (and more frequent) ACE events (100-year). Additionally, residents in these communities may benefit from discounted flood insurance premiums offered by the NFIP should the FIRMs be updated to reflect changes in the delineation of Special Flood Hazard Zones showing lower overall flood risk. Positive cumulative impacts to population and housing associated with providing risk reduction for 1% (and more frequent) ACE events may occur. The lower flood risk that would accrue to the study area under the 1% AEP Alternative may enhance the desirability of living within the protected areas which may manifest itself in in-migration to the study area.

Additionally, construction of the project has the potential to raise water levels outside the levees by several feet during storm events. These areas include portions of the communities of Gibson, Bayou Dularge, Dulac, and Cocodrie. For reasons discussed in the PAC report, the USACE has assumed the worst case compensation scenario, a 100% buy-out of all of the structures outside of the project alignment (including 876 residential structures). Should this scenario prove to be the appropriate mitigation method (again, see the PAC report for details), approximately 2,500 people would need to be relocated to areas behind the Federal protection system. Additional residential structures may need to be bought out and additional residents may need to be relocated as a result of construction of the Larose Section C-North Variant Reach.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Direct impacts to population and housing under this alternative include the displacement of approximately 7 housing units which are located within the project footprint. Indirect impacts include increased protection from flooding for residents and residential structures in the study area for 3% (and more frequent) AEP events (35-year). However, under this alternative flood protection in the study area would not be provided to the 1% AEP event and therefore residents would not qualify from discounted flood insurance premiums offered by the NFIP (unless the FIRMs are updated to reflect a reduction in the area classified as Special Flood Hazard Zone). Positive cumulative impacts to population and housing

associated with providing risk reduction for 3% events may occur. The lower flood risk anticipated in the study area under the 3% AEP Alternative may enhance the desirability of living within the protected areas which may manifest itself in in-migration to the study area.

Additionally, construction of the project has the potential to raise water levels outside the levees by several feet during storm events. These areas include portions of the communities of Gibson, Bayou Dularge, Dulac, and Cocodrie. For reasons discussed in the PAC report, the USACE has assumed the worst case compensation scenario, a 100% buy-out of all of the structures outside of the project alignment (including 876 residential structures). Should this scenario prove to be the appropriate mitigation method (again, see the PAC report for details), approximately 2,500 people would need to be relocated to areas behind the federal protection system.

6.14.2 EMPLOYMENT, BUSINESSES, AND INDUSTRIAL ACTIVITY

No Action Alternative

Direct, Indirect, Cumulative Impacts. The No Action Alternative would not provide risk reduction for businesses and industry in the study area. There would be no direct impacts to employment, businesses, and industrial activity under the No Action Alternative. However, since this alternative fails to provide reduced flood risk in the study area, the actual and perceived risks to employment, businesses, and industrial activity under this alternative would be higher than under the proposed alternative. Indirect impacts under the No Action Alternative include a higher potential for businesses to relocate outside of the study area as compared to the proposed alternative. Cumulative impacts under the No Action Alternative include the potential for a steady decline in employment opportunities as businesses relocate to areas with lower flood risks. The oil and gas industry, energy sector, fisheries, and agriculture would all continue to be at a higher risk for major disruption during flood events under this alternative as compared to the two project alternatives.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, there may be direct, temporary impacts to businesses within proximity to the project footprint due to delays caused by increased vehicular traffic congestion. Additionally, businesses and industries that rely on navigable channels (e.g., the GIWW, the HNC, and Bayou Lafourche) for transport of goods could also experience delays during construction of floodgates and lock structures. There is also expected to be a direct, temporary increase in employment as a result of construction activity. Indirect impacts under this alternative include increased protection from flooding for businesses and industries within the study area. Positive cumulative impacts to employment, businesses, and industrial activity associated with providing risk reduction for 1% (and more frequent) ACE events may occur. The lower flood risk that would accrue to the study area under the 1% AEP Alternative may spur additional economic growth in the region than would otherwise occur. As a result, an increase in the number of firms and the output of business and industry may manifest itself in such growth.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), 114 commercial warehouses, four professional facilities, a retail store, grocery store, and a restaurant would need to be relocated to the protected side of the project. The warehouses and businesses would have the same functions as in the previous locations and would still have use of the local waterways as transfer points for goods and services. The worst-case scenario analysis did not include the Lockport to Larose or the Larose Section C-North Variant reaches. These two reaches may require additional relocations of warehouses and businesses. A more detailed examination of impacts would be conducted in a future NEPA document before construction would occur.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, there may be direct, temporary impacts to area businesses due to delays caused by increased traffic congestion. Additionally, businesses and industries that rely on navigable channels (e.g., the GIWW, the HNC, and Bayou Lafourche) for transport of goods could also experience delays during construction of floodgates and lock structures. There is also expected to be a direct, temporary increase in employment as a result of construction activity. Indirect impacts under this alternative include increased protection from flooding for businesses and industry within the study area. Positive cumulative impacts to employment, businesses, and industrial activity associated with providing risk reduction for 3% (and more frequent) ACE events may occur. The lower flood risk that would accrue to the study area under the 3% AEP Alternative may spur additional economic growth in the region than would otherwise occur. As a result, an increase in the number of firms and the output of business and industry may manifest itself in such growth.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), 114 commercial warehouses, four professional facilities, a retail store, grocery store, and a restaurant would need to be relocated to the protected side of the project. The warehouses and businesses would have the same functions as in the previous locations and would still have use of the local waterways as transfer points for goods and services.

6.14.3 PUBLIC FACILITIES AND SERVICES

No Action Alternative

Direct, Indirect, Cumulative Impacts. The No Action Alternative would not provide risk reduction for public facilities in the study area. There would be no direct impact to public facilities under this alternative. However, since this alternative fails to provide reduced flood risk in the study area, the actual and perceived risks to public facilities under this alternative would be higher than under the proposed alternative. Indirect impacts under the No Action Alternative include a higher potential for disruption to public facilities and services within the study area as compared to the proposed alternative. Cumulative impacts under this alternative include the continued costs associated with protecting and maintaining public facilities during and after flood events.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, there may be temporary, construction-related impacts to public facilities in the immediate vicinity of the project areas. Indirect impacts under this alternative include increased protection from flooding for public facilities in the study area. Cumulative impacts associated with the completion of the 1% AEP Alternative may occur. The lower flood risk that would accrue to the study area under this alternative may enhance the desirability of living within the study area. As a result, in-migration to the area may occur which could increase the demand for public facilities and services.

Additionally, 14 public facilities, including the Lower Bayou du Large School, are located outside of the project alignment and, should the worst-case scenario prove to be the appropriate mitigation method, would need to be relocated to the protected side of the project. The worst-case scenario analysis did not include the Lockport to Larose or the Larose Section C-North Variant reaches. These two reaches may require additional relocations of public facilities. A more detailed examination of impacts would be conducted in a future NEPA document before construction would occur.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, there may be temporary, construction-related impacts to public facilities in the immediate vicinity of the project areas. Indirect impacts under this alternative include increased protection from flooding for public facilities in the study area. Cumulative impacts associated with the completion of the 1% AEP Alternative may occur. The lower flood risk that would accrue to the study area under this alternative may enhance the desirability of living within the study area. As a result, in-migration to the area may occur which could increase the demand for public facilities and services.

Additionally, 14 public facilities, including the Lower Bayou du Large School, are located outside of the project alignment and, should the worst-case scenario prove to be the appropriate mitigation method, would need to be relocated to the protected side of the project.

6.14.4 TRANSPORTATION

No Action Alternative

Direct, Indirect, Cumulative Impacts. The No Action Alternative would not provide risk reduction for the transportation infrastructure in the study area. There would be no direct impacts to transportation under this alternative. However, since this alternative fails to provide reduced flood risk in the study area, the actual and perceived risks to transportation under this alternative would be higher than under the proposed alternative. Indirect impacts under the No Action Alternative include a higher potential for flood-related damage to the transportation infrastructure within the study area. Cumulative impacts under this alternative include the continued costs associated with maintaining and rebuilding the transportation infrastructure during and after flood events.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, there would be direct impacts in the form of increased vehicular congestion along roads, highways, and streets leading to the construction site as well as disruptions to navigation during construction of floodgates and lock structures. These impacts are expected to be moderate but temporary, lasting only as long as construction activities. Indirect impacts include moderate to severe degradation of the transportation infrastructure, primarily local roads and highways, as a result of wear and tear from transporting construction materials. Cumulative impacts associated with the completion of the 1% AEP Alternative may occur. The lower flood risk that would accrue to the area under this alternative may enhance the desirability of living within the protected areas. As a result, in-migration to the area may occur which would increase vehicular traffic in the area. This could increase traffic congestion and may require rehabilitation to the transportation infrastructure in the study area sooner than would normally be expected.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (again, see the PAC report for details), there would be less usage of the vehicular transportation infrastructure outside of the project alignment. As a result, utilization and maintenance requirements of the portions of Highways 315 and 56 outside of the alignment, as well as smaller highways and local streets located outside the project boundaries, may be reduced.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, there would be direct impacts in the form of increased vehicular congestion along roads, highways, and streets leading to the construction site as well as disruptions to navigation during construction of floodgates and lock structures. These impacts are expected to be moderate but temporary, lasting only as long as construction activities. Indirect impacts include moderate to severe degradation of the transportation infrastructure, primarily local roads and highways, as a result of wear and tear from transporting construction materials. Cumulative impacts associated with the completion of the 3% AEP Alternative may occur. The lower flood risk that would accrue to the area under this alternative may enhance the desirability of living within the protected areas. As a result, in-migration to the area may occur which would increase vehicular traffic in the area. This could increase traffic congestion and may require rehabilitation to the transportation infrastructure in the study area sooner than would normally be expected.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (again, see the PAC report for details), there would be less usage of the vehicular transportation infrastructure outside of the project alignment. As a result, utilization and maintenance requirements of the portions of Highways 315 and 56 outside of the alignment, as well as smaller highways and local streets located outside the project boundaries, may be reduced.

6.14.5 COMMUNITY AND REGIONAL GROWTH

No Action Alternative

Direct, Indirect, Cumulative Impacts. Under the No Action Alternative, risk reduction would not be provided for the study area and the storm surge risk reduction system would not allow many properties in these communities to benefit from discounted flood insurance premiums offered by the NFIP (should the FIRMs be updated to reflect changes in the delineation of Special Flood Hazard Zones showing lower overall flood risk). There would be no direct impacts to community and regional growth under this alternative. Indirect impacts under the No Action Alternative include a higher potential for less community and regional growth compared to the proposed alternative as residents and businesses relocate to areas with lower flood risks. Cumulative impacts under this alternative include a steady decline in the economic vitality of the study area as residents and businesses relocate to other areas due to the lack of enhanced flood protection in the area.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. This alternative would reduce flooding for communities in the study area for 1% (and more frequent) ACE events (100-year). Without strong storm and flood protection, a community's sustainability and opportunity for growth will necessarily be limited. Although improvements to flood and hurricane protection would not fully eliminate the threat of storm damages in the future, by providing risk reduction, confidence and investment in the study area would increase. Since this alternative would provide the most reliable flood risk reduction, it would most likely have the greatest effect in enhancing community sustainability and preserving growth opportunities. This alternative would have no direct or indirect adverse effect on community and regional growth. Increased protection from flooding would preserve the opportunity for community and regional growth. Cumulative impacts associated with the completion of the 1% AEP Alternative may occur. The lower flood risk that would accrue to the area under this alternative may have the effect of spurring additional economic growth in the region than would otherwise occur. In addition, the lower incidence of flooding that this alternative is designed to achieve would reduce the propensity for disruption of community life. Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), all residents and businesses located outside of the project alignment would be relocated to areas behind the federal protection system. To the extent that these communities re-establish community ties behind the federal protection system, the opportunity for community growth would be preserved as a result of the increased protection from flooding. Regional growth is not expected to be impacted under this scenario.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. This alternative would reduce flooding for communities in the study area for 3% (and more frequent) ACE events (35-year). This alternative would have no direct or indirect adverse effect on community and regional growth. Increased protection from flooding would preserve the opportunity for community and regional growth. Cumulative impacts associated with the completion of the 3% AEP Alternative may occur. The lower flood

risk that would accrue to the area under this alternative may have the effect of spurring additional economic growth in the region than would otherwise occur. In addition, the lower incidence of flooding that this alternative is designed to achieve would reduce the propensity for disruption of community life.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), all residents and businesses located outside of the project alignment would be relocated to areas behind the federal protection system. To the extent that these communities re-establish community ties behind the federal protection system, the opportunity for community growth would be preserved as a result of the increased protection from flooding. Regional growth is not expected to be impacted under this scenario.

6.14.6 TAX REVENUES AND PROPERTY VALUES

No Action Alternative

Direct, Indirect, Cumulative Impacts. Under the No Action Alternative, risk reduction would not be provided for the study area and the storm surge risk reduction system would not allow many properties in these communities to benefit from discounted flood insurance premiums offered by the NFIP (should the FIRMs be updated to reflect changes in the delineation of Special Flood Hazard Zones showing lower overall flood risk). There would be no direct impacts to tax revenues and property values under this alternative. Indirect impacts under the No Action Alternative include a higher potential for a reduction in tax revenue to communities as property values decline due to the high flood risk as well as the potential loss of residents and businesses to areas with less risk of flooding. Cumulative impacts under the No Action Alternative include the potential for a steady decline in the economic vitality of the study area as residents and businesses relocate to other areas due to the lack of enhanced flood protection in the area.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, property values near the construction site itself may decrease temporarily due to the added traffic congestion and construction noise and dust. The impact, however, would be temporary, lasting only as long as the construction. Indirect impacts under the proposed alternative may include an increase in tax revenue and property values due to the increased protection from flooding for residential properties and businesses in the study area. Positive cumulative impacts to tax revenues and property values under the proposed alternative may occur. The lower flood risk that would accrue to the study area under this alternative may have the effect of spurring additional economic growth in the region than would otherwise occur. It follows that increases in tax revenues would ensue given additional economic growth. In addition, the lower incidence of flooding that the 1% AEP Alternative is designed to achieve would have the effect of preserving, if not enhancing, property values within the protected areas.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), all residents and businesses located outside of the project alignment would be relocated to areas behind the federal protection system. Tax revenues would be

expected to shift to the new locations. Property values for the owners relocated to the protected side would be expected to experience the same potential growth as a result of increased protection from flooding as those for property owners currently within the boundaries of the proposed alternative.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under this alternative, property values near the construction site itself may decrease temporarily due to the added traffic congestion and construction noise and dust. The impact, however, would be temporary, lasting only as long as the construction. Indirect impacts under the proposed alternative may include an increase in tax revenue and property values due to the increased protection from flooding for residential properties and businesses in the study area. Positive cumulative impacts to tax revenues and property values under the proposed alternative may occur. The lower flood risk that would accrue to the study area under this alternative may have the effect of spurring additional economic growth in the region than would otherwise occur. It follows that increases in tax revenues would ensue given additional economic growth. In addition, the lower incidence of flooding that the 3% AEP Alternative is designed to achieve would have the effect of preserving, if not enhancing, property values within the protected areas.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), all residents and businesses located outside of the project alignment would be relocated to areas behind the Federal protection system. Tax revenues would be expected to shift to the new locations. Property values for the owners relocated to the protected side would be expected to experience the same potential growth as a result of increased protection from flooding as those for property owners currently within the boundaries of the proposed alternative.

6.14.7 COMMUNITY COHESION

No Action Alternative

Direct, Indirect, Cumulative Impacts. Under the No Action Alternative, risk reduction would not be provided for the study area. There would be no direct impacts to community cohesion under this alternative. Indirect impacts under the No Action Alternative include a higher potential for a reduction in community cohesion if the civic infrastructure within the study area is damaged as a result of flood events. In addition, community cohesion within the study area may also be reduced if residents relocate to areas with less risk of flooding. Cumulative impacts under the No Action Alternative include the potential for a steady decline in the community cohesion of the study area as residents relocate to other areas due to the lack of enhanced flood protection in the area.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. Storm surge protection measures are designed to protect the community from the catastrophic effects of flooding, preserving the physical integrity of the developed landscape that promotes patterns of social interchange. No direct, indirect, or cumulative adverse effects on community cohesion in the study area are expected as a result of this alternative. Indirect impacts may include an increase in community cohesion due to the increased protection from flooding for the residents and civic infrastructure in the study area. Positive cumulative impacts to community cohesion under the proposed alternative may occur as the lower incidence of flooding allows communities to focus more on community-building activities rather than preparing for and recovering from flood events.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), all residents and social institutions located outside of the project alignment would be relocated to areas behind the Federal protection system. To the extent that these communities re-establish community ties behind the federal protection system, the opportunity for community cohesion would be preserved as a result of the increased protection from flooding.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Storm surge protection measures are designed to protect the community from the catastrophic effects of flooding, preserving the physical integrity of the developed landscape that promotes patterns of social interchange. No direct, indirect, or cumulative adverse effects on community cohesion in the study area are expected as a result of this alternative. Indirect impacts may include an increase in community cohesion due to the increased protection from flooding for the residents and civic infrastructure in the study area. Positive cumulative impacts to community cohesion under the proposed alternative may occur as the lower incidence of flooding allows communities to focus more on community-building activities rather than preparing for and recovering from flood events.

Additionally, should the worst-case scenario prove to be the appropriate mitigation method (see the PAC report for details), all residents and social institutions located outside of the project alignment would be relocated to areas behind the Federal protection system. To the extent that these communities re-establish community ties behind the federal protection system, the opportunity for community cohesion would be preserved as a result of the increased protection from flooding.

6.14.8 ENVIRONMENTAL JUSTICE

No Action Alternative

Direct, Indirect, Cumulative Impacts. The No Action Alternative would not provide risk reduction to the residents living within the study area. There would be no direct impact on minority and/or low-income population groups under this alternative. However, since this alternative fails to provide flood risk reduction, the actual and perceived risks to minority and/or low-income population groups under this alternative would be higher than under the alternatives.

Indirect impacts under the No Action Alternative include a higher potential for permanent displacement of minority and/or low-income population groups as compared to the proposed alternative as residents relocate to areas with higher levels of flood protection. Cumulative impacts under the No Action Alternative include the potential for a steady decline in minority and/or low-income population groups as residents move to areas with lower flood risks as well as continued financial and emotional strain placed on these groups as they prepare for and recover from flood events.

1% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under the 1% AEP Alternative, minority and/or low-income population groups residing or working near the construction site itself may experience direct, temporary impacts due to the added traffic congestion and construction noise and dust. The impact, however, would be temporary, lasting only as long as the construction and all residents are expected to be similarly impacted. Indirect impacts under this alternative include an increase in protection from 1% (and more frequent) flood events for minority and/or low-income populations in the study area. However, as stated previously, the residents of the communities of Gibson, Bayou Dularge, Dulac, Isle de Jean Charles, and Cocodrie would not benefit from the increase in protection. Positive cumulative impacts to minority and/or low-income populations associated with providing risk reduction are expected to occur as a result of the lower flood risk that would accrue to the area under this alternative. If the 1% AEP Alternative encourages regional economic growth, any additional jobs thus created may benefit minority and/or low-income groups living within the study area. Although multiple communities outside the system, including the residents of Isle de Jean Charles, would be impacted by the project, the impacts are comparable for non-minority/non-low income communities and minority/low income communities; therefore, we have determined that there is no "disproportionate impact to a minority or low income community.

Construction of the project has the potential to raise water levels outside the levees by several feet during storm events. These areas include portions of the communities of Gibson, Bayou Dularge, Dulac, Isle de Jean Charles, and Cocodrie. For reasons discussed in the PAC report, the USACE, for purposes of this report, has assumed the worst-case compensation scenario, a 100% buy-out of all of the structures outside of the project alignment (including 876 residential structures). Should this scenario prove to be the appropriate mitigation method (again, see the PAC report for details), at least 2,500 people would need to be relocated to areas behind the Federal protection system. Although multiple communities outside the system, including the residents of Isle de Jean Charles, would be impacted by the project, the impacts are comparable for non-minority/non-low income communities and minority/low income communities; therefore, we have determined that there is no "disproportionate impact to a minority or low income community.

3% AEP Alternative

Direct, Indirect, Cumulative Impacts. Under the 3% AEP Alternative, minority, and/or low-income population groups would be impacted similarly to the 1% plan. Although multiple communities outside the system, including the residents of Isle de Jean Charles, would be

impacted by the project, the impacts are comparable for non-minority/non-low income communities and minority/low income communities; therefore, we have determined that there is no "disproportionate impact to a minority or low income community.

6.15 Cultural Resources

The Morganza to Gulf levee alignments have received multiple cultural resources considerations that have examined past and existing alignments, including the current constructable features. Not all lands of the entire current levee alignment have received field testing, but sample surveys have been conducted in order to verify probability models for the most likely locations and density of cultural resources (Brown et al. 2000, Goodwin and Associates 2010, Goodwin and Associates 2011, Goodwin and Associates 2012, Moreno et al. 2011, Roblee et al. 2000). As such, strong and educated statements can be made about the nature and number of cultural resources within the lands affected and impacted by the proposed Morganza to Gulf alignment.

6.15.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Cultural resources in the study area could be directly impacted under the No Action Alternative. Flooding due to storm events like Hurricane Rita causes erosion to land mass containing cultural resources; this impact is permanent and its severity is based on the duration of the storm event.

Adverse indirect impacts to cultural resources in the study area under the No Action Alternative would be due to the continual incremental loss of natural ridges and already-subsided lands that hold both known and potential unknown cultural resources due to sea level rise, subsidence and erosion.

Cumulative impacts to cultural resources under the No Action Alternative would be due to the historical and future incremental loss of the natural ridges regionally and nationwide due to sea level rise, subsidence and erosion. Wetland and shoreline erosion and associated wetland fragmentation's conversion to open water may adversely affect the preservation of remaining cultural resources.

6.15.2 1% AEP ALTERNATIVE

Direct Impacts

The construction of levee may directly negatively impact any cultural resource that lies in the path of the levee or its associated borrow or mitigation areas. Site 16TR193 is located on the Barrier Alignment. Site 16TR71 is located near the transition from Reach B to Reach E. On Alternative 5 of Reach G, cultural resources 16TR26, 16TR304, and 16TR305 are located. These sites are not assessed for eligibility for the National Register of Historic Places (NRHP). Site 16TR261 is located on Reach H and is a scatter of prehistoric and historic artifacts that is judged not eligible for the NRHP. Site 16TR33 is located on Reach J1. Within Reach K, site 16LF108 is a scatter of prehistoric ceramics and faunal remains, and is not assessed for NRHP eligibility. Other sites may be newly discovered in the areas of direct impacts, according to low and high probabilities of their existence. The majority of Reach K and Reach L are low

probability areas. Reaches H, I, J-1 and J-2 include areas of high probability that are sunken land and only accessible today with difficulty. Reach G has a mix of low and high and medium likelihood to contain undiscovered cultural resources. Reach F along the Houma Navigation Canal is primarily high probability land. Reach E is mostly low probability land, but does contain Site 16TR71 as demonstration that even low probability lands deserve some degree of consideration for cultural resources. Reach B contains some high probability sunken landforms and is only accessible with difficulty. Reach A is primarily low probability land. The Barrier Alignment Reach is a mixture of low, medium, and high probability depending on its proximity to Black Bayou. As part of a larger cultural resources survey effort, Goodwin and Associates, Inc. (2012) have produced a letter report summarizing the field survey of all constructible features outlined in this EIS. No cultural resources were found within the constructible features rights-of-way, and no impacts to cultural resources will occur by the construction discussed in this EIS. A full cultural resources report will be available for consultation when other segments of levee reaches have been surveyed and discussed.

The main portion of the Lockport to Larose Ridge reach extending from the GIWW towards Larose, east of Bayou Lafourche, received a records check level investigation by Coastal Environments (Kelley 2009). This investigation found areas of high and low probability for cultural resources along the proposed alignment, and found that no previously recorded cultural resources exist on the proposed alignment. Although not yet checked by cultural resources survey on the ground, the high probability areas give good indication and evidence for areas requiring future cultural resources study before levee construction occurs. The northern portion of this reach that trends west-east from Lockport, was not considered by the records check. This area would require cultural resources survey in the area nearest to Lockport, as this is high ground on natural levee that is high probability for past human activity and archaeological traces. Similarly, the eastern end of this section is an area of high probability as identified by Kelley (2009), and therefore the similar conditions would require that it be more closely examined with on-ground cultural resources survey.

The Larose Section C-North Variant has received cultural resources survey for much of its length. A 1986 (Poplin et al. 1986) survey found no cultural resource and recommended no further investigations as necessary, for the portion starting on the south bank of Bayou Lafourche and following the GIWW, and from GIWW to its juncture with Reach L of the Morganza PAC Alignment. A 1981 (McIntire et al. 1981) survey found no cultural resources along the east bank of GIWW, from the north bank of Bayou Lafourche to the beginning of the Lockport to Larose Ridge on the western side of GIWW. There are, however, numerous historic structures located in the nearby urban zone of this alignment. In addition, Site 16LF76 is recorded on the eastern edge of GIWW near the terminus of Larose Section C-North Variant, and will require closer examination to determine if it is endangered by potential construction or is avoided by the currently proposed alignment intersections.

Potential direct positive impacts result to areas protected by the proposed hurricane storm damage risk reduction project. Cultural resources that are less exposed to storm conditions and flooding, are more likely to be preserved.

Indirect Impacts

The enhanced hurricane storm damage risk reduction project could improve chances to access certain cultural resources. This could result in negative indirect impacts from destructive activities such as looting.

Cumulative Impacts

Cumulative impacts to cultural resources under the proposed action may be due to similar regional and national risk reduction projects. In particular, the enhanced hurricane storm damage risk reduction project could reduce damages to cultural resources in an increased percentage of coastal low-lying areas.

6.15.3 3% AEP ALTERNATIVE

Direct

Direct impacts of the 3% Alternative would generally be similar to the 1% Alternative.

Indirect

Indirect impacts of the 3% Alternative would generally be similar to the 1% Alternative.

Cumulative

Cumulative impacts of the 3% Alternative would generally be similar to the 1% alternative.

6.16 Recreation

6.16.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Recreational resources in the entire region that would most likely be impacted under the No Action Alternative are those related to inundation from storm surges and loss of wetlands and habitat diversity as well as substantial salinity changes. Over time, land and habitat loss and associated changes in salinity levels encroaching from the southeast could begin to negatively affect both freshwater and saltwater based fishing as well as waterfowl hunting and land based recreational resources such as boat ramps and parks.

By taking no action, continued saltwater intrusion, storm surge inundation and wetland and shoreline erosion and associated wetland fragmentation and conversion to open water will likely continue in the study area with negative impacts on recreation resources. As marsh habitat decreases, areas for fish spawning decrease and ultimately the populations and diversity of fish species will diminish, which would affect recreational fishing opportunities negatively. Similarly, with less freshwater and intermediate marsh habitat, waterfowl hunting opportunities would likely decrease. Ridge habitat would also likely continue to decline, reducing opportunities for deer and other small game hunting.

Long term impacts may include loss of associated recreational support facilities such as marinas and bait shops that are the basis for most recreational use. This would result in a reduction in economic activity associated with recreation uses.

Cumulative impacts are the impacts on the environment that will result from the incremental impact of the No Action Alternative from the other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Existing and planned projects in the project vicinity include those supported by various sources including, but not limited to, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and the U.S. Army Corps of Engineers (USACE) Atchafalaya to Northern Terrebonne Marshes (ANTM) ecosystem restoration project. The ANTM project will supply freshwater to the project area, improve hydrologic distribution of water and provide structures that will reduce salt water intrusion, all of which are expected to have positive long-term benefits on recreational resources. Despite these other efforts, continued coastal erosion and increased levels of salinity would likely occur throughout much of the project area.

Localized beneficial impacts may include improved habitat from ANTM freshwater diversion and protection for fish and wildlife habitat during coastal storms due to the proposed water control structures. The CWPPRA West Lake Boudreaux Shoreline Protection and Marsh Creation project will provide additional nursery habitat for fish and improved food supply for waterfowl.

Other recent projects in the area had similar purposes and would similarly benefit recreation by improving fish and wildlife habitat. The Avoca Island Diversion and Land Building Project (CWPPRA Project Number TE-49) was approved in 2003 to divert freshwater, sediment, and nutrients from Bayou Shaffer to rebuild eroded wetlands of the Avoca Lake area. The Avoca Island Marsh Restoration project funded through The North American Wetlands Conservation Act was scheduled to begin in summer 2005 to restore coastal marsh. The GIWW Bankline Restoration Project was approved for funding through the Natural Resources Conservation Service in 2003 to protect wetland habitat and protect emerging freshwater floating marsh.

6.16.2 1% AEP ALTERNATIVE

Direct Impacts

There will be no direct impacts to recreational facilities, such as boat launches and marinas, as the proposed levee alignment avoids these features. Direct impacts to recreational fishing and hunting could occur in the work zone as construction disturbs marshes and open water increasing turbidity and temporarily causing recreational species to shift away from these areas. The proposed levee alignment includes permanently converting marsh habitat, open water habitat, and active oyster leases to uplands and project features. However, long-term, direct impacts to fishing and hunting are expected to be minimal as fish and wildlife resources will relocate once construction activities begin.

An expanded levee system will have both beneficial and detrimental effects to recreation areas and to recreational opportunities. Constructing levees will benefit recreation areas by providing additional protection to the structures and utility systems at recreational areas, which will decrease the amount of time that the areas cannot be used following severe storms. Following Hurricane Katrina, many recreational areas were used for several months for temporary housing. Additional levees will also be beneficial to recreation by providing new recreational opportunities such as the development of walking trails along the levees that may connect with existing trails.

Detrimental effects to recreation mostly relate to access to fishing areas via smaller canals, bayous, and waterways that may be both temporarily and permanently impacted by construction of the proposed levee system. The floodgates and lock will remain open most of the time, closing only in times of storms and high tides. Construction of these facilities will impact boat passage through the canals and bayous where they are placed. However, these impacts will be short term and occur during construction. Smaller access canals may no longer be available for use to gain entry to fishing areas and fisherman may have to travel alternative routes to gain access. Once the levee is in place, boaters using boat launches or coming from the camps along a section of Bayou Petite Caillou will have to travel longer distances to gain access to fishing and hunting areas east of the levee alignment--to Bush or Placid canals. Floodgates and other structure features will allow for recreational boating egress and ingress through larger canals and bayous. When the floodgates and lock are open, there will be no impact to users, however when these facilities are closed, users will be contained within the levee system.

The proposed levee alignment passes through the northwest corner of the Mandalay NWR, in particular, across the Sunrise Canal, while not impacting any facilities. The Point-Aux-Chenes Wildlife Management Area (WMA) will be directly impacted by the action. The proposed levee dissects the WMA reducing the amount of contiguous hunting acres. However, hunting which currently takes place on the land where the new levees will be constructed will transfer to adjacent areas with minimal apparent losses to the overall hunting experience. The levees will provide a linear walking path for hunters and sightseers within the perimeter of the WMA.

Indirect Impacts

Indirect impacts from project features include positive freshwater flow benefits to the vegetative and fishery communities by closing the water control structures in times of high tides, thereby restricting saltwater intrusion. Improved vegetative growth provided by way of the water control structures will benefit the marsh, which in turn will provide suitable food and cover for game species. Fisheries also benefit by improved estuarine conditions and increased food sources. The proposed floodgates, water control structures, and lock will provide similar benefits by restricting saltwater flow when necessary.

Indirect impacts to recreational fishing and hunting could result from changes in salinity levels in the project area as a result of water control structures. The slight changes in salinities would likely have minor effects on the distribution of fish and shellfish species. Marine species assemblages and the young of species that prefer higher salinities such as brown shrimp and spotted seatrout could shift slightly Gulfward from areas freshened by water control structures.

The young of species such as Gulf menhaden, blue crab, white shrimp, and red drum that commonly use low to medium salinity areas and SAV habitats and freshwater species, such as crayfish, freshwater catfish, largemouth bass, and other centrarchids could slightly benefit in areas where salinities slightly decrease from implementation of the 1% AEP Alternative. Conversely, in areas where salinities slightly increase, the young of species that prefer higher salinities could move slightly inland.

Reductions in salinity due to the project would likely have minor effects on oysters. Expected slight decreases in salinity in the marshes south of Falgout Canal would likely have little effect on oyster leases and seed grounds south of this area.

Organism access to marsh and open-water areas would be impeded by some features included in this alternative and would be enhanced by others. Features with a potentially beneficial influence on fish access include environmental control structures along Falgout Canal in Reach B (Appendix G) and along Grassy Bayou in Reach H-1 (Appendix G) and a structure just to the east of Bayou Pointe aux Chenes in Reach K (Appendix G). In some areas, the proposed levee would restrict fish access to navigable and environmental structures only. The modified operation of the lock complex would block organism movement in the HNC; however, other migration routes (e.g., Bayou Grand Caillou) would remain open. Effects of water control structures depend on the type of structure and how they are operated, and salinities and water depths upstream and downstream of the structure. Higher salinity water from storm surges can become trapped behind structures; in other cases, salinities behind structures can become fresher. Fresh and low-salinity areas behind structures and levees can have increased SAV coverage.

Reduced salinity levels will help to stabilize fresh, intermediate, and brackish marsh in and around Lake Boudreaux and the Central region, stabilizing and improving habitat for waterfowl, which in turn, would enhance waterfowl hunting opportunities. Freshwater based recreational fishing should improve and current levels of recreational saltwater fishing would possibly be maintained.

According to WVAs, the 1% AEP Alternative is expected to benefit marsh (Section 6.2 and Appendix F). Improved marsh habitats and increased SAV could benefit many juvenile fishes, shrimp, crabs, and other species by increasing food and cover. Portions of the project area that are expected to benefit from improved marsh habitat as a result of this alternative would be expected to better maintain most of its current ability to support GMFMC-managed species (such as white shrimp, brown shrimp, and red drum), as well as other estuarine-dependent species (such as spotted seatrout, gulf menhaden, striped mullet, and blue crab) that are preyed upon by other GMFMC-managed species (such as mackerels, red drum, snappers, and groupers) and highly migratory species (such as billfish and sharks). Potential increases in SAV could increase the habitat available to escape predation for juveniles of some species.

Adverse effects on marsh habitat are expected to occur in some portions of the study area. Declines in fishery productivity are expected to accelerate in these areas as a result of implementing this alternative.

Cumulative Impacts

The cumulative impacts of the 1% AEP Alternative and other planned or ongoing measures will be stabilization and potential enhancement of wetlands and marsh habitat throughout the study area. Some reduction in overall salinity levels is also anticipated. Planned and on-going measures along with 1% AEP Alternative measures will likely be beneficial to the ecosystem and to recreation resources in numerous ways as habitat for various stages in the life-cycles of fish and wildlife are stabilized, protected, improved, and expanded. Improved fish habitat will increase the numbers and variety of fish, which will be beneficial to recreational fishing. Similarly, introduction of freshwater and dredge material placement will improve vegetation and habitat for birds and wildlife and will enhance opportunities for birding, hunting, and hiking. Stabilization and enhancement of fresh and intermediate marsh should enhance waterfowl hunting.

However, the temporary effects of planned, ongoing, and proposed measures would include turbidity and associated reductions in water quality. This may result in some short-term reduction in freshwater and saltwater based recreation opportunities.

Beneficial impacts to recreational resources are expected to ultimately outweigh the negative, temporary impacts due to project construction. These projects will likely stabilize and potentially enhance recreational resources and associated economic activity well into the future.

Restoration efforts in the state through programs such as LCA and CWPPRA have improved fisheries habitat, and are likely to continue. These projects would contribute positive cumulative effects on fisheries in the project area. Adverse impacts to fisheries may result from the construction of levees, water control structures, and hurricane protection features by local interests to protect themselves and their property from hurricane damage and flooding. Implementation of the 1% AEP Alternative would contribute a beneficial increment to impacts from other projects and initiatives in the project area by marsh acreages to the project area.
Increased levees will be detrimental to recreation if they necessitate the destruction of cabins that are currently available for vacation rentals along waterways in State Parks. At Bayou Segnette State Park, a larger levee, depending upon the design, might also necessitate the destruction of a swimming pool because it is located near the base of the current levee. Due to their proximity to potential projects to increase the size of levees, the following parks and refuges are most likely to be affected: Bayou Sauvage, Big Branch Marsh, Bayou Teche and Lacassine National Wildlife Refuges, St. Tammany Wildlife Refuge, the Bonnet Carre Spillway, Fairview-Riverside and Fontainebleau State Parks, and the Maurepas Swamp, Pearl River, Salvador-Timken, and Point Aux Chenes Wildlife Management Areas.

Increased levees along Highway 82, which is along a natural levee or Chenier in Planning Unit 4, will also be detrimental to recreation if the projects necessitate the destruction of homes along the roadway. This will negatively affect recreation in the area because these are the homes of many guides and people who work to support recreation in the area.

Increased levees will be detrimental or more costly to recreation areas by requiring longer access roads so that the grade over the higher levees will be manageable for mobile homes and a boat trailers.

6.16.3 3% AEP ALTERNATIVE

Direct

Direct impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

Indirect

Indirect impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

Cumulative

Cumulative impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

6.17 Aesthetics

6.17.1 NO ACTION ALTERNATIVE (FUTURE WITHOUT PROJECT CONDITIONS)

Visual resources in the study area could be directly impacted under the No Action Alternative. Flooding due to storm events like Hurricane Rita reduces accessibility to the Wetland Cultural Byway (Figure 6-4); this impact is temporary and its severity is based on the duration of the storm event.

Adverse indirect impacts to visual resources in the study area under the No Action Alternative would be due to the incremental loss of wetlands and the natural ridges due to sea level rise, subsidence and erosion. Wetland and shoreline erosion and associated wetland fragmentation's conversion to open water may adversely affect the viewsheds within the Mandalay NWR and the Pointe aux Chenes WMA, and along the Southern portions of the Wetlands Cultural Scenic Byway. Opportunities for visual use including wildlife observation, environmental interpretation, and cultural awareness would diminish if the marsh and natural ridges erode.

Cumulative impacts to visual resources under the No Action Alternative would be due to the historical and future incremental loss of wetlands and the natural ridges regionally and nationwide due to sea level rise, subsidence and erosion. Wetland and shoreline erosion and associated wetland fragmentation's conversion to open water may adversely affect the viewsheds within significant visual resources including wildlife refuges and management areas, and scenic streams and byways. Opportunities for visual use including wildlife observation, environmental interpretation, and cultural awareness would diminish with the loss of the marsh and natural ridges.

6.17.2 1% AEP ALTERNATIVE

Direct Impacts

Visual resources in the study area may be directly adversely impacted as the result of levee construction where the levee alignment crosses the Wetlands Cultural Byway south of Chauvin. Project construction details are insufficient to determine the magnitude of impacts to this visual resource.

Indirect Impacts

Visual resources in the study area positively indirectly impacted under the proposed action would be due to an enhanced hurricane storm damage risk reduction project. In particular, the enhanced hurricane storm damage risk reduction project could reduce inaccessibility to the Wetlands Cultural Scenic Byway due to storm related flooding.

Cumulative Impacts

Cumulative impacts to visual resources under the proposed action may be due to similar regional and national risk reduction projects. In particular, the enhanced hurricane storm damage risk reduction project could reduce inaccessibility to scenic byways and other significant visual resources due to storm related flooding.

6.17.3 3% AEP ALTERNATIVE

Direct Impacts

Direct impacts of the 3% Alternative would generally be similar to the 1% Alternative.

Indirect Impacts

Indirect impacts of the 3% Alternative would generally be similar to the 1% Alternative.

Cumulative Impacts

Cumulative impacts of the 3% AEP Alternative would generally be similar to the 1% AEP Alternative.

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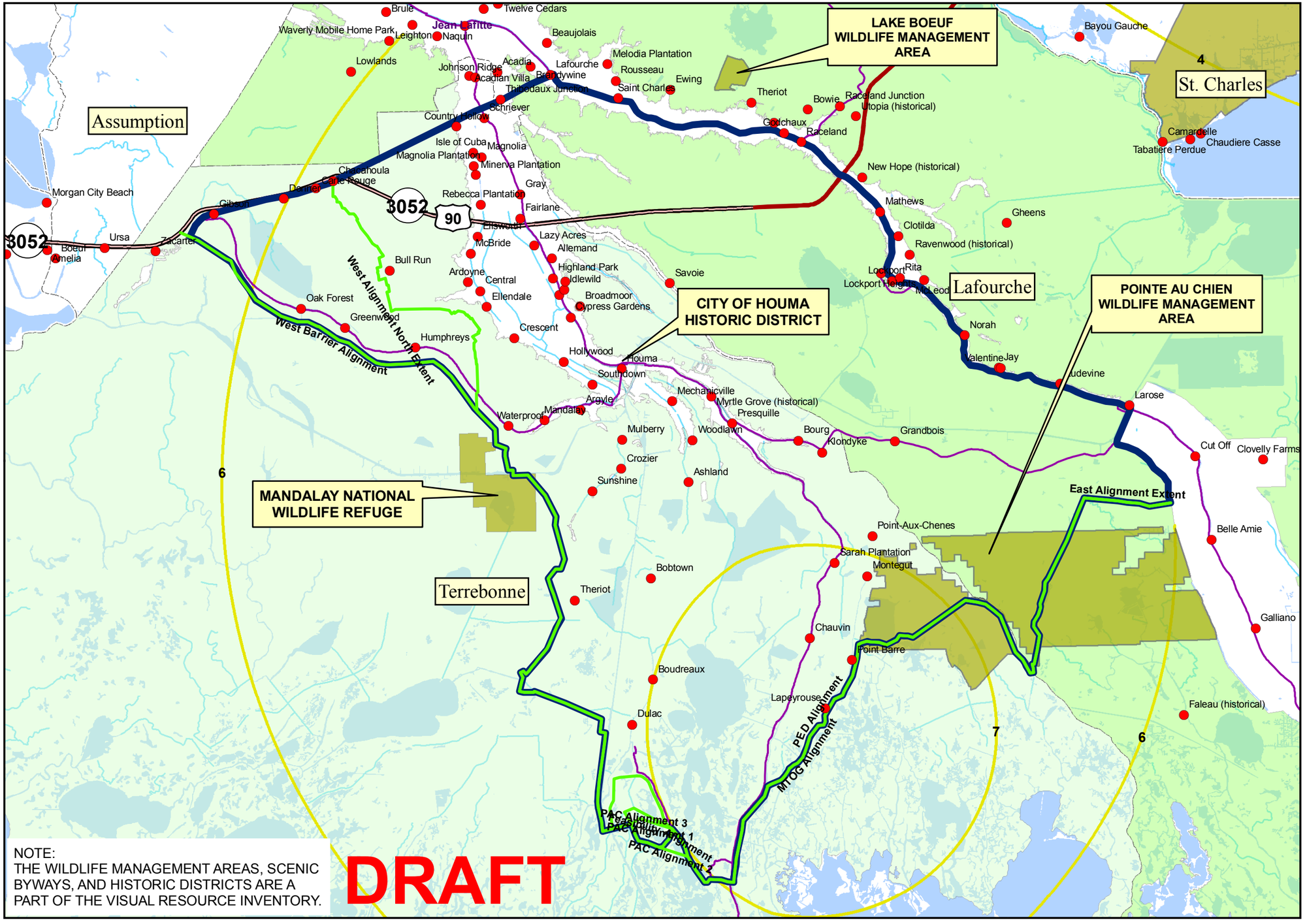
NEW ORLEANS DISTRICT

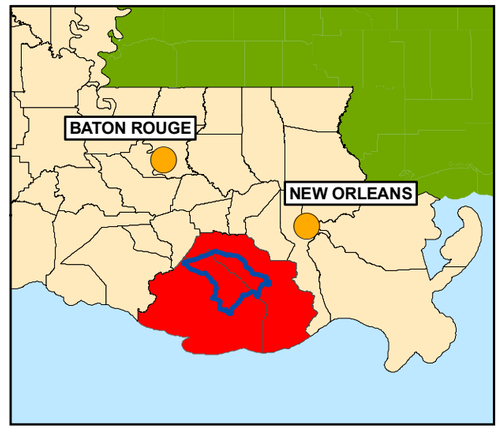
Figure 6-4. MORGANZA TO THE GULF FLOOD INUNDATION AND STORM SURGE - HURRICANE RITA



LEGEND

- Communities
- MTOG Alignments
- MTOG-Boundary
- Wetlands Cultural Byway
- Louisiana Highways
- US Highways
- Interstate Highways
- Louisiana Parishes
- USFWS National Refuges
- Hurricane Rita-Storm Surge Contours
- Lafourche Parish-Hurricane Rita Flood Inundation
- Terrebonne Parish-Hurricane Rita Flood Inundation

LOCATION MAP



NOTE:
THE WILDLIFE MANAGEMENT AREAS, SCENIC BYWAYS, AND HISTORIC DISTRICTS ARE A PART OF THE VISUAL RESOURCE INVENTORY.

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6.18 Cumulative Effects

Cumulative effects are defined in 40 CFR 1508.7 as those effects that result from:

> *...the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative environmental effects for the proposed project were assessed in accordance with guidance provided by the President's Council on Environmental Quality (CEQ).

In addition to the cumulative impacts previously addressed for each significant resource, the following evaluation focuses on potential cumulative impacts of significant environmental resources.

6.18.1 METHODOLOGY

A six-step process was followed to assess cumulative effects on resources affected by the Recommended Plan. The first step was to identify which resources to consider in this analysis. All impacts on affected resources can be called cumulative. However, according to CEQ guidance, "the role of the analyst is to narrow the focus of the cumulative effects analysis to important issues of national, regional, or local significance" (CEQ, 1997, p. 12). In addition to this "significance" criterion, only those resources expected to be directly or indirectly affected by the Action Alternatives (the 1% and 3% AEP alternatives) as well as by other actions within the same geographic scope and time frame were chosen for the analysis. Based on these criteria, the following resources were identified as target resources for the cumulative effects analysis:

- Wetlands
- Hydrology
- Water Quality
- Fishery Resources
- Protected Species

The temporal boundaries for the assessment were established as follows:

- Past: Starting with the Flood Control Act of 1928, when flood control projects of the Mississippi River and its tributaries were first authorized. Since that time, the Atchafalaya Basin Floodway; GIWW; Atchafalaya River; Bayous Chene, Boeuf, and Black Navigation Channel; Houma Navigation Canal; and Houma area levees and pump systems, drainage canals, and access canals have altered the hydrology of the project area.
- Present: 2035, when construction of project features is expected to be completed.
- Future: 2035 to 2085. Fifty years is considered a reasonable period of assessment given the indefinite life of the project.

The next steps of the cumulative effects analysis included:

- Defining the study area for each resource.
- Describing the historical context and existing condition of each resource. Descriptions of affected resources are summarized in more detail in Chapter 5.0 of this report.
- Summarizing the direct and indirect effects of the Action Alternatives on each identified resource. Environmental effects of the Action Alternatives are presented in more detail in sections 6.2 to 6.17 of this report.
- Identifying the accumulated effects on each resource from the Action Alternatives and other past, present, and reasonably foreseeable actions.
- Summarizing the magnitude of the cumulative effects of the projects and actions on the affected resources.

The information derived from these steps of the cumulative effect assessment is presented below for each resource. A summary of the cumulative effects analysis is provided in Table 6-4.

6.18.2 STUDY AREA

The study area lies at the southern end of the Terrebonne Basin, which is situated within the Barataria-Terrebonne estuary (Figure 5-1). This estuary extends from the west bank levees of the Mississippi River (north and east), to the East Guide Levee of the Atchafalaya River (west), to the Gulf of Mexico (south), and to the town of Morganza (north). Detailed descriptions of the study area and its features are located in Section 5.1, *Environmental Setting of the Study Area*.

6.18.3 PAST, PRESENT, AND REASONABLY FORSEEABLE FUTURE ACTIONS

Descriptions of past, present, and reasonably foreseeable future projects related to the study area and the proposed project are located in Section 3.11, *Related Projects.*

6.18.4 EXISTING CONDITIONS

Existing conditions for each resource are described in Section 5.0, *Affected Environment*.

6.18.5 DIRECT, INDIRECT, AND CUMULATIVE IMPACTS

Direct, indirect, and cumulative effects of the proposed action on each of the resources considered are discussed in sections 6.5 through 6.17. A summary of effects is presented in Table 6-4.

Table 6-4. Summary of Direct, Indirect, and Cumulative Effects of Key Significant Resources

Resources/ Issues	Past Actions & Their Effects	Effects of the Tentatively Selected Plan	Other Present and Reasonably Foreseeable Future Actions & Their Effects	Cumulative Effects of All Actions
Wetlands	Coastal Louisiana has lost an average of 34 square miles of land, primarily marsh, per year for the last 50 years because of development, oil and gas activities, loss of sediment input, and natural subsidence.	Wetlands would be filled to construct project features. These losses would be compensated through the establishment of vegetated wetlands.	Vegetated wetlands in the study area are anticipated to be improved through LCA, CWPPRA, and other Federal, state, and local restoration programs.	When combined with LCA, CWPPRA, and other Federal, state, and local restoration efforts, the net effects would be beneficial to wetland resources of the study area.
Hydrology	Anthropogenic changes within the study area have altered the natural hydrology. Canals, pipelines, roads, railroads, navigation channels, and levees have altered the natural flow patterns. Historically, freshwater inflows within the study area were driven by the Atchafalaya River and Bayou Lafourche, whose connection with the Mississippi River was closed. Existing flows within the study area are driven by the lower Atchafalaya River. Other major channels are the GIWW, and the HNC, which has been implicated in higher salinity in the Houma area. Most of the study area is influenced by tidal movement from the Gulf of Mexico.	Levees will reduce risk in the study area from storm surge and tidal influences from the Gulf of Mexico. The levees will endure atypical conditions and have to perform differently than other levees in a normal river system due to their continuous exposure to water on both sides. Additional issues associated with levees include tidal fluctuation, wave run-up; poor foundation conditions (organic soils).	Local parish and levee districts are currently constructing interim levees and structures for hurricane and storm surge risk reduction.	It is anticipated that this project, acting in concert with other storm surge/levee projects in coastal Louisiana, would provide cumulative benefits by enhancing safety and aid in protecting the lives and property of coastal communities.
Water Quality	Shallow lakes are eutrophic with high nutrient levels; do not fully support their designated uses	Construction activities would result in localized increases in turbidity and suspended	Although proper management of tidal exchange structures can minimize changes in flow	The proposed project, combined with other coastal activities (such as those

Resources/ Issues	Past Actions & Their Effects	Effects of the Tentatively Selected Plan	Other Present and Reasonably Foreseeable Future Actions & Their Effects	Cumulative Effects of All Actions
	because of pathogen indicators. Pathogen indicators are the most frequent causes of use impairment in bayous, creeks, and canals followed by organic enrichment/ low-dissolved oxygen and nutrients. Estuarine/coastal waters experience eutrophication/ hypoxia, habitat modification, and produced water discharges. Sources include wastewater treatment plants, minor point sources, septic tanks, and inflow and infiltration, and agricultural runoff. Salinity increases resulted from expanded open waters, loss of marsh vegetation, and storms trapping salt water trapped behind levee and natural ridges. Damage may have occurred with the BP Oil Spill of 2010. Organics in elutriate samples were below detection limits. Mercury (one site) and lead (three sites) exceeded chronic LDEQ thresholds. Some metals in sediments exceeded NOAA benchmarks.	solids, at both the dredging and placement sites. It is not anticipated construction or the use of adjacent borrow for levee fill would have significant impacts. Levee construction would convert wetlands, which benefit water quality, to uplands. The TSP would restrict the entry of salt water into interior water bodies as SLR occurs.	and water level between the flood and protected side of the proposed levee alignment, the proposed alignment may alter the study area by inhibiting water exchange between the protected and flood sides of the proposed levee and result in stagnation. The potential exists for expansion of developed areas, which could degrade water quality on the protected side of the propose alignment.	included in the discussion of future without project conditions) would cumulatively impact study area water quality. In addition, it is foreseeable that the proposed project may impact the attainment of state water quality standards in the study area, leading to changes in regulation of point and nonpoint source discharges within the area, particularly on the protected side of the proposed hurricane risk reduction alignment.
Fishery Resources	The study area contains a variety of aquatic habitats, including ponds, lakes, bayous, canals, shallow open water areas, and bays. Commercial fisheries resources are important to the	No direct impacts on fishery species would result from the TSP. Minimal indirect impacts on fishery resources due to changes in fishery access, salinity, turbidity, and	Aquatic habitats in the study area are anticipated to be improved through LCA, CWPPRA, and other Federal, state, and local restoration programs.	When combined with LCA, CWPPRA, and other Federal, state, and local restoration efforts, the net effects associated with the TSP would benefit fishery

Resources/ Issues	Past Actions & Their Effects	Effects of the Tentatively Selected Plan	Other Present and Reasonably Foreseeable Future Actions & Their Effects	Cumulative Effects of All Actions
	study area, with landings at the ports at Dulac-Chauvin and Golden Meadow-Leeville. Salinity and submerged vegetation affect the distribution of fish and invertebrates in coastal marshes. The most abundant species collected in freshwater and intermediate marsh areas adjacent to the project area were residents predominantly associated with submerged aquatic vegetation. Important freshwater species include largemouth bass, yellow bass, crappie, bluegill and other sunfishes, and catfishes. Marshes in the area support commercially and recreationally important marine fish and shellfish species including red and black drum, sheepshead, mullet, flounder snappers, seatrout, white shrimp, brown shrimp, blue crab, eastern oyster, and Gulf stone crab. The most abundant marine transient species collected near the project area included menhaden, blue crab, bay anchovy, and mullet.	SAV. The TSP would partially offset the loss of aquatic habitats thereby benefiting fishery species dependant on these habitats.		resources of the study area.
Threatened and Endangered Species	The piping plover, the Gulf sturgeon, and Kemp's ridley sea turtle may occur in or near the study area. The bald eagle and the brown pelican, previously listed, but both species were removed	No direct impacts on threatened or endangered species would result from the TSP. The TSP would partially offset the loss of coastal habitats thereby	The incremental effects of the proposed project would contribute to beneficial effects associated with other coastal projects, including LCA, CWPPRA, and other	The overall cumulative effects of these projects would be the maintaining of coastal habitats along a greater portion of the Louisiana coastline, thereby

Resources/ Issues	Past Actions & Their Effects	Effects of the Tentatively Selected Plan	Other Present and Reasonably Foreseeable Future Actions & Their Effects	Cumulative Effects of All Actions
	from the Federal list of threatened and endangered species.	benefiting threatened and endangered species dependant on these habitats.	Federal, state, and local restoration programs.	reducing any adverse effects of local disturbances on threatened or endangered species.

6.19 Mitigation

6.19.1 INTRODUCTION

Laws, regulations, and USACE policy ensure that adverse impacts to significant resources have been avoided or minimized to the extent practicable and that remaining, unavoidable impacts have been compensated to the extent justified. The appropriate application of mitigation is to formulate an alternative that first avoids, then minimizes, and lastly, compensates for unavoidable adverse impacts. This section serves as the mitigation plan required by 33 CFR 332.4(c) and 40 CFR 230.92.4(c).

6.19.2 WATER QUALITY

Contracted construction companies would be required to follow standard best management practices (BMPs) to minimize the introduction of suspended solids into surrounding waters. These BMPs include such practices as the use of siltation fences and hay bales to reduce erosion at construction sites. Requirements to comply with BMPs would be included in and made part of construction contracts.

6.19.3 WETLAND MITIGATION

In the development of the action alternatives, features that were incorporated to avoid and minimize potential adverse environmental effects included, where practical, the placement of levees at locations that would avoid or minimize effects on wetlands or other significant features of the project area.

An interagency Habitat Evaluation Team (HET) was formed to use Wetland Value Assessment (WVA) methodology to assess the quality of wetlands of the area, make a determination of the effects various aspects of the project on future conditions, and calculate the amount of mitigation required to compensate for impacts caused by the constructible features of the project. The HET was composed of representatives from the USFWS, NMFS, USACE, USEPA, NRCS, LDWF, CPRAB, and LDNR. A description of the WVA methodology, analysis, and assumptions made by the HET may be found in Appendix F, *Wetland Value Assessment.*

While the HET made a preliminary assessment of the impacts to wetlands resulting from the programmatic elements of the project, no attempt was made to calculate mitigation requirements. Design details of each of the programmatic elements will be further refined and the impacts assessed in a future NEPA document. At that time, the wetland impacts will be reevaluated and a mitigation plan developed in accordance with the requirements of 33 CFR Part 332. It is anticipated that the future mitigation plans will be similar to the following plan.

6.19.4 WETLAND MITIGATION PLAN FOR CONSTRUCTIBLE FEATURES

Compensatory mitigation alternatives considered the purchase of mitigation credits from an approved mitigation bank and USACE constructed in-kind mitigation. The Water Resources Development Act of 2007 requires that the USACE first consider using commercial mitigation banks to provide compensation for environmental impacts to wetlands. The USACE determined that the use of mitigation banks for the constructible features was not feasible for the following reasons: (1) No mitigation banks with credits for saline, brackish or intermediate marsh were located in the vicinity of the project area; (2) project structures would be constructed using clay material dredged from areas adjacent to the proposed structures; however, the overburden consists of approximately five feet of organic material unsuitable for use as construction material. To reduce project costs, the Corps proposes to use this organic material to create/restore coastal marsh habitat to compensate for losses resulting from the project. If the amount of the overburden material is insufficient, additional material would be obtained from offsite sources. There are two mitigation banks in the area that would be considered for the programmatic features. They may potentially provide credits for fresh marsh, Cypress/Tupelo Gum Swamp, and Bottomland Hardwoods.

This mitigation plan is intended to provide compensation for direct impacts associated with the constructible elements of the project: levee reaches F1, F2, G1; the HNC Lock Complex; and the Bayou Grand Caillou Floodgate. The HET determined that may be minor indirect impacts to wetlands would result from the project due to a change in fisheries access..

The proposed mitigation actions will include construction (summarized below), with the Non-Federal Sponsor responsible for operation, maintenance, repair, rehabilitation, and replacement (OMRR&R) of functional portions of work as they are completed. On a cost-shared basis, the USACE will monitor completed mitigation to determine whether additional construction, invasive species control and/or planting are necessary to achieve mitigation success. The USACE will undertake additional actions necessary to achieve mitigation success in accordance with cost sharing applicable to the project and subject to the availability of funds. Once the USACE determines that the mitigation has achieved initial success criteria, monitoring will be performed by the Non-Federal Sponsor as part of its OMRR&R obligations. If, after meeting initial success criteria, the mitigation fails to meet its intermediate and/or long-term ecological success criteria, the USACE will consult with other agencies and the Non-Federal Sponsor to determine whether operational changes would be sufficient to achieve ecological success criteria. If, instead, structural changes are deemed necessary to achieve ecological success, the USACE will implement appropriate adaptive management measures in accordance with the contingency plan and subject to cost sharing requirements, availability of funding, and current budgetary and other guidance.

The 12 components of this compensatory mitigation plan are described in Table 6-5.

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
1. Objectives	National and planning objectives are presented in Section 3.9 of this document.
2. Site Selection	Section 4, *Alternatives*. Mitigation areas are depicted on maps in Appendix G, *Mapbook.* Mitigation for constructible features would be located in the areas depicted in map 7 of 12 of the 1% and 3% AEP mapbooks in Appendix G.
3. Site Protection Instrument	Private lands within both sites would be acquired in fee, excluding oil and gas with restrictions on the use of the surface. Any land that is owned, claimed, or controlled by the state or any other nonfederal governmental entity will be brought to the project via an Authorization for Entry. Any Federal lands would be brought to project, whether via a Special Use Permit or otherwise. The Non-Federal Sponsor would be responsible for operation, maintenance, repair, rehabilitation and replacement of the mitigation site in perpetuity.
4. Baseline Information	Baseline wetland information is provided in Section 5.2.1 and Appendix F, *Wetland Value Assessment.*
5. Determination of Credits	Credit determinations were made through the use of WVA methodology and detailed in Appendix F, *Wetland Value Assessment*.
6. Mitigation Work Plan	The mitigation work plan is anticipated to include the following: • Containment Dikes: Dikes would be used at each marsh restoration site to contain placed earthen materials until the materials have consolidated and wetland vegetation has become established. A low containment dike would be constructed around an area of appropriate size to form a "cell." The cell would then be filled with earthen material to a target fill height as determined by geotechnical, engineering, and survey analysis for the planned habitat. The material would be allowed to consolidate to form a substrate that would be conducive for marsh development to take place. The earthen dikes would be constructed by sidecasting adjacent clay materials. Where feasible, the dike construction materials would be excavated from the interior of the placement area. The sidecast borrow ditch may increase circulation of the site by creating a natural depression. • Dike Degradation: The dikes around mitigation sites and cells would be designed to slowly deteriorate and subside to the level of the adjacent marsh substrate, thereby promoting the tidal exchange of water. Earthen dikes may require mechanical degradation to the settled elevations of the disposal area if natural erosive processes do not degrade them sufficiently to meet the required water

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
	exchange and fishery/organism access needs. Such breaches would be undertaken after sediment has consolidated and vegetation has become established on the exposed soil surface. • Target Elevations: The target elevations of placed and consolidated fill at each site would be determined through geotechnical analyses. These analyses would consider long-term settlement of the earthen materials and placement area foundations, as well as elevation surveys of the nearby planned wetland habitat to determine the appropriate target range (Table 6-5). It is anticipated that the final result of the material placement would be a combination of wetlands and shallow open water habitat within the site. Slurry would be allowed to overflow over existing emergent marsh vegetation within the proposed disposal areas, but would not be allowed to exceed a height of about one foot above the existing marsh elevation. • Vegetation: The establishment of vegetation on marsh areas would provide stability and reduce erosion. The vegetation of marsh areas would rely on natural recruitment. However, marsh vegetation, such as smooth cordgrass, may be planted by other agencies and organizations as desired. • Access Corridors: Access corridors to mitigation sites would be a maximum of about 200 feet wide and would cross over uplands, wetlands, and shallow open water as necessary. Access corridors also may be placed across or along the crown of existing levees in the project vicinity. • Flotation Access Corridors: Channels would be excavated as needed in shallow open water areas to allow construction equipment to access sites. If necessary, flotation access channels would be excavated by a mechanical dredge to maximum dimensions of approximately 80 feet wide and 10 feet deep. Flotation access channel material would be used in dike/closure construction or refurbishment, to backfill flotation access channels, or be placed adjacent to and behind the dikes and closures in shallow open water to an elevation conducive to wetlands development following consolidation of the material. Flotation access channel material used to backfill the flotation access channels following completion of disposal work would be

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
	temporarily stockpiled on water bottoms adjacent to the flotation access channels. If existing canals are used for access, they may be dredged to facilitate the flotation of pipelines and the transport of other necessary equipment to material discharge sites. Material removed from existing canals would be placed on adjacent levees and/or into shallow open water on either side of canals. Canal dredged material placed in shallow open water areas would be placed at a height conducive for wetlands development. • Existing Levee Access Corridors: If construction equipment and discharge pipelines are placed across or along the crown of existing levees in the project vicinity, the levees may be refurbished using borrow material from adjacent shallow open water to facilitate their use as access corridors for construction equipment and discharge pipelines. Access corridors crossing existing levees would be no wider than about 100 feet. Levees surrounding mitigation sites may be degraded as necessary to provide access. Levees degraded for construction access may be rebuilt following completion of disposal activities. Degraded levee material would be placed/stockpiled in shallow open water adjacent to the degraded levee sections or on adjacent levees. Material degraded from levees may be used to rebuild degraded levee sections. Borrow material required to rebuild degraded levee sections would be excavated from adjacent shallow water. If levees are not to be rebuilt using material removed during levee degradation activities, any levee material that was placed in shallow open water would be degraded, if necessary, to a height conducive to wetlands development. • Staging Areas: The construction or designation of staging areas may be necessary for construction equipment and for the unloading of pipeline and other equipment necessary to perform disposal operations. Staging areas would have a maximum area of about 300 feet by 300 feet. If necessary, materials such as gravel, sand, dirt, shell, or some combination of earthen materials would be permanently placed over existing upland, wetland, and shallow open water habitat to construct staging areas.

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
	• Board Roads: Temporary board roads may be constructed along access corridor alignments and staging areas wherever emergent marsh exists. Board roads would be removed when work is completed. Fill material may be deposited where the board road would be located to offset damage to the underlying marsh caused by soil compression. Board road fill material may be degraded to adjacent marsh elevations following completion of disposal activities either by placing excess material into nearby shallow open water to elevations conducive to wetlands development, by placing material on existing uplands/levees, or by removing material from the project vicinity. Minimal site-specific data exist for the majority of the proposed sites. An interactive approach would be taken with landowners and resource agencies, as necessary, to achieve the maximum benefits at each site. A collaborative, adaptive management strategy that involves engineers, scientists, and resource agencies would be employed throughout the life of the project to improve design, construction, and post-construction procedures to promote circulation, establish vegetation, and manage mitigation use sites. The intent of adaptive management for this project is to account for uncertainties and allow decision-making and implementation to proceed while acknowledging that some structural or operational changes may be necessary (EC 1105-2-409 [31 May 2005; expired 30 September 2007]. Although this project is not an ecosystem restoration project, it would comply with the adaptive management guidance of ER 1105-2-100, paragraph 3-5b(8), which states: *For complex specifically authorized projects that have high levels of risk and uncertainty of obtaining the proposed outputs, adaptive management may be recommended*. As mitigation sites are constructed and completed, the adaptive management process would be used to adjust and improve the sites. During construction of the mitigation sites, agencies and landowners would be advisors but final decision-making will rest with the USACE and the local sponsor. Initial success criteria are described in Item No. 8 of this table.
7. Maintenance Plan	To be outlined in OMRR&R Manual

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
8. Performance Standards	Performance Standards are established to measure achievement of planned compensation for unavoidable impacts to wetland and wildlife habitat. The mitigation sites must be shown to progress from their current state towards vegetated marsh/wetland platform with an elimination of shoreline erosion. Elements that can be measured to show this progression include: height of marsh/wetland platform, % plant cover, USGS land loss rates (shoreline retreat), dike height, and number, size, and location of gaps in dikes. Success Criteria are as follows: **After initial placement** of earthen materials has been completed, at least 80 percent of the marsh platform must be within "as-built" or initial construction elevation and settlement range (+2.5 feet NAVD 88 to 1.37 feet NAVD 88) + or -0.25 feet, and 90 percent of the dike surrounding each cell must be within "as-built" or initial construction elevation range (+3.00 feet NAVD 88) + 0.25 feet. These will be considered the as-built success criteria. The completion of the initial placement of earthen materials to create a marsh platform will mark the beginning of the time periods (1, 3, 5, 10 and every 5 years thereafter for 50 years) discussed herein. **Three years** after initial placement of earthen materials, no less than 90 percent of the marsh platform must be within the “functional marsh” elevation range (i.e., +0.5 feet NAVD 88 to + 1.5 feet NAVD 88). At least 85% of the marsh platform should be vegetated and 80 percent of this vegetation should be classified as facultative or wetter. There should be gaps in the dike approximately every 2,000 feet with a bottom depth set at – 1.0 NAVD 88 and the gaps should be approximately 10 feet wide at the bottom. The dike height should be approximately +1.5 NAVD 88. **Five years after** initial placement of earthen materials, at least 75 percent of the marsh platform must remain within the "functional marsh" target elevation range. At least 85 percent of the marsh platform should be vegetated and 80 percent of this vegetation should be classified as facultative or wetter. Observations must be made of the use of the created marsh by wildlife species and estuarine-dependent fishery species typically found in natural marsh habitats of similar salinity regime. **Every five years starting at year ten**, at least 75 percent of the marsh platform should remain within the "functional marsh" target elevation range. At least 75 percent of the marsh platform should be vegetated and 80 percent of this vegetation should be classified as facultative or wetter. The WVAs that were run for the mitigation sites predicted that 19% and 64% of the intermediate and brackish marsh respectively would be left of at the end of 50

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
	years with expected land loss due to subsidence and sea level rise (see Appendix F, Figure 7). Observations must be made of the use of the created marsh by wildlife species and estuarine-dependent fishery species typically found in natural marsh habitats of similar salinity regime
9. Monitoring Requirements	Monitoring will be conducted during the spring following years 1, 3, 5, 10 and every 5 years thereafter for 50 years (unless as noted otherwise) after the construction of the marsh platform (i.e., the initial placement of earthen materials). Monitoring reports will be provided to the CEMVN Chief of Environmental Planning and Restoration Branch (Chief CEMVN PDR-RS) by July 1 of each monitoring year. CEMVN will then determine if the success criteria have been met or if remedial action is needed. This information will be provided to the state and Federal resources agencies for their concurrence. Ongoing mitigation efforts will also be discussed at the yearly resource agency meeting. The data from these reports will also be used to update the Civil Works Project Mitigation Database (CWPMD) maintained by USACE. The Corps will prepare the year one monitoring report and provide this report to the necessary resource agencies for each cell of the marsh creation feature within one year following the construction of the marsh platform. This report shall contain a survey providing the areal extent of the filled area and the settled grade of the marsh platform and the dike (as-built). It will be used to verify the as-built success criteria. **The Other Monitoring Reports** shall contain a description of the conditions of the mitigation project and shall measure those conditions against the success criteria (initial, interim, or long-term, as applicable) and should contain the following: aerial photography, ground level photographs of the plant species and dike gaps, drawings based upon the site plan depicting topography, gaps, sampling plots and photo stations, results of vegetation survey (% cover, % exotic, % facultative or wetter, and % survival of any planted vegetation), and a detailed narrative summarizing the condition of the mitigation project, all regular maintenance activities and any corrective action needed. **The three years after marsh platform construction monitoring event** will be performed by CEMVN or its designee. It will be used to verify achievement of the initial success criteria. If the initial success criteria are not obtained, the report should include a list of corrective actions (planting, gapping, etc.) and when each will be performed. A monitoring report shall be required to be completed by CEMVN for each consecutive year until all initial success criteria have been satisfied (i.e., that corrective actions were successful). After the initial success criteria are obtained, CEMVN will deem the construction phase of the mitigation project to be complete and the Mitigation Project Closeout Plan will be activated.

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
	The Mitigation Project Closeout Plan will facilitate the transfer of responsibility for OMRR&R (including monitoring) to the non-Federal sponsor. The non-Federal sponsor will be given: (1) the monitoring report demonstrating that all the initial success criteria have been met; (2) the OMRR&R manual; and (3) the monitoring report criteria. **The every five years after marsh platform construction monitoring events** (will be prepared by non-Federal sponsor only after construction phase is deemed complete) shall be performed by the non-Federal sponsor or its designee in accordance with the OMRR&R requirements. It will be used to verify the interim or long-term success criteria as appropriate.
10. Long-Term Management Plan	CEMVN is responsible for this mitigation project for the duration of the construction phase to verify mitigation success and to complete project features if necessary. The non-Federal sponsor shall be responsible for OMRR&R once the CEMVN deems the construction phase to be complete and transfers responsibility to the non-Federal sponsor. The non-Federal sponsor shall be responsible for maintaining the mitigation site in perpetuity.
11. Adaptive Management Plan	In the event reports in component 9 submitted to CEMVN reveal that any success criteria have not been met during OMRR&R phase, the non-Federal sponsor, or its assigns after consultation with CEMVN and other appropriate agencies, will take all necessary measures to modify management practices in order to achieve these criteria in the future. While in the construction phase, if the results of the monitoring program support the need for physical modifications to the project, CEMVN will determine and implement the appropriate corrections in accordance with current authority and budgetary and other guidance, including the potential to consider implementing corrective measures under separate authority. The following actions are the responsibility of CEMVN. If, during the construction phase, the marsh creation sites do not naturally vegetate within three years of creation then planting of suitable species would occur. If, two years after planting, survival is less than 50 percent of the initial number of plants, as determined by sampling or by observing high mortality at any location within the planted tract, CEMVN, or its assigns, will take appropriate actions to address the causes of mortality and replace all dead plants. If, during the construction phase, openings do not naturally develop in the continuous breakwater by year three, they would be constructed by CEMVN or its partners to provide nekton access and water exchange (fish dips).
12. Financial	Financial assurances are required to ensure that the compensatory mitigation

Table 6-5. Twelve Components of the Compensatory Mitigation Plan	
Components	**Sections**
Assurances	project will be successful. In this case, the Morganza to the Gulf, Louisiana Project Partnership Agreement between the CPRAB of Louisiana, TLCD, and the Federal Government provides the required financial assurance for this mitigation project. In the event that the non-Federal sponsor fails to perform, the CEMVN has the right to complete, operate, maintain, repair, rehabilitate or replace any project feature, including mitigation features, but such action would not relieve CPRAB of its responsibility to meet its obligations and would not preclude the CEMVN from pursuing any remedy by law or equity to ensure CPRAB's performance.

The loss of coastal wetlands would be compensated by the potential restoration, creation, and nourishment of sufficient acreage to replace the functional value of the wetlands lost. Table 6-6 provides determinations made by the HET for average annual habitat units (AAHUs) that would be lost through direct impacts associated with the constructible features of the project and that would be required for mitigation. In addition, Table 6-6 provides the acres of wetlands required to mitigate for the direct impacts. The HET determined through WVA modeling that the project would result in no indirect impacts to wetlands.

Table 6-6. Estimated Direct Impacts and Mitigation Requirements, Constructible Features, by Sea Level Rise Scenario and Marsh Type.

Alternatives	Intermediate Marsh			Brackish Marsh		
	Low SLR	Med SLR	High SLR	Low SLR	Med SLR	High SLR
Direct Impacts (AAHUs)						
1% AEP (TSP)	-40.78	-39.48	-37.53	-378.95	-350.98	-297.05
3% AEP	-36.71	-35.54	-33.78	-304.91	-283.32	-236.95
Mitigation Requirements (Acres)						
1% AEP (TSP)	140.62	136.14	129.41	842.11	779.96	660.11
3% AEP	126.59	122.55	116.48	677.58	629.60	526.56

Source: Appendix F, Wetland Value Assessment.

For each of the mitigation sites, containment features would be required for retaining material within the site boundary. For the majority of the mitigation sites, it was assumed that earthen

materials would be placed in a manner that would allow for water circulation, terracing, and marsh creation.

In most cases, the establishment of mitigation sites would be done at the same time as the construction of levees and other project features.

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7. LIST OF PREPARERS/CONTRIBUTORS

Many individuals were involved with the completion of this document. The following table lists those people who contributed to this RPEIS.

Table 7-1. List of RPEIS Preparers/Contributors

Name	Affiliation	Discipline	Role in Present Study
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Carnes, Laura	GEC, Inc.	Environmental Scientist	RPEIS preparation and management
Creel, Travis	CEMVN	Plan Formulator	RPEIS review
Dayan, Nathan	CEMVN	Fishery Biologist	RPEIS oversight and review
Ettinger, John	U.S. Environmental Protection Agency	Environmental Protection Specialist	Habitat Evaluation Team
Fontenot, Kayla	CEMVN	Social Scientist	Socio-Economics/Environmental Justice
Glisch, Eric	CEMVN	Environmental Engineer	Water Quality/Hydrology & Hydraulics
Hebert, Barry	Louisiana Department of Wildlife and Fisheries	Biologist	Habitat Evaluation Team
Hudson, George	GEC, Inc.	Hydrologist	Hydrology & Hydraulics
Hughbanks, Paul	CEMVN	Archeologist	Cultural Resources
Landry, Amanda	CEMVN	Engineer	RPEIS review
Langlois, Summer	Louisiana Coastal Protection and Restoration	Coastal Resources Scientist	Habitat Evaluation Team
Lindquist, Jennifer	GEC, Inc.	Geologist	Geology/Soils/Climate
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Paille, Ronnie	U.S. Fish and Wildlife Service	Biologist	Habitat Evaluation Team
Perez, Andrew	CEMVN	Recreation Specialist	Recreation
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Rogers, Donna	GEC, Inc.	Fishery Biologist	Fisheries/EFH
Stark, Elaine	CEMVN	Engineer	RPEIS review

Name	Affiliation	Discipline	Role in Present Study
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Wadsworth, Lisa	HDR	Engineer	RPEIS review
Williams, Pat	National Marine Fisheries Service	Fishery Biologist	Habitat Evaluation Team

*CEMVN: Corps of Engineers, Mississippi Valley-New Orleans.

8. PUBLIC INVOLVEMENT

In compliance with USACE policies and NEPA, input on projects is solicited from the public and other government agencies. The public was invited to comment during the scoping process and during public meetings, and comments will be solicited for this document. USACE will continue to coordinate with the communities and the public and will hold additional public meetings.

8.1 Scoping and Interagency Coordination

Public involvement has been a key component of this study since its inception in the 1990s. A Notice of Intent to prepare a Draft EIS was published in the *Federal Register* on April 7, 1993, and invited public comment. A public scoping meeting was held in Houma, Louisiana, on May 12, 1993. The purpose of the meeting was to provide interested parties with information regarding the project and to answer questions. A scoping document summarizing all comments and concerns voiced in the public meeting and in letters to the USACE was sent to all stakeholders on April 12, 1994. These issues and concerns were later considered during the planning and analysis of project alternatives.

The greatest area of public concern was related to the importance of providing hurricane, storm, and flood damage risk reduction for businesses and residences. Other concerns included potential adverse impacts to existing marshes, improvement of marsh habitat both inside and outside the proposed levee system, maintaining or improving ingress and egress of marine organisms for the benefit of commercial fisheries, and avoiding adverse water quality impacts. A more detailed summary of the public scoping comments can be found in the 2002 Morganza to the Gulf FPEIS, available online: http://www.mvn.usace.army.mil/prj/mtog.

As the study progressed, its magnitude and complexity became evident, and it was found to be difficult to determine all the details of such a large-scale system during the feasibility phase. Therefore, it was decided that a Programmatic EIS would be more appropriate for the project than the original EIS first envisioned. Impacts of an overall hurricane protection system for this area and a mitigation plan would be presented with as much detail as possible, but additional NEPA and other environmental documentation would disclose details of the various components and impacts of the project when designs were finalized. A Notice of Intent concerning the change to a Programmatic DEIS was issued in the *Federal Register* on October 22, 1999.

An interagency habitat evaluation team was formed in 1995 to evaluate impacts of proposed plans, suggest methods for reducing impacts, develop compensatory mitigation if needed, and to suggest monitoring efforts. The team is still active and is comprised of representatives from CEMVN, TLCD, USFWS, NMFS, NRCS, LDNR, and LDWF. Numerous environmental planning meetings have been held on a regular basis throughout the study process.

8.2 Public Review

The public comment period for the Draft PEIS (DPEIS) occurred from November 13, 2001 to February 21, 2002. Thirty-three comment letters were received and were used to modify the DPEIS. A public meeting was held during the public comment period on December 12, 2001, in Houma, Louisiana. The comments, responses, and a transcript of the public meeting can be found in Volume IV of the 2002 Morganza to the Gulf FPEIS, available online: http://www.mvn.usace.army.mil/prj/mtog.

A public meeting will be held for this Revised Draft PEIS (RDPEIS) during the public comment period.

8.3 Recommendations of U.S. Fish and Wildlife Service

A list of the major mitigation and conservation measures recommended by the USFWS in their FWCA Report, dated July 20, 2000, and the USACE responses to those recommendations are provided below (Table 8-1). The full FWCA Report may be found in Appendix B.

Table 8-1. Recommended Mitigation and Conservation Measures

No.	USFWS Comment	USACE Response
1	The feasibility report should clearly state that a goal of the recommended plan is to maintain existing and future without-project freshwater flows transported by the GIWW from the Atchafalaya River to the central project area and to distribute those flows to optimize project benefits to coastal wetlands and associated fish and wildlife resources.	The Corps' analyses verified that the floodgates west of Houma in the GIWW have little or no impact on water flowing to the east. Two adjacent floodgates in the GIWW are anticipated to perform better than attempting to place flap-gate structures in the tie-in walls. The Corps can not commit to distributing and optimizing flows into coastal wetlands. That function may be conducted by other agencies or under separate project authorities, such as CWPPRA and Coast 2050. The Corps has committed to maintaining existing and projected future flows from the Atchafalaya River through the GIWW. The Corps recognizes that the project, though very large, has been formulated to cause as little disruption to existing flow patterns as possible.
2	Estimates of all direct and indirect project-related wetlands impacts, including those associated with changes in freshwater inflow and distribution, should be refined during the engineering and design phase.	The Corps agrees that as project components are refined, environmental impact analyses would need to be conducted for each of those features using the latest available information and models.

No.	USFWS Comment	USACE Response
		Environmental compliance would be obtained for individual components as details of each component are refined in the next phase.
3	Because of its substantial wetland benefits, construction of the HNC Lock should be given top priority for implementation.	The Corps agrees.
4	The Corps should coordinate closely with the Service and other fish and wildlife conservation agencies throughout the engineering and design of the proposed HNC Lock, floodgates, and other water control structures (including fish and wildlife structures in the levees) to ensure that those structures are designed, constructed and operated consistently with wetland and associated fish and wildlife resource needs. In that regard, the Service recommends the following items.	
4a	The Bayou Grand Caillou Floodgate shall include installation and operation of one or more large auxiliary gates sufficient to maintain existing downstream freshwater flows and to preclude saltwater intrusion.	The Corps agrees.
4b	The Service and other fish and wildlife conservation agencies shall be involved in developing operation plans for all fish and wildlife structures and the final coordinated operation plans for the HNC Lock, the Bayou Grand Caillou Floodgate, and the structures along Falgout Canal Road. Those plans should include floodgate, lock, auxiliary gate, and fish and wildlife structure closures to prevent saltwater intrusion, and operations to improve freshwater distribution during high Atchafalaya River stages or high southward freshwater flows.	The Corps intends to continue to involve the interagency HET for evaluation and planning purposes on individual components of the project and systematic operation of all components.
4c	Where the operation plans referenced in item number 4.b. above include salinity, water level, or flow criteria, monitoring of those parameters shall be as recommended by the Service and other fish and wildlife conservation agencies.	Monitoring would be an integral part of the selected plan and the interagency HET would be involved in the development of detailed monitoring plans.

No.	USFWS Comment	USACE Response
4d	Should the design studies for the Grand Bayou Floodgate show that additional cross-section is needed to pass 1,000 cfs (see additional information request number 8d below); it should be provided via additional non-navigable gates.	The Corps recognizes that there is an authorized CWPPRA project for this area and intends to meet its obligations fully to allow that project to function as designed.
5	To the greatest degree practical, the hurricane protection levees and borrow pits should be located to minimize direct and indirect impacts to emergent wetlands. Further efforts should be made to reduce those direct impacts by hauling in fill material and/or using sheetpile for the levee crest to reduce the size of the levee base. If possible, the levee and/or borrow canal reach along the southern end of the Lake Boudreaux Basin should be constructed on the north side of Louisiana Highway 57 where impacts would be lessened by siting that feature in an area of high wetland loss rates.	The current analyses of direct impacts are most likely a liberal estimate. The Corps would attempt to reduce those impacts by locating borrow from open water areas, hauling fill, etc. in the next phase.
6	Material dredged during construction should be used to create or restore emergent wetlands to the greatest extent practicable.	The Corps recognizes that there may be opportunity to create wetlands from material obtained from the surface of borrow areas. The Louisiana Department of Natural Resources would require that material be used for beneficial purposes. Use of this material to create marsh would likely reduce compensatory mitigation. However, because the exact location of borrow areas would likely change this beneficial use was not accounted for in the present evaluation.
7	Full, in-kind compensation (quantified in AAHUs) should be provided for unavoidable net adverse project impacts on forested wetlands, marsh, and associated submerged vegetation, including any additional losses that are determined during post-authorization engineering and design studies. To ensure that the proposed marsh-creation mitigation features meet their goals, the Service provides the following recommendations:	

No.	USFWS Comment	USACE Response
7a	The proposed enlargement of Minors Canal should include the installation of piling barricades on both ends of the canal to preclude use by heavy vessels that cause excessive bank erosion, a water control structure on the southern end of the canal to regulate freshwater flows and preclude saltwater intrusion, and the maintenance of spoil banks along both sides of the canal.	The Corps agrees.
7b	Brackish marsh impacts should be mitigated in subarea G6 through the creation of a brackish marsh land bridge separating the fresh and low-salinity habitats to the north from brackish marshes to the south.	The Corps agrees to this concept.
7c	Marsh creation mitigation projects shall be determined to have met their goals (in AAHUs) when the acreage of created marsh/land equals or exceeds that projected by the HET at target year 3.	The Corps agrees to offset AAHU's lost for specific wetland types. The Corps also agrees that by target year 3, a created wetland should be functional. This may be just a different way of stating recommendation 7.c.
7d	The Service should be consulted in the development of plans and specifications for mitigation features.	The Corps agrees.
8	Extensive additional information is needed by the Service to complete our required evaluation of project effects and fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Much of that information will not be available until engineering and design of the selected plan is completed. To help ensure that sufficient information is provided, the Service recommends that the Corps perform the following tasks during the engineering and design phase. The Service also recommends that the Corps provide the Service with the opportunity to review and comment on model assumptions and input data prior to initiating modeling analyses necessary to complete those tasks.	
8a	Conduct a hydrologic model analysis of the entire project to determine system-wide effects on the flow and distribution of fresh water entering the project area via the GIWW. That analysis should simulate a	The Corps agrees.

No.	USFWS Comment	USACE Response
	range of Atchafalaya River stages and provide outputs including discharge, water levels and (where appropriate) salinities. The results of those analyses are needed to aid in siting, design, and developing coordinated operating plans for the various water control structures.	
8b	Determine the effects of the West GIWW Floodgate, including water level changes west of the floodgate and on the passage of existing and projected future eastward flows of Atchafalaya River water.	While an analysis has been conducted for the West GIWW Floodgate, the Corps recognizes that additional modeling would be needed to detail the impacts of the structure.
8c	Determine the effects of the Bayou Grand Caillou Floodgate, including water level changes north of the floodgate and the passage of existing and projected future southward flows of Atchafalaya River water.	The Corps agrees that additional work needs to be done in this area.
8d	Determine the effects of the Grand Bayou Floodgate on the Grand Bayou/GIWW Freshwater Diversion Project, including water level changes across the floodgate, velocities at the structure, and the ability of that floodgate to pass 1,000 cfs. This analysis should validate the previous modeling assumption (i.e., that velocities of 3 feet per second would occur at the floodgate, and that the floodgate would thus be able to pass at least 1,000 cfs of fresh water during periods of maximum freshwater availability).	The Corps believes that it has conducted analyses to show that the structure will pass 1,000 cfs and will operate in concert with the Grand Bayou/GIWW Freshwater Diversion Project.
8e	Determine, through an analysis of hourly water levels in the HNC at Bayou Pelton, how the operation of the HNC Lock and Bayou Grand Caillou Floodgate would affect the intended function of the CWPPRA-funded Lake Boudreaux Basin Freshwater Introduction Project.	A more complete analysis of the influences would be conducted.
8f	Determine the effect of HNC Lock and Bayou Grand Caillou Floodgate operations on salinities north of the HNC Lock and in the Lake Boudreaux Basin.	Additional information would be provided on salinity changes caused by the various components of a hurricane protection project. The Corps has been criticized at this point for not giving these structures more beneficial impact, but the Corps

No.	USFWS Comment	USACE Response
		would rather err on the conservative side at this point if there is an error.
8g	Provide additional information on anticipated construction techniques and their associated wetland impacts, such as additional dredging to install floodgates and water control structures, dredging temporary by-pass channels, and the method for disposing organic surface soils that are unsuitable for levee construction.	Each component would be evaluated thoroughly when details are generated. Because this is a Programmatic EIS, details may be evaluated in additional NEPA documents.
8h	Provide final locations and designs for borrow sites used in levee construction.	When details on final borrow locations are known for the various reaches, environmental compliance would be conducted and the Service would be included in those evaluations. Because this is a Programmatic EIS, details may be evaluated in additional NEPA documents.
9	Sufficient funding should be provided to the Service for participation in the post-authorization engineering and design studies, and to allow the Service to fulfill its responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.	Funding would be provided.
10	The Corps should obtain a right-of-way from the Service prior to conducting any work on Mandalay National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that proposed work will be compatible with the purposes for which the refuge was established.	The Corps would comply with this recommendation.

A list of the major mitigation and conservation measures recommended by the USFWS in their Draft FWCA Report, dated December 6, 2012. The full Draft FWCA Report may be found in Appendix B.

"The Service does not oppose the implementation of the constructable features and provides the following recommendations to avoid and/or minimize project impacts on fish and wildlife resources, and for mitigating unavoidable impacts to those resources.

1. The Post Authorization Change Report, in keeping with the project's Congressional Authorization, should clearly reiterate that features of the Tentatively Selected Plan will be designed to maintain existing freshwater inflows from the Atchafalaya River via the Gulf Intracoastal Waterway. Those designs shall accommodate restoration needs determined via future restoration planning, to the extent possible. The Service also recommends that the Corps provide the Service with the opportunity to review and comment on model assumptions and input data prior to initiating the modeling analyses necessary to complete those tasks. Tasks should include the following:

a. Future design of the Grand Bayou Floodgate should accommodate southward freshwater flows.

b. Construction of Reach Land K levees should avoid use of material dredged from Grand Bayou Canal and from the Cutoff Canal so that saltwater intrusion via those channels is not increased.

c. The eastern Gulf lntracoastal Waterway (GIWW) floodgate should have the smallest possible cross-section to reduce the loss of Atchafalaya River freshwater to the Barataria Basin and to retain that freshwater within the Terrebonne Basin.

d. The design of the west GIWW floodgate should avoid stage increases west of that structure and should be capable of passing Atchafalaya River freshwater flows, especially during periods of high Atchafalaya River stages, without any loss of flow.

e. The two environmental water control structures along Falgout Canal should be designed and operated to only discharge freshwater southward and not to allow northward flow of saltwater into Falgout Canal.

2. The Corps should coordinate closely with the Service and other fish and wildlife conservation agencies throughout the engineering and design of project features including levees, floodgates, and environmental water control structures to ensure that those features are designed, constructed and operated consistent with wetland restoration purposes and associated fish and wildlife resource needs.

3. Operational plans for floodgates and water control structures, excluding the Falgout Canal environmental structures, the HNC Lock Complex, and the east GIWW floodgate, should be developed to maximize the open cross-sectional area for as long as possible. Operations to maximize freshwater retention or redirect freshwater flows could be considered if hydraulic modeling demonstrates that is possible and such actions are recommended by the natural resource agencies. Development of water control structure operation manuals or plans should be done in coordination with the Service and other natural resource agencies.

4. To the greatest extent possible, the Bayou Grand Caillou floodgate should remain open during HNC Lock Complex saltwater closure periods to maintain water exchange in this natural bayou and thereby reduce or avoid impacts to fish access.

5. The location of the Barrier Reach, Reach A, and the Larose to Lockport levees should be modified to reduce direct wetland impacts and enclosure of wetlands, to the degree possible. Features such as spoil bank gapping or other measures should also be added to avoid impacts to enclosed wetlands due to unintentional impaired drainage. The Corps should coordinate with the Service and other natural resource agencies to develop the best approach for avoiding drainage impacts.

6. Estimates of all direct and indirect project-related wetland impacts, including those associated with changes in freshwater inflows and distribution, should be refined during the engineering and design phase, including impacts associated with the proposed HNC Lock closures to preclude saltwater intrusion.

7. To determine acreage of forested habitat types impacted by future levee construction activities, those acreages should be obtained by digitizing current aerial imagery and ground truthing, rather than through use of 2008 NWI data.

8. To the greatest degree practical, the hurricane protection levees and borrow pits should be located to avoid and minimize direct and indirect impacts to emergent wetlands. Efforts should be made to further reduce those direct impacts by hauling in fill material, using sheetpile for the levee crest, deep soil mixing, or other alternatives.

9. When organic soils must be removed from the construction site, that material should be used to create or restore emergent wetlands to the greatest extent practicable. If that is not practicable, then use of that material to improve borrow pit habitat quality (e.g., construct bank slopes, reduce depths, etc.) should be examined.

10. Forest clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

11. A void adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. Surveys prior to construction should be undertaken by the construction agency to ensure no nesting birds are within 1,000 feet of any proposed work. If nesting birds are found within 1,000 feet of any proposed work sites, the Service and the Louisiana Department of Wildlife and Fisheries should be contacted for procedures to avoid impacts.

12. Full, in-kind compensation (quantified as AAHUs) should be provided for unavoidable net adverse impacts on forested wetlands, marsh, and associated submerged aquatic vegetation, including any additional losses identified during post-authorization engineering and design studies. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.

a. Mitigation measures should be constructed concurrently with the features that they are mitigating (i.e., mitigation should be completed no later than 18 months after levee construction has begun. Completion of mitigation means that initial fill elevations have been achieved. If mitigation is provided via an in-lieu fee program, completed mitigation would be achieved when credits were purchased from an approved mitigation bank.

b. Proposed mitigation in the open water area south of Falgout Canal (in subunit B 13) should be coordinated with ongoing Corps Regulatory Branch mitigation plans to avoid conflicts.

c. In coordination with the Service and other fish and wildlife conservation agencies, the Corps should address the Environmental Protection Agency's12 requirements for each mitigation measure (Appendix B).

d. Mitigation performance should be assessed using the draft performance criteria used by the Corps and natural resource agencies for the Hurricane Storm Damage Risk Reduction Study.

e. The Service and other fish and wildlife conservation agencies should be consulted in the development of plans and specifications for all mitigation features and any monitoring and/or adaptive management plans.

f. Unavoidable impacts to wetlands within Mandalay National Wildlife Refuge should be mitigated on the refuge.

g. The acreage of marsh created to mitigate project impacts should meet or exceed the marsh acreage projected by the Habitat Evaluation Team for target year 5. If deficiencies occur in year 5 acres, additional mitigation shall be provided.

h. To avoid shortfalls in marsh creation acreage, the contractor should be required to guarantee the creation of at least the target acreage of marsh platform, or excess acres should be created.

i. The acreage of marsh created for mitigation purposes, and adjacent affected wetlands, should be monitored over the project life to evaluate project impacts, the effectiveness of compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.

j. Dredged material borrow pits, including those utilized to create marsh for mitigation purposes, should be carefully designed and located to minimize anoxia problems and excessive disturbance to area water bottoms, and to avoid increased saltwater intrusion.

k. If applicable, a General Plan should be developed by the Corps, the Service, and the managing natural resource agency in accordance with Section 3(b) of the Fish and Wildlife Coordination Act for mitigation lands.

13. Additional information is needed by the Service to complete the required evaluation of project effects and fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Much of that information will not be available until engineering and design of the project features has progressed. To help ensure that sufficient information is provided, the Service recommends that the Corps perform the following tasks during the engineering and design phase.

1. Provide additional information on anticipated construction techniques and their associated wetland impacts, such as additional dredging to install floodgates and water control structures, dredging temporary by-pass channels, and the method for disposing organic surface soils that are unsuitable for levee construction.

2. Provide final locations and designs for borrow sites used in levee construction.

14. Funding should be provided for full Service participation in the post-authorization engineering and design studies, and to facilitate fulfillment of its responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.

15. The Corps should obtain a right-of-way from the Service prior to conducting any work on Mandalay National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established.

16. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on Mandalay National Wildlife Refuge (NWR) will require the Corps to obtain a Special Use Permit from the Refuge Manager; furthermore, all activities on that NWR must be coordinated with the Refuge Manager. Therefore, we recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (985/853-1 078) for further information on compatibility of flood control features, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

17. If mitigation lands are purchased for inclusion within a NWR, those lands must meet certain requirements. A summary of some of those requirements was provided in appendix C to our May 2012 Coordination Act Report. Other land-managing natural resource agencies may have similar requirements that must be met prior to accepting mitigation lands; therefore, if an agency is proposed as a manager of a mitigation site, they should be contacted early in the planning phase regarding such requirements.

18. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Point au Chene Wildlife Management Area (985-594-5494). To fully evaluate indirect impacts of MTG structure operations on enclosed wetlands and fisheries access, the Service provides the following recommendations regarding information needed to conduct a full assessment of indirect project impacts and benefits.

1. Because stages are generally higher along the more exposed MTG east side, historic stage data (in NAVD88) from locations near proposed MTG east-side floodgates should be provided to the Service to facilitate prediction of future closure durations for floodgates along the MTG east side.

2. Hydraulic modeling to predict project effects on future salinities has been conducted but not for a scenario incorporating the proposed saltwater closures of the HNC Lock Complex, nor the planned freshwater introduction operations of the Falgout Canal environmental water control structures. If possible, the Corps should conduct such model runs to enable a more accurately assessment of the effects of the proposed project feature operations, rather than using model runs with all structures closed or open.

3. Hydraulic model runs to predict salinities at target year 50 year were conducted for the medium and high sea level rise scenarios, but not for the low sea level rise scenario. Model runs should also be conducted to predict salinities at target year 50 for the low sea level rise scenario.

4. Predicted average subunit salinities are needed to evaluate project-induced salinity change effects. Those model runs should be completed and results provided to the Service. Runs should be conducted for all sea level rise scenarios and should include baseline salinity conditions and future without project salinities at target year 50, plus future with project salinities at target year 1 and target year 50.

5. Model-generated tidal flux outputs should be made available to assist in quantifying project-related water exchange reductions and associated fisheries access impacts."

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10. INDEX

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11. ACRONYMS

AAHU	Average Annual Habitat Unit
AEP	Annual Exceedance Probability
ANTM	Atchafalaya to Northern Terrebonne Marshes
AQCR	Air Quality Control Region
AQI	Air Quality Index
BA	Biological Assessment
CEMVN	Corps of Engineers, New Orleans District
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cfs	Cubic Feet Per Second
CIAP	Coastal Impact Assistance Program
CPRAB	Louisiana Coastal Protection and Restoration Authority Board
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
DNR	Louisiana Department of Natural Resources
DOTD	Louisiana Department of Transportation and Development
DPEIS	Draft Programmatic Environmental Impact Statement
EC	Engineering Circular
EO	Executive Order
EFH	Essential Fish Habitat
ER	Engineering Regulation
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FPEIS	Final Programmatic Environmental Impact Statement
FWCA	Fish and Wildlife Coordination Act
GIWW	Gulf Intracoastal Waterway
HNC	Houma Navigation Canal
HTRW	Hazardous, Toxic, and Radioactive Waste
IPCC	Intergovernmental Panel on Climate Change
LCA	Louisiana Coastal Area
LDWF	Louisiana Department of Wildlife and Fisheries
NAAQS	National Ambient Air Quality Standards
NBEM	National Bald Eagle Management
NED	National Economic Development
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWR	National Wildlife Refuge
OMRR&R	Operation, Maintenance, Repair, Rehabilitation and Replacement
PAC	Post Authorization Change report
PED	Pre-Construction, Engineering and Design
PL	Public Law

PPA	Project Partnership Agreement
ppt	Parts-Per-Thousand
REC	Recognized Environmental Condition
ROD	Record of Decision
RDPEIS	Revised Draft Programmatic Environmental Impact Statement
RPEIS	Revised Programmatic Environmental Impact Statement
RSLR	Relative Sea Level Rise
SAV	Submerged Aquatic Vegetation
TLCD	Terrebonne Levee and Conservation District
TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMA	Wildlife Management Area
WRDA	Water Resources Development Act
WVA	Wetland Value Assessment